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About this course:

This is a self-study course. By studying this course, you can improve your professional/military knowledge, as well as prepare for the Navywide advancement-in-rate examination. It contains subject matter about day-to-day occupational knowledge and skill requirements and includes text, tables, and illustrations to help you understand the information. An additional important feature of this course is its references to useful information to be found in other publications. The well-prepared Sailor will take the time to look up the additional information.

History of the course:

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FOREWORD AND ACKNOWLEDGEMENTS

In this 2010 edition of the Hospital Corpsman NAVEDTRA 14295B, also referred to as, Rate Training Manual (RTM) and/or Non-Resident Training Course (NRTC), the subject matter has been revised, expanded, and brought up-to-date with the diverse medical aspects discussed in various chapters and sections.

The Hospital Corpsman NAVEDTRA 14295B is intended to serve as a general guide and reference manual for the Hospital Corpsmen of the U. S. Navy, especially those performing duty independent of Medical Department Officers. It contains information and instructions concerning the generalized duties based upon the most current occupational standards for the Hospital Corps of the Navy. Hospital Corpsmen, particularly those in senior ranks, are urged to make frequent references to other Navy publications for additional information and instructions not contained within.

The principle subjects have been arranged in an organized manner ranging from the Heritage of the Hospital Corps to Decedent Affairs. As these subjects are presented in condensed form, readers should realize that the information contained in it must be supplemented by reference to the standard textbooks and professional journals usually available in the medical libraries of medical treatment facilities, ships, and various other stations.

The Bureau of Medicine and Surgery, Navy Medicine Support Command, and Navy Medicine, Manpower, Personnel, Training and Education Command herewith expresses gratitude and appreciation to the following members of the Medical Department, U.S. Navy for the time and effort spent in preparing, reviewing, and revising the material for this manual:

Bureau of Medicine and Surgery Force Master Chief and Director of the Hospital Corps, Bureau of Medicine and Surgery Force Master Chief’s Senior Enlisted Board of Advisors, Bureau of Medicine and Surgery Historian, Specialty Leaders, Enlisted Technical Leaders, Subject Matter Experts, and Academics and Governance Directorate (Navy Medicine Manpower, Personnel, Training and Education Command) are acknowledged.
SCOPE OF RATING:

Hospital Corpsman (HM)

Assist health care providers in delivering medical care to armed service personnel and their families. Supervises personnel in the performance of clinical or ward duties; maintains health records; instructs medical and non-medical personnel in general and emergency medical care and in self-administration of medications. Administers first aid; assists with physical examinations and makes basic clinical assessments; assists in the transportation of the sick and injured; maintains mechanical equipment; and conducts health education training programs. They also perform medical administrative and clerical functions. Additionally, completion of Dental Assistant training allows Hospital Corpsman to perform diverse duties in the prevention and treatment of oral disease, injury and assist dental care professionals in providing quality dental care. Hospital Corpsman also serve with the Marine Corps rendering emergency and stabilization care in various combat environments while also providing administrative and technical assistance to support the mission and functions of operational units.
CORPSMAN PLEDGE

I solemnly pledge myself before God and these witnesses to practice faithfully all of my duties as a member of the Hospital Corps. I hold the care of the sick and injured to be a privilege and a sacred trust and will assist the Medical Department Officer with loyalty and honesty. I will not knowingly permit harm to come to any patient. I will not partake of nor administer any unauthorized medication. I will hold all personal matters pertaining to the private lives of patients in strict confidence. I dedicate my heart, mind, and strength to the work before me. I shall do all within my power to show in myself an example of all that is honorable and good throughout my naval career.
Sailor’s Creed

“I am a United States Sailor.

I will support and defend the Constitution of the United States of America and I will obey the orders of those appointed over me.

I represent the fighting spirit of the Navy and those who have gone before me to defend freedom and democracy around the world.

I proudly serve my country’s Navy combat team with honor, courage and commitment.

I am committed to excellence and the fair treatment of all.”
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CHAPTER 1
HERITAGE OF THE HOSPITAL CORPSMAN

INTRODUCTION

LEARNING OBJECTIVES:

Describe the historical significance of the Hospital Corps.

Explain how the lessons of yesterday inform the decisions and conduct of tomorrow.

The heritage of the Hospital Corps places a special expectation on every new member. You are responsible for upholding its proud tradition. The tradition of "service with distinction" has been established by your predecessors in every corner of the world and under every kind of adversity. Your shipmates deserve your respect and count on your skills. They merit your confidence; coupled with your skills you will carry on in the proud tradition of the Hospital Corps. Professional ethics is the key to service with distinction.

ORIGIN AND DEVELOPMENT OF THE CORPS

The tradition of excellence in the Hospital Corps has been molded by over two hundred years of history. In March 2, 1799, Congress mandated that the newly commissioned sailing warships—that comprised the first U.S. naval fleet—contain a “cockpit,” or sick bay, where sick and injured men could be brought and cared for by “Surgeons,” and “Surgeon’s Mates.” These first Navy physicians were ably assisted in this task by the forerunners of today’s Hospital Corpsman, called “Loblolly Boys.” The curious name relates to one of their less dramatic responsibilities: serving the daily ration of porridge or “loblolly” to the ill and injured. Other pertinent duties included providing the cockpit with containers to collect amputated limbs and providing containers of coal to heat tar, which was used to stop hemorrhaging.

Loblollies served with distinction in the Quasi-War with France (1797-1800) and in the First Barbary War (1801-1805). However, many of their names and individual accomplishments have been obscured by or lost in time. The few identifiable names that remain with us include John Wall (the Navy’s first Loblolly Boy), John Domyn (the first Loblolly prisoner of war), and Joseph Anderson (the first African-American Loblolly).

The Navy regulations first listed “Loblolly Boy” as an official rate in 1814. Over the next seventy four years, medical enlisted Sailors were given several classifications. From the age of American expansion to the end of the Civil War, medical enlisted Sailors were called “Surgeon Stewards.” In the post-war decades that bridged the naval decline to the rebirth of sea power, the medical enlisted Sailors were called “(male) nurses,” “baymen,” and even “apothecaries.” The term nurse was used for junior enlisted medical personnel; it was replaced in 1873, by bayman which was defined in the Naval Regulations as simply “one who manned the sick bay.”

The Hospital Corps became an organized unit of the Navy Medical Department under the provisions of an act of Congress approved 17 June 1898 signed into law by President William McKinley. This act provided for appointment to the warrant rank of pharmacist and established the following ratings: Hospital Steward (Chief Petty Officer), Hospital Apprentice First Class (Third Class Petty Officer) and Hospital Apprentice.

Under this act, the Secretary of the Navy appointed 25 senior Apothecaries as Pharmacists. These original 25 are rightfully referred to as the charter members of the Hospital Corps. Among these plankowners was Cornelius O’Leary. At the time of his appointment, he had already had 38 years of experience as an apothecary. Another notable
early Hospital Corpsman was Hospital Apprentice Robert Stanley. In 1900, Stanley became the first of twenty-two Hospital Corpsmen to be awarded the Medal of Honor.

SERVICE IN WORLD WAR I

In 1916, on the eve of America’s involvement in World War I, the Hospital Corps saw further structural changes; it could be argued that these set the foundation for the current system of rank structure used today. As part of this revision, the rates would be: Hospital Apprentice; Hospital Second Class; Hospital First Class; Pharmacist Mates Third, Second, and First; and Chief Pharmacist Mate. All would wear a red cross on their sleeve. By adding an improved rank structure the Hospital Corps allowed for a massive expansion of personnel which was needed for the war in France and for the occupation of Haiti (1915-1934).

During World War I, the reputation of the Hospital Corps, especially in the field with the Marine Corps, was greatly enhanced by its many achievements. Both the United States and France cited many Hospital Corpsmen for valor and performance of duty under fire. Fifteen Hospital Corpsmen were killed in action, 2 died of wounds, and 146 were wounded or gassed. They were the recipients of some 460 major awards and citations, including 2 Medals of Honor, 55 Navy Crosses, 31 Distinguished Service Medals, 2 U. S. Army Distinguished Service Medals, and 27 Letters of Commendation.

WORLD WAR II AND THE YEARS FOLLOWING

Women were first brought into the Hospital Corps during World War II. On 12 January 1944, the first Hospital Corps School for Women Accepted for Volunteer Emergency Service (WAVES) was commissioned at the U.S. Naval Hospital, National Naval Medical Center, Bethesda, Maryland. The first class consisted of 230 enlisted women. These women served important functions at hospitals stateside allowing the Navy Medical Department to fulfill its wartime duties to the fullest.

During World War II, a total of 15 Navy enlisted men were awarded the Medal of Honor; of this number, seven were Hospital Corpsmen. Members of the Hospital Corps received 820 major awards and citations (an honor of unique distinction since none of them bore arms). On the summit of Mount Suribachi, Iwo Jima, along with six marines, Pharmacist Mate John Bradley proudly participated in the raising of our flag. This scene has been reproduced thousands of times and is symbolized by the U.S. Marine Corps War Memorial.

At the end of the war, the Honorable James Forrestal, Secretary of the Navy, and later the first Secretary of Defense, paid honor to the Hospital Corps of the United States Navy for its singular attainments during this conflict. His words ring true today and tell so well the role of the Corpsman, not only in that conflict and the conflicts that have followed, but also in times of peace. Insofar, that can be determined; this is the first time in military history that a single corps has been commended by the Secretary of the Navy.

“Out of every 100 men of the United States Navy and Marine Corps who were wounded in World War II, 97 recovered. That is a record not equaled anywhere, anytime. Every individual who was thus saved from death, owes an everlasting debt to the Navy's Hospital Corps. The Navy is indebted to the corps. The entire nation is its debtor for thousands of citizens are living normal, constructive, happy and productive lives who, but for the skill and toil of the Hospital Corps, might be dead or disheartened by crippling invalidism. So, to the 200, 000 men and women of the Hospital Corps, I say on behalf of the United States Navy: "Well Done. Well done, indeed!"

On 02 April 1948, the nomenclature of the Hospital Corps’ ratings was changed to read: Hospital Recruit; Hospital Apprentice; Hospitalman; Hospital Corpsman Third Class; Hospital Corpsman Second Class; Hospital Corpsman First Class; and Chief Hospital Corpsman. At this same time, the rating insignia of the Hospital Corps was changed from the Red Cross to the caduceus.
KOREA AND THE YEARS FOLLOWING

As part of a United Nations force, Marines were committed to the Korean peninsula when South Korea was invaded by its northern neighbor in the summer of 1950. Within the first year, Hospital Corpsmen had participated in the dramatic landing at Inchon and the frigid retreat from the Chosin Reservoir. Although only one Marine division was involved in the war between 1950 and 1953, the Hospital Corps lost 108 killed in action. Disproportionate to their numbers was their heroism. In Korea, Hospital Corpsmen earned 281 Bronze Star Medals, 113 Silver Star Medals, and 23 Navy Crosses. All five enlisted Navy Medals of Honor were awarded to Navy Hospital Corpsmen serving with the Marines.

VIETNAM AND THE YEARS FOLLOWING

With the escalation of the Vietnam conflict between 1963 and 1975, Hospital Corpsmen were called to serve in Southeast Asia. They served in Marine Corps and Navy air/ground forces, naval support activity hospitals, hospital ships, Riverine Warfare ("Brown Water Navy"), and Navy ships on the "Gun Line" off the coast of South Vietnam and "Yankee Station" off the coast of North Vietnam. They served in Cambodia and supported troops from Thailand. Like their predecessors, they performed emergency treatment in all kinds of combat conditions. They were assigned to small medical teams that provided care and health advice to Vietnamese civilians. Some were assigned as medical advisors to Vietnamese military units. Hospital Corpsmen truly felt the brunt of the Vietnam conflict. Six hundred twenty were killed or mortally wounded and another 3,353 were wounded in action.

Following the fall of Saigon in April 1975, Hospital Corpsmen continued to serve in the many "hot spots" around the world. Fifteen hospital corpsmen were killed in the line of duty when the Marine Barracks in Beirut, Lebanon, was bombed and destroyed by terrorists.

Hospital corpsmen were present at sea and ashore when the United States took military action in Grenada and during operation Desert Storm.

SEPTEMBER 11TH

The attacks on the Pentagon and World Trade Center on 11 September 2001 (9/11) awoke the proverbial American “sleeping giant.” In the days that followed the fall of the towers, America relentlessly searched out terrorist havens across the world and neutralized them. As our focus shifted from hotspot to hotspot, from Afghanistan to the Philippines, Hospital Corpsmen were there to support the mission.

As the mission of Navy Medicine changed, so did its philosophy. On 27 September 2001, by order of Navy Surgeon General Michael Cowan, new signal flags, “Charlie Papa: Steaming to Assist” were flown above all Navy medical activities. As VADM Cowan explained, “The men and women of Navy Medicine were among the first to respond, providing aid to the injured at the Pentagon and comfort and care for thousands of rescue workers who worked around the clock in the desperate race to find survivors beneath the rubble that was the World Trade Center. [Similarly] we are no longer standing by to help when a Sailor or Marine is sick or injured. We are out in front of the problem, providing preventive care, promoting wellness, and anticipating crises before they occur.”

GLOBAL WAR ON TERROR (GWOT)/OVERSEAS CONTINGENCY OPERATIONS

Afghanistan

The attacks of September 11th were traced to Al Qaida, an ultra conservative Sunni Islamist terrorist organization and its leader Osama bin Laden. Requiring a base of operations, Al Qaida had associated itself with the Taliban, the fundamentalist religious and political movement then in control of the remote and mountainous Afghanistan. Following the Soviet withdrawal from Afghanistan in 1989, the Taliban seized
control of this land in turmoil and fostered much of Al Qaida’s extreme ideology. When the United States demanded that the Taliban give up Bin Laden and the other Al Qaida members operating in the country, the Taliban began to actively protect and aid the terrorists in their struggle against the West. Left with no other choice the United States, allied with Afghanistan’s Northern Alliance and the local Afghan resistance, began combat operations against the Taliban on 07 October 2001.

Afghanistan’s landlocked location and hostile, arid landscape severely hindered any traditional form of land based military campaign. As such the attacks began with an intensive air bombardment, which was successful largely due to the aid of the Navy SEALs who, along with other Special Forces units, called in devastatingly accurate air strikes in support of a renewed Northern Alliance ground offensive. SEAL Corpsmen, operating hundreds of miles away from higher echelon support, treated not only their own injured, but also provided essential medical aid to their poorly trained and equipped Afghan allies.

In November, after flying over 372 miles by helicopter from the USS Peleliu and the USS Boxer in the North Arabian Sea, the Marines and Hospital Corpsmen landed in Afghanistan. The Marines faced the daunting task of hunting down the Taliban in an operating area that had seen almost continuous conflict since the time of Alexander the Great. Few since Alexander have successfully managed to hold this troubled land.

The austere and unforgiving mountainous environment of Afghanistan is as much of an enemy as the terrorists who hide in the many caves and grottoes it provides. The lack of infrastructure prevents rapid evacuation of casualties by land and its extreme elevation makes helicopter travel difficult. Corpsmen who had been trained to expect to be able to move wounded Marines to higher echelon care within hours of injury, were now often faced with the very real prospect of stabilizing and maintaining them for days.

As America continues to withdraw from Iraq and as the responsibility for Afghanistan shifts from the Army to the Marine Corps, Hospital Corpsmen are being deployed to Afghanistan in large numbers in support of national objectives. Faced with an ongoing conflict, tomorrow’s Corpsmen will be challenged with living up to the standards set by those who serve there today.

Iraq

When, in accordance with United Nations Security Council Resolution 1441, American forces invaded Iraq on the 20 March 2003 to remove Sadaam Hussein, the Corpsmen assigned to the 1st Marine Expeditionary Force (1 MEF) were among the first Americans to cross the border. During the assault the Marines and Sailors of I MEF, in conjunction with the 3rd Infantry Division (3rd ID) and the 1st U.K. Armored Division, drove over 300 miles into Iraq; the deepest penetrating ground operation in Marine Corps history. As they had since Belleau Wood, battalion Hospital Corpsmen served beside their Marines and rendered lifesaving care even while the battle raged around them. The 1st Medical Battalion, 1st Marine Logistics Group, as part of the historic assault, provided essential forward medical care to rapidly advancing units.

In March 2004, the 1st Medical Battalion returned to Iraq, providing much needed relief to the 82d Airborne Division Medical Units in the Sunni Triangle. During Operation IRAQI FREEDOM II, the Battalion conducted operations in support of Marine units throughout Al Anbar Province, culminating in Operation AL FAJR. This liberated the insurgent stronghold of Fallujah and enabled the first legitimate elections to occur in Iraq.

The Iraqi conflict gave Navy Medicine an opportunity to utilize the newly developed Shock Trauma Platoon (STP) concept. Each surgical company in the Medical Battalion had two STPs attached to them. The STP, a small, mobile medical unit, was designed to advance with assault units and support combat operations from just behind the front lines. Between 17 February and 21 September 2004, STP 2, treated
141 combat casualties with a phenomenal 98% survival rate allowing evacuation of its patients to definitive care at higher echelon medical facilities.

While most of the war in Iraq was conducted by land forces, the contributions of Hospital Corpsmen serving with the fleet cannot be overlooked. The Tomahawk missile that opened the Iraqi conflict was launched from the USS Cheyenne, a submarine that could not have sailed without her independent duty corpsman (IDC).

An inescapable legacy of the Overseas Contingency Operations in Iraq and Afghanistan are the thousands of Marines, Sailors, and Soldiers returning with traumatic brain injury (TBI) as well as deeper psychological wounds categorized as Post-Traumatic Stress Disorder (PTSD). PTSD is nothing new. Over the course of 140 years of warfare, PTSD has been labeled as nostalgia, neurasthenia, shell shock, and combat fatigue. Though medical professionals have long studied the symptomology and treatment for PTSD, only recently, since 1980, has it been acknowledged as a diagnosable psychological disorder. Recent studies have revealed that as many as one in six returning from combat operations in Iraq suffer from the disorder with as many as 300,000 returning veterans from Iraq and Afghanistan. Combat medical personnel are in the unique situation of taking care of the psychologically wounded while also being exposed to the same stressors that induce PTSD.

Combat stressors and burnout are the unfortunate and inevitable byproduct of hard-fought wars and campaigns. However, our Sailors and Marines with war-induced psychological trauma do not have to suffer in silence like many of their ancestral combat veterans. The Navy Medical Department can boast of some of the finest mental health care providers who offer a wide array of treatment for PTSD.

An interesting footnote to Hospital Corps history occurred in 2004 when, while visiting wounded Marines at Bethesda Naval Hospital, Chief Warrant Officer Four Brian Dix, the Director of the Marine Corps’ Drum and Bugle Corps, met HM3 Joe Worley. Badly wounded by a rocket propelled grenade and six bullet wounds during the battle of Fallujah, Iraq, “Doc” Worley stunned the Marine Officer when he recalled that harrowing day that proved so costly to him and his platoon. Thus inspired by the heroic actions of all Hospital Corpsmen which were so exemplified by HM3 Worley, CWO4 Dix composed a military march entitled appropriately “Corpsman Up!” to honor all the Hospital Corpsmen past and present. Such a unique and moving tribute is a testament to the bond we share with those whose lives we are entrusted and stands unequaled in military medicine.

CORPSMEN WITH THE FLEET

Even as the first tower fell in New York on 9/11, Hospital Corpsmen assigned to the National Capitol Region rushed to make the USNS Comfort ready for sea. Arriving on the 14th, the Comfort provided much needed respite to the thousands of rescue workers who searched in vain for survivors amid the rubble of the Twin Towers. During the initial phase of fighting in Iraq, Corpsmen on the Comfort treated more than 650 casualties, many of them Iraqi civilians.

While most of the attention given to sea based medicine goes to the two hospital ships, Mercy and Comfort, the unsung Hospital Corpsmen assigned to the rest of the fleet continue to prove their ability to support combat operations anytime, anywhere. Even the transport ships that carry Marine battalions to the fight bring with them the tools to save the lives of the men and women sent into harm’s way. Each class of amphibious assault ship is fitted out as well as most civilian hospitals, bringing two to four fully functional operating rooms, ICU beds, vast surgical wards, fully stocked pharmacies and even dental clinics to every corner of the world where they are needed.

In August 2009, the U.S. “Global War on Terror” in Afghanistan and Iraq was rebranded the “Overseas Contingency Operations.” Despite
this name change, Hospital Corpsmen continue to support ongoing operations serving where needed. Whether as a flight deck “HM” on a carrier supporting combat flight operations or an IDC aboard a destroyer conducting anti-piracy patrols off the Horn of Africa, Navy Corpsmen have been, and always will be, in the vanguard of all naval activities.

**SOFT POWER: A GLOBAL FORCE OF GOOD**

As America moves into the new century, more focus is placed upon “Soft Power,” i.e., the doctrine of using goodwill and cooperation to influence nations and peoples of the world. In an article entitled “International Neighborliness” published in *Outlook* magazine in January 1911, former president Theodore Roosevelt forecasted a global climate where fellow nations would band together to help those who have been struck by “terrible and overwhelming disaster.” The Navy Medical Department has long been on the forefront of what President Roosevelt called “acts of sincere disinterested friendliness.” For well over a hundred years, Navy medical personnel have exhibited diplomacy in the form of medical assistance to nations and peoples afflicted by natural disaster and poverty.

Navy Corpsmen have played a pivotal role in disaster relief operations. Following devastating earthquakes in San Francisco (1906) and Messina, Sicily (1908), Hospital Corpsmen were among the first medical providers to partake in relief efforts. During the occupation of Haiti (1915-1934), Navy physicians and Hospital Corpsmen alike, traveled throughout the country providing medical care to civilians and spearheaded the creation of a Haitian public health office (National d’Hygiene Publique).

The Hospital Corps’ role in disaster relief and humanitarian campaigns continues through the present. On 26 December 2004, a magnitude-9 earthquake shook the Indian Ocean just off the Indonesian coastal city of Banda Aceh. Within hours the resulting tsunami devastated shorelines from Indonesia to South Africa leaving at least 230,000 dead and millions homeless. Navy medical teams from the USS *Bonhomme Richard*, USS *Abraham Lincoln*, Carrier Air Wing Two, and the USNS *Mercy* worked tirelessly to provide medical care to survivors.

Less than a year after the horror of the tsunami, Americans were shocked by their own disaster. At 6:10 am on Monday, 29 August 2005, Hurricane Katrina made landfall. In less than 12 hours much of the city of New Orleans lay in ruins underwater. The devastation wrought by that “perfect storm” left much of the Gulf Coast reeling. Throughout these disasters, Hospital Corpsmen were among the first to respond. Within days those assigned to ships were deployed ashore as members of response teams. The hospital ship USNS *Comfort* arrived in New Orleans a week after the storm and provided vital medical care to nearly 2,000 survivors.

During the first decade of the millennia Hospital Corpsmen deployed to Cambodia and Sri Lanka to provide care to those with landmine blast injuries; Djibouti to conduct an industrial health survey; Baghdad as part of the Coalition Provisional Authority to assist in training the newly formed Iraqi Army in combat lifesaver skills; Zambia to conduct an HIV/AIDS research project and provide HIV lectures to Zambian military personnel; Ghana to provide humanitarian aid, civic assistance, and medical peacetime support; Honduras for a humanitarian support mission; and interestingly, Vietnam, Laos, and Cambodia with the Joint POW/MIA Accounting Command (JPAC) providing medical support for those searching, recovering, and identifying the remains of American service members.

In the twenty-first century, the Navy Medical Department continues to perform a wide range of humanitarian operations. These missions have evolved into complex, cooperative efforts with other government agencies and non-governmental organizations (NGOs). One example was USNS *Comfort*’s 120-day humanitarian mission to South America, Central America, and the Caribbean in 2007. During this mission the hospital ship visited 12 nations and personnel saw over
98,000 patients. However, the Navy was not alone in this effort. On board were personnel from the Army, Air Force, Air National Guard, Coast Guard, Canadian Defense Forces, U.S. Public Health Service, and civilian NGOs (e.g., Operation SMILE, Project HOPE, USAID and others). In 2008, this humanitarian effort was countered in Pacific by USNS Mercy, whose 4-month deployment to the Republic of the Philippines, Vietnam, the Federated States of Micronesia, Timor-Leste, and Papua New Guinea served as a model for future “Pacific Partnership(s).”

In 2009, USNS Comfort travelled to Central and South America on a 4-month humanitarian assistance operation called Continuing Promise. During this effort, Navy medical personnel, in partnership with other government and non-government agencies, treated over 100,000 patients, conducted 1,657 surgeries, and filled some 13,238 prescriptions. The legacy of this and previous campaigns has strengthened U.S. relations with the developing nations while further defining what it means to serve in the Navy Medical Department.

NAVY DENTAL TECHNICIANS

On 01 October 2005, the Dental Technician (DT) rating, a separate enlisted specialty since 12 December 1947, merged with the Hospital Corps. This merger impacted nearly 3,000 DTs serving “chairside” and administratively at dental and medical activities worldwide. Although enlisted personnel no longer wear dental ratings, Hospital Corpsmen continue to serve in such sub-specialties as dental laboratory technicians, advanced dental assistants, surgical technologists, maxillofacial technicians biomedical equipment repair technicians, and dental hygienists.

Specialized dental training for medical enlisted Sailors extends back to 03 February 1923 when the first class of Hospital Corpsmen attended the U.S. Dental School in Washington, DC. Following World War II, dental enlisted training was greatly enhanced by the establishment of special dental technician schools at the U.S. Naval Training Centers Great Lakes, IL, and San Diego, CA, in 1948. Enlisted personnel could thus be procured by direct recruitment into the dental rating group; they no longer were required to prepare themselves for advancement in a rating group (i.e. Hospital Corpsman) that did not reflect their duties.

The Korean War marked the first time that Hospital Corpsmen wearing dental rating badges served in combat. Throughout this conflict, Navy Dental Technicians treated patients hand in hand with their medical counterparts both at home, overseas, and most notably on the frontlines. Wherever the Marines went, Dental Technicians were there, generally assisting with casualty care and treatment. The heroic performance of Dentalman Thomas A. Christensen, Jr. was representative of the dedication and sacrifices of Dental Technicians. Christensen received the Navy Cross posthumously for valor demonstrated on 06 November 1950 while treating casualties. Navy Dental Technicians and Hospital Corpsmen were chief recipients of the 1,115 major combat awards given to Navy medical personnel in the Korean War.

Dental Technicians have served in all wars and conflicts since. Although, these men and women are now known as “dental assistants,” they can continue to boast of a distinguished heritage.

THE CORPS OF THE FUTURE

The current joint environment has led to the consolidation of what had once been service independent treatment facilities. A prime example of this is the merging of the Bethesda National Naval Medical Center (NNMC) and the current Walter Reed Army Medical Center (WRAMC) into the Walter Reed National Military Medical Center (WRNMMC). This will occur when WRAMC closes its doors in 2011.

Bethesda Naval Hospital has been the Flagship of Navy Medicine since 11 November 1940, and its conversion into a joint service medical center marks the end of an era. This consolidation is far from unique. In 2005, Base Realignment and Closure (BRAC) legislation
mandated that the Army, Navy, and Air Force must co-locate all enlisted medical education and training programs to Fort Sam Houston, San Antonio, TX. For the Navy, this will re-align all Corpsmen training programs except IDC and air affiliated training programs.

For the Navy Hospital Corps, this tri-service integration marks the closing of another chapter in its history. Since 1902, with the establishment of the School of Instruction in Portsmouth, VA, the Navy has operated unique Hospital Corps Schools to develop and teach new recruits how to care for the sick and wounded aboard ship and ashore. Unlike the other service’s training centers, which have traditionally focused training their medical personnel for specialized tasks, Naval Corps Schools use a broader brush. This jack-of-all-trades focus fostered the unique identity of the Hospital Corps by producing a well-rounded Sailor prepared to operate in all expeditionary environments.

Over the years, the Navy has operated Hospital Corps Training Schools in Bainbridge, MD (1943-1957); Farragut, ID (1943-1945); Great Lakes, IL (1913-1921; 1942 to 2011), Newport, RI (1917-1921); Portsmouth, VA (1902-1906; 1921 to 2011), San Diego, CA (1928-1932; 1935 to 2011); and San Francisco, CA (1917-1921). The three remaining schools—Hospital Corps School Great Lakes, Naval School of Health Sciences Portsmouth, VA, and Naval School of Health Sciences, San Diego, CA, will be consolidated and co-located with the 882nd Training Group of the Air Force, and the Army’s Academy of Health Sciences. Even though co-location threatens service dilution, steps are being taken to ensure fidelity to naval culture within the training environment. This is yet another example of the challenges joint service missions will have for Hospital Corpsmen of the future.

As the military becomes leaner and more specialized, the Hospital Corps must remain flexible enough to meet any requirement asked of them. Whether attached to a Marine Battalion in the mountains of Afghanistan, part of a ship’s crew, or augmenting an Army unit in Iraq, Hospital Corpsmen will continue to set the standard for enlisted medical care far into this century.

**HOSPITAL CORPSMEN AWARDS**

The Hospital Corps is the most decorated branch of the United States Navy and has fought on the front lines of every battle in United States history. Hospital Corpsman have served courageously on ships and valiantly on the battlefields of every conflict, caring for injured Sailors and Marines.

To date, there have been 22 Medal of Honor recipients from the Hospital Corps; this is half of all the Medal of Honor’s awarded to the Department of the Navy. There have been 174 Navy Crosses, 31 Distinguished Service Medals, 946 Silver Stars, and 1582 Bronze stars awarded to Hospital Corpsman since the establishment of the Hospital Corps. Additionally, there have been 14 Naval Vessel’s that have been named for Hospital Corpsman, and several hospitals and clinics also bear the names of courageous individuals that paid the ultimate sacrifice for our country and our freedom.
HOSPITAL CORPSMEN WHO RECEIVED THE MEDAL OF HONOR

Pre-World War I
- Hospital Apprentice Robert H. Stanley, USN (Boxer Rebellion)
- Hospital Apprentice First Class William Zuiderveld, USN (Veracruz Incursion)
- Hospital Apprentice Fred H. McGuire, USN (Philippine Insurrection)
- Hospital Steward William S. Shacklette, USN (Boiler Explosion aboard USS Bennington)

World War I
- Pharmacist's Mate First Class John H. Balch, USN
- Hospital Apprentice First Class David E. Hayden, USN

World War II
- Hospital Apprentice First Class Robert Eugene Bush, USN
- Pharmacist's Mate 2nd Class William D. Halyburton, Jr., USNR
- Hospital Apprentice First Class Fred F. Lester, USN
- Pharmacist's Mate First Class Francis J. Pierce, USN
- Pharmacist's Mate Second Class George E. Wahlen, USN
- Pharmacist's Mate Third Class Jack Williams, USN
- Pharmacist's Mate First Class John H. Willis, USN

Korean War
- Hospital Corpsman Third Class Edward C. Benfold, USN
- Hospital Corpsman Third Class William R. Charette, USN
- Hospitalman Richard D. Dewert, USN
- Hospitalman Francis C. Hammond, USN
- Hospitalman John E. Kilmer, USN

Vietnam War
- Hospital Corpsman Second Class Donald E. Ballard, USN
- Hospital Corpsman Third Class Wayne M. Caron, USN
- Hospital Corpsman Third Class Robert R. Ingram, USN
- Hospital Corpsman Second Class David R. Ray, USN
CHAPTER 2

EXPEDITIONARY MEDICINE ADMINISTRATION

INTRODUCTION

Although most duties are performed in a clinical environment, the Hospital Corpsman (HM) may be assigned to clerical positions aboard ship, assigned to duty with the Fleet Marine Force, Naval Mobile Construction Battalions, or detailed to Fleet Hospitals or staff duty where knowledge of administrative procedures and reports is a must. Handling, updating, and using official directives and publications are important administrative duties. The efficiency of an office depends on having publications and directives that are up to date and staff members who know them well.

As the HM progresses in rate and assumes greater responsibility, there will be requirements to maintain various logs, records, and directives. Additionally, duties include being able to draft, type, and file correspondence. The HM will use Navy directives and publications more and more as the job is learned. The HM will also be required to maintain computer data for command use.

This chapter covers medical reports, logs, and records commonly used by Navy Medical and Dental Departments. It will review the maintenance and disposal of instructions and notices, preparation of correspondence, and filing procedures. Additionally, it will outline the organization of the Fleet Marine Force, Fleet Hospitals, and Naval Mobile Construction Battalions, and special qualifications available to the HM.

REPORTING REQUIREMENTS

LEARNING OBJECTIVE:

Identify the medical department reporting requirements.

As a member of a Medical or Dental Department in a clinic, on a ship, or working sick call, a Corpsman’s duties will include the maintenance of various logs and the preparation of reports required by higher authority. These reports are in the Manual of the Medical Department, NAVMED P-117. Specific instructions for management of reports and forms are covered in the current version of the BUMEDINST 5210.9 series, Forms and Reports Management Program.

REPORTS TO THE OFFICER OF THE DECK OR DAY (OOD)

All important occurrences are reported by the Senior Medical Department Representative (SMDR) to the OOD for entry into the duty log or journal of the command. The SMDR can be the senior medical or dental officer or it can be the Independent Duty Corpsman (IDC). On some ships, the medical and dental departments are separate and others they are combined into one Health Services Department.

Items that need to be reported include severe injuries, conditions that can affect the health of the crew, and damage or loss of medical and dental equipment. The names of patients in serious condition are reported directly to the Commanding Officer and the OOD, with the information necessary for notification of the patient’s next of kin.
MEMORANDUM FOR THE RECORD

A Memorandum for the Record is prepared in accordance with (IAW) the SECNAVINST 5216.5 series, Department of the Navy Correspondence Manual, series for any event of historical or legal importance, or for which good judgment dictates that it should be recorded. It provides a medium for recording special occurrences that might need to be reconstructed in detail at a later time. Memorandum for the Record may be drafted for any serious injury or death, patients who refuse treatment or are noncompliant, or when recommendations to the command in regards to the health and safety of the crew are not followed due to the Commanding Officer’s discretion.

SHIPBOARD NON-TACTICAL AUTOMATIC DATA PROCESS (SNAP) AUTOMATED MEDICAL SYSTEM (SAMS)

SAMS is an administrative management tool that tracks the medical and dental readiness of Navy and Marine Corps operational units. SAMS enables health care providers to update patient medical information and record medical encounters. Additionally SAMS is used to track supply inventory, log preventative medicine inspections, report and receive radiation exposure data, and manage medical training.

MEDICAL READINESS REPORTING SYSTEM (MRRS)

MRRS is an administrative management tool that is used to track the medical and dental readiness of every active duty and reserve Sailor or Marine. It is an Internet based communication program that allows for health care providers to update and manage a member’s readiness regardless of the member’s permanent duty station. For example, if is a member is stationed in Naval Medical Center San Diego (NMCSD) and goes on a weeklong evolution with a Marine Corps unit without the health record and receives an immunization, that Marine Corps unit has the ability to update this information into MRRS. Once that member returns to the permanent duty station, in this case NMCSD, the readiness coordinator will see this up to date information. There are gateways known as the Central Data Repository (CDR) and Defense Enrollment Eligibility Reporting System (DEERS) that allow SAMS and MRRS to communicate and share information.

SICK CALL TREATMENT LOG

The Sick Call Treatment Log is maintained in SAMS for each ship or activity. The log contains each patient’s reporting date and time, name, rate, division, chief complaint, diagnosis, treatment, and disposition. The report is forwarded to the Commanding Officer on a daily basis.

TRAINING LOG

All lectures and training periods that are administered by the medical department should be recorded in the training management module of SAMS. The entries should include the date, title of the lecture, division of personnel attending, duration of the lecture, and the number of Officers, Chiefs, and E-6 and below attending.

The location may be a necessary item to put into the log book. For example, the Battle Dressing Station (BDS) is a designated location for the treatment of casualties and is maintained and managed by the medical department. It can be used to provide training to medical and non-medical personnel. Additional BDS information can be found in the COMANVSURFORINST 6000.1 series, Shipboard Medical Procedures Manual.

POTABLE WATER LOG

The purpose of the potable water log is to record the readings of daily residual chlorine or bromine levels and the weekly bacteriological examinations required on potable water aboard ship and in the field. Records will be maintained IAW the, Manual of Naval Preventive Medicine, NAVMED P-5010, chapter 6. Record the results using the SAMS Environmental Management Module.
WORK CENTER PMS MANUAL

The standard Navy Maintenance and Material Management System (3-M) was developed to meet the need to record, report, and evaluate the maintenance requirements of the fleet and provide the organizational level with the tools to plan, schedule, and control planned maintenance effectively. 3-M Systems are the nucleus for managing maintenance aboard all ships and applicable shore station equipment. This system provides all maintenance and material managers throughout the Navy with a means to plan, acquire, organize, direct, control, and evaluate the manpower and material resources expended or planned for expenditure in support of maintenance.

OPNAVINST 4790.4 series, Ships’ Maintenance and Material Management (3-M) System policy provides guidance for the program. Often new equipment that requires regular and sometimes highly specialized maintenance is procured and used throughout Navy Medicine. The 3-M systems endeavor to substitute preventative maintenance for corrective maintenance, thus reducing equipment malfunction and downtime. This is accomplished through the Planned Maintenance System (PMS).

The Work Center Planned Maintenance System (PMS) Manual reflects the planned maintenance requirements for a particular work center such as medical or dental. It is maintained in the work area near the Weekly PMS Schedule and outlines the periodicity and the required work to maintain medical and dental equipment. The maintenance procedures developed for planned maintenance are the minimum standards required to maintain equipment within specifications.

DIRECTIVES ISSUANCE SYSTEM

LEARNING OBJECTIVE:

Describe the policies and procedures for maintaining directives, drafting correspondence, and filing.

A HM in an administrative billet will be responsible for maintaining the command’s files and Navy directives. Refer to the OPNAVINST 5215.17 series, Navy Directives Issuance System, for complete details of the responsibilities.

TYPES AND PURPOSES OF DIRECTIVES

There are two basic types of directives: permanent and temporary. Permanent directives regulate administration, establish policy, delegate authority, and assign a mission function or task. Temporary directives are normally issued as a notice to request comments or approval, and announce information such as a change of command or education and promotion opportunities. Notices cannot remain in effect for more than a year.

CHANGE TRANSMITALS

A change transmittal is used to issue changes to instructions and notices. Each transmittal describes the nature of the change and gives directions for making it. Changes and corrections are made by inserting new pages, removing obsolete pages, and making pen and ink changes. Change transmittals are numbered consecutively. That is, the first change transmittal to an instruction is Change Transmittal 1, the second 2, and so on. They are filed in the front of the respective instruction with the most current change on top.

CORRESPONDENCE

A HM working in an administrative billet must be able to draft and type correspondence, maintain directives and logs, submit reports, and efficiently file correspondence so that it may be retrieved quickly.
Official Navy correspondence is usually prepared and referred to as the standard naval letter. The standard naval letter is used when corresponding with certain agencies of the United States Government. Some civilian companies dealing extensively with the Navy may prepare correspondence using the standard naval letter. Instructions for typing standard naval letters are very precise and must be followed to the last detail. All information to prepare naval correspondence can be found in the **SECNAVINST 5216.5 series, Department of the Navy Correspondence Manual.**

**MAINTAINING DIRECTIVES**

Instructions are normally placed in large three-ring binders in numerical sequence according to a Standard Subject Identification Code (SSIC) number and issuing authority. At some activities, directives may be maintained in a CD-ROM library. For security purposes, classified directives and documents are filed in separate binders and maintained in a safe in accordance with the **SECNAV M-5510.36 series, Department of the Navy Information Security Program.**

Because of the brief duration, notices ordinarily do not need to be filed in the master file (main files of instructions). If it is necessary to file them temporarily with instructions, tab the notices so that each one may be easily and promptly removed as soon as its cancellation date is reached.

**FILE NUMBER**

The size and complexity of the naval correspondence demands a standard method for filing paperwork. Standardization frees personnel from learning new filing systems when moving from one activity to another. The Department of the Navy SSIC system of coding correspondence through the use of a four- or five-digit number to represent its subject matter provides a consistent method of filing and retrieving documents. SSICs are found in the **SECNAVINST 5210.11 series, Department of the Navy Standard Subject Identification Codes.** They serve as file numbers for and are required on all Navy and Marine Corps letters, messages, directives, forms, and reports. The extent of the HM’s knowledge of this standardization system of subject identification will determine the efficiency in being able to retrieve correspondence from the files.

**Numerical Subjects Grouping**

SSICs are divided into 13 major groups:
- 1000 series – Military Personnel
- 2000 series – Telecommunications
- 3000 series – Operations and Readiness
- 4000 series – Logistics
- 5000 series – General Administration and Management
- 6000 series – Medicine and Dentistry
- 7000 series – Financial Management
- 8000 series – Ordnance Material
- 9000 series – Ships Design and Material
- 10000 series – General Material
- 11000 series – Facilities and Activities Ashore
- 12000 series – Civilian Personnel
- 13000 series – Aeronautical and Astronautical Material

and
- 16000 series – Coast Guard Missions
These major groups are subdivided into primary, secondary, and tertiary (third-level) subdivisions. Primary subjects are designated by the last three digits of the code number, secondary subjects by the last two digits, and tertiary subjects by the last digit. For example: 6421

- 6000 Medicine and Dentistry
  - 6400 Special Fields (Primary)
    - 6420 Submarine and Diving Medicine (Secondary)
    - 6421 Hyperbaric Treatment – Diving Accidents (Tertiary)
- 6500 Research
- 6650 Operative Dentistry

CLASSIFYING

Classifying, as it is used here, is the process of determining the correct subject group or name-title codes under which correspondence should be filed and any subordinate subjects that should be cross-referenced. Classifying is typically accomplished by the originator. Correspondence that has not been previously classified will need to be assigned upon receipt.

The proper method to subject-classify a document so that it can be readily identified and found when needed is to read it carefully, analyze it, and then select the SSIC that most closely corresponds to the subject of the document.

MANAGEMENT OF RECORDS

The Navy creates and uses records of many different types, formats, and media to execute its mission. The SECNAVINST 5210.8 series, Department of the Navy Records Management Program, provides guidance for records maintenance, use, and disposition. The Records Management Program is designed to retain records that are needed to execute the mission and dispose of records that have expired. It is important to maintain and dispose of records according to the guidance regardless of the type of medium they exist on. Files in a digital format which are easy to store should not be kept indefinitely. If the HM is in doubt about the disposal of certain records, superiors should be consulted to determine the course of action to take.

OPERATIONAL MEDICAL AND DENTAL READINESS

LEARNING OBJECTIVE:

Identify the basic requirements of medical and dental readiness.

The mission of the medical and dental departments is to provide care to sailors of navy ships and units that they are assigned, and to prevent and treat disease and injuries. The senior dental and medical division officers report to the Health Services department head and the Commanding Officer on all matters affecting the health of the crew or deployable unit. To accomplish the mission, medical and dental personnel must keep themselves informed of planned operations and anticipate any possible demands placed upon them or the members under their care. The Navy and Marine Corps overall, must maintain the highest degree of health and readiness in order to function as a fighting force.

MEDICAL READINESS

Assessing Individual Medical Readiness (IMR) is a continuous process and must be monitored and reported on a regular basis to provide service leaders and operational commanders the ability to ensure a healthy and fit fighting force.
The requirements are outlined in the SECNAVINST 6120.3 series, *Periodic Health Assessment for Individual Medical Readiness*. IMR is composed of the following six elements:

- Individual Medical Equipment (glasses, gas mask inserts)
- Immunizations (TB Screening, Tetanus)
- Readiness Laboratory Studies (DNA, G6PD)
- Deployment Limiting Conditions
- Periodic Health Assessment (PHA)
- Dental Readiness

**PERIODIC HEALTH ASSESSMENT (PHA)**

The PHA is used to review and correct any IMR deficiencies. For example, a member needs an immunization, new pair of glasses, or a dental exam. It is also used to verify compliance with the various elements of Deployment Health Assessments. The PHA provides the opportunity to assess changes in a member’s health on an annual basis that could potentially impact the ability to perform military duties and deploy worldwide. For the PHA to be complete, all six elements must be met and/or a continued plan of care received for any ongoing medical conditions.

**DENTAL READINESS**

The Fleet and Force Dental Officers ensure that the Fleet is dental ready. A service member who is Class 1 or 2 is considered worldwide deployable. This means that no dental treatment is needed (Class 1) or an oral condition, if not treated, does not have the potential to become an emergency (Class 2) within the next 12 months.

- Any oral condition that will result in an emergency condition within the next 12 months (Class 3)
- An individual who needs a dental exam or has oral conditions that are unknown (Class 4)

An individual who has been assigned a dental Class 3 or 4 is likely to compromise combat effectiveness and potentially impact the mission by experiencing a dental emergency. Any member in Class 3 or 4 is considered non-deployable and go to the head of the line for treatment prior to deployment.

**DEPLOYMENT LIMITING CONDITIONS**

The assessment for future deployability includes a review of medical history and any administrative issues. To be considered deployable, the service member should **NOT** be on limited duty or undergoing any type of Physical Evaluation Board (PEB) or Medical Evaluation Board (MEB).

**MEDICAL AND DENTAL SUPPORT TO THE FLEET MARINE FORCE (FMF)**

**LEARNING OBJECTIVE:**

*Describe the medical and dental organization of the Fleet Marine Force.*

To understand the complexity of medical and dental support to FMF, the HM must be familiar with the overall organization. Medical and dental personnel are not members of the U.S. Marine Corps. They are detailed from the Navy and assigned to the FMF, which is a balanced force of combined air and ground troops trained, organized, and equipped primarily for offensive deployment. The FMF consists of a headquarters, a Marine Logistics Group (MLG), and Marine divisions, brigades, and aircraft wings.

**BATTALION AID STATION**

A battalion aid station (BAS) is used to provide direct support to company and platoon corpsman, and provide advanced trauma life support under fire. The BAS of an infantry battalion is the most forward deployed and most mobile. It is normally comprised of two medical officers and up to 65 HMs, depending on the size of the battalion. A dental detachment would
also be assigned to the BAS to provide level 1, 2, and 3 dental care and dental health maintenance with a focus on emergency care. A specific number of medical and dental support personnel are assigned to provide an interrelated network of health care support.

**FMF MEDICAL SUPPORT**

In general, Medical Department personnel serving with FMF may be divided into two groups:

- **Combat personnel**, providing medical and initial first aid to prepare the casualty for further evacuation
- **Support personnel**, providing surgical and medical aid to those who need early definitive care and cannot be further evacuated.

Medical personnel are an integral part of the combat unit to which they are assigned; they train and live with their units.

All units comprising a FMF have Medical Department personnel organic to them. However, the majority of medical support comes from the medical battalion of the MLG. The MLG is a composite grouping of functional units providing combat service support beyond the organic capability of all elements of the FMF. The medical battalion provides combat medical support required for independently deployed Marine Corps elements. The primary mission of the medical battalion is to provide:

- Casualty collection
- Emergency treatment
- Temporary hospitalization
- Specialized surgery
- Evacuation

In addition, medical battalions must plan, supervise, and coordinate timely preventive measures for controlling disease.

**FMF DENTAL SUPPORT**

The mission of the FMF dental organization is to ensure the combat effectiveness of the FMF by providing comprehensive dental services. By assigning dental detachments to the task force, battalion personnel maintain dental readiness during exercises, deployments, and combat operations.

In an emergency environment, the dental battalion’s primary mission is emergency care to ensure long term dental health maintenance. Personnel from these detachments may also provide postoperative, ward, central sterilization, and supply room support, and other medical support as determined to be appropriate by the medical battalion and surgical company commanders.

**FLEET HOSPITALS**

**LEARNING OBJECTIVE:**

Describe the role and mission of Fleet Hospitals and Expeditionary Medical Facilities.

Fleet hospitals are used to provide medical support during intense combat operations and in lengthy low-intensity scenarios. Fleet hospitals are transportable, capable of performing advanced medical and surgical procedures, and deployable in a variety of operational scenarios. HMs deploy with Expeditionary Medical Facilities (EMF) with up to 500 beds, to be organized and scaled to fit the requirements identified by the Combatant Commander (COCOM). Fleet hospitals are designed to be used in operations greater than 60 days. Moderately sophisticated care is provided, along with resuscitative medical and surgical care.
ORGANIZATION

The internal organization of the fleet hospital is similar to a shore-based military treatment facility (MTF). It consists of the command staff (Commanding Officer, Executive Officer, and Command Master Chief) and five directorates: nursing services, medical services, surgical services, ancillary services, and administrative services.

MISSION

A fleet hospital’s mission depends on the requirements of the COCOM. They are typically staffed and equipped to provide advanced medical, surgical, and trauma care similar to a civilian trauma center.

NAVAL MOBILE CONSTRUCTION BATTALIONS

LEARNING OBJECTIVE:

Describe the medical and dental organization of Naval Mobile Construction Battalions.

The Navy organized the Construction Battalions, or CBs during the first days of WWII, and the name “Seabees” was quickly adopted to identify these personnel. Seabees are at work all over the world designing and building air fields, structures, and camps in support of the Navy and Marine Corps mission. This is accomplished with fully trained, combat ready and rapidly deployable units and battalions. HMs are assigned to various battalions to provide world-wide dental and medical support to active and reserve Seabees.

ORGANIZATION

Medical support to the Naval Mobile Construction Battalions (NMCBs) is provided at the battalion level by medical and dental personnel assigned to the NMCBs. There are a total of eight NMCBs home ported in Gulfport, MS and Port Hueneme, CA.

MISSION

The mission of the NMCB medical and dental support is to ensure the combat effectiveness of the NMCB by providing the medical and dental needs of the Seabees. During contingency, disaster control, or mass casualty situations, NMCB dental personnel augment with the medical effort under the direction of the cognizant authority.

SPECIAL QUALIFICATIONS

LEARNING OBJECTIVE:

Identify the opportunities that Hospital Corpsmen have to qualify as warfare specialists and the importance of being qualified.

HMs on ships, submarines, or with squadrons, the FMF, the Seabees, or other special duty assignments are taking great steps towards a successful naval career. A warfare qualification signifies that Sailors are competent in their rate and have acquired additional general knowledge that enhances their understanding of war fighting, mission effectiveness, and command survivability. Sailors wearing warfare devices stand out as integral members of the units that they serve with and are significant contributors to the effectiveness of the mission.

HMs assigned to a ship can qualify as an Enlisted Surface Warfare Specialist (SW) or Enlisted Expeditionary Warfare Specialist (EXW) and at times as an Enlisted Air Warfare Specialist (AW); with the FMF as an Enlisted Fleet Marine Force Warfare Specialist (FMF); with the Submarine Force as an Enlisted Submarine Warfare Specialist (SS); and with a NMCB as an Enlisted Seabee Combat Warfare Specialist (SCW). The insignia are shown below in Figures 2-1 through 2-6. Contact the Command Master Chief or coordinator for Personnel Qualification Standards (PQS) to begin the qualification process. The goal is to qualify early and qualify often in whatever specialties are available.
SUMMARY

This chapter reviewed medical reports, logs, and records commonly used by Navy Medicine and Dental. It covered maintenance and disposal of instructions and notices, preparation of correspondence, and filing procedures. Additionally, medical and dental readiness was covered to include IMR and PHAs. Finally, it discussed the role of Fleet Hospitals, medical and dental support to the FMF and Seabees, and the special qualifications that are available to HMs who serve with these units.

i Photographs provided by HM2 Timothy Hanna of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD.
CHAPTER 3

HEALTHCARE ADMINISTRATION PROGRAMS

INTRODUCTION

One of the most important aspects of healthcare administration is the appropriate documentation and disposition of healthcare information. Although much information is now recorded in the electronic medical record (EMR); Armed Forces Health Longitudinal Technology Application (AHLTA), there remains considerable vulnerability to ensure the contents of patient information are held in accordance with laws such as the Health Information Portability and Accountability Act (HIPAA), Privacy Act, and Freedom of Information Act (FOIA). Specifically, information is only provided to persons in a need to know status.

It is imperative that all pertinent information be provided in a beneficiary’s record whether it is electronic or paper. This data follows a beneficiary until the sponsor retires or separates from military service. The medical record is the vehicle that ensures the continuum of care throughout the beneficiary’s life.

Hospital Corpsmen (HMs) are often the very first individual a beneficiary encounters upon entering a military treatment facility (MTF), outpatient or inpatient. In order to adequately assist the beneficiary, HMs must be knowledgeable and skilled in the administrative affairs concerning outpatients and inpatients.

This chapter will provide information on the function of healthcare programs with which the HM may be involved or responsible. It will discuss the legal implications in medical care, including the various aspects of consent, incident reports, and release or non-release of medical information. Further, guidance concerning the relationship and interaction with law enforcement personnel and the legal community will be outlined.

Regardless of the job title, HMs will have administrative responsibilities which may be primary or equal to their clinical responsibilities.

The role of the HM includes:

- Greeting the patient entering the clinic or inpatient floor
- Assisting patients in completing medical treatment forms
- Performing the initial assessment of the beneficiary, specifically vital signs
- Providing initial clinical documentation
- Preparing follow-up appointments for patients
- Assisting with the referral process
- Preparing and maintaining files and medical treatment records, including reports derived from them
- Developing and maintaining a proactive and responsive supply process

PATIENT ELIGIBILITY FOR HOSPITALIZATION AND NON-FEDERAL CARE

LEARNING OBJECTIVE:

Explain the policies and procedures for DEERS and TRICARE.

Not all persons working for the federal government are eligible for treatment in a medical treatment facility. The following resources provide guidance regarding eligibility verification by presentation of a valid identification (ID) card and utilization of the Defense Enrollment Eligibility Reporting System (DEERS).
DEFENSE ENROLLMENT ELIGIBILITY REPORTING SYSTEM (DEERS)

DEERS is a computer-based enrollment and eligibility verification system. It was developed to improve distribution and control of military healthcare services including the projection and allocation of costs for healthcare programs and to minimize fraudulent healthcare claims. Navy Medicine’s eligibility for care instruction, NAVMEDCOMINST 6320.3 series, provides guidance as to who and under what circumstances members can receive medical and dental care at Navy Medical Department facilities; the extent and conditions under which such care may be provided; and the collection process to pay for that care.

Family member enrollment is accomplished for all seven uniformed services (i.e., Army, Air Force, Marine Corps, Navy, Coast Guard, Public Health Service, and National Oceanic & Atmospheric Administration) by completing the Uniformed Services Identification and Privilege Card application, DD 1172. When a new ID card is obtained for the family member, the service member’s DEERS data is updated online. If problems exist within a patient’s database, active duty personnel and their family members must be referred to the sponsor’s personnel support detachment (PSD). Refer all other beneficiaries (e.g., retired personnel and their family members) to the nearest PSD.

Both DEERS and the ID card are utilized to establish eligibility for care. Initially the HM will examine the beneficiary’s ID card. The beneficiary’s status (e.g., active or reservist; service component, etc.) is depicted on the ID card; also note the date of expiration. Next using the online computer terminal, the HM will perform an electronic DEERS check via CHCS; the DEERS verification process is outlined in OPNAVINST 1750.2 series, Defense Enrollment Eligibility Reporting System.

Eligibility

Patients who present for non-emergency treatment without a valid ID card but are in the DEERS database will not be provided medical care without first signing a statement that they are eligible and giving the reason why a valid ID card is not in their possession. If a valid ID card is not provided within 30 calendar days, the patient will be billed as a Civilian Humanitarian Non-indigent IAW the Resources Management Handbook, NAVMED P-5020. Such billing may be delayed if the commanding officer of the medical facility is convinced proof is delayed for reasons beyond the control of the patient or sponsor. In all cases where a patient presents without an ID card and does not appear in the DEERS database, non-emergency care will be denied.

REASONS FOR INELIGIBILITY.— When a DEERS check is performed and the patient is found ineligible for any of the following reasons, routine non-emergent healthcare will be denied (except as noted later in this section).

- Sponsor not enrolled in DEERS
- Family member not enrolled in DEERS
- Ineligible due to passed terminal (end) eligibility date, i.e. child who ages out at 18 years of age
- Sponsor has separated from active duty
- Spouse is divorced from sponsor and is not entitled to benefits as a former spouse
- Family member child is married
- Secretary of the Navy Designee

UNDER NO CIRCUMSTANCES WILL THE CLERK PERFORMING THE ELIGIBILITY CHECK DENY THE REQUESTED CARE. Only command-designated supervisory personnel can perform this function.
DEERS ELIGIBILITY OVERRIDES.—
The nine "DEERS eligibility overrides" are listed below. Unless otherwise stated, all overrides must be supported by a valid ID card.

1. **DD 1172**—The patient presents an original or copy of the DD 1172 used for DEERS enrollment. There are other specific items required for verification, and current service directives must be checked.

2. **All Other Family Members Recently Becoming Eligible for Benefits**—New mothers, babies, recent adoption, and dependent parents.

3. **New Identification Card**—Patients presenting with a new valid ID card, issued within the previous 120 days, will not be denied care.

4. **Ineligible Due to ID Card Expiration**—When the database shows a patient as ineligible because of ID card expiration, care may be rendered as long as the patient has a new ID card issued within the previous 120 days. After 120 days, follow the procedure in item 1, above.

5. **Sponsors Entering Active Duty Status for a Period of Greater than 30 Days**—A copy of orders ordering a reservist or guardsman to an active duty period of greater than 30 days may be accepted for the first 120 days of the active duty period. After that, follow the procedure in item 1 above.

6. **Newborns**—Newborns will not be denied care for a period of 60 days. On the 61st day the newborn will shift to TRICARE STANDARD if not enrolled in Prime. Enrollment into Prime CANNOT occur unless the newborn is put on the sponsor’s Page 2 and enrolled in DEERS. Newborns of Dependent Daughters must be approved for Secretary of the Navy Designee or they are not eligible for care.

7. **Emergency Care**—This is a medical decision and shall be determined by criteria established within the command.

8. **Sponsor’s Duty Station is Outside the 50 United States or has an APO/FPO Address**—Family members whose sponsors are assigned outside the 50 United States or to a duty station with an APO/FPO address will not be denied care as long as the sponsor is enrolled and eligible in DEERS.

9. **Survivors**—When an eligibility check indicates that a deceased sponsor is not enrolled in DEERS or the survivor is listed as the sponsor; the survivor will be treated on the first visit and referred to the appropriate personnel support detachment (PSD) for correction of the DEERS database. For second and subsequent visits, the survivor will be required to follow the procedure in item 1, above. While deceased, the sponsor remains the sponsor in order to facilitate eligibility for family members.

DEERS ELIGIBILITY EXCEPTIONS.—
The following beneficiaries are categorized as “DEERS Eligibility Exceptions.” Although authorized care, they may not be authorized to be enrolled in the DEERS system. These beneficiaries will NOT be denied care based upon a DEERS check.

- **Secretary of the Navy Designees**—Secretary of the Navy Designees will be treated as indicated on their letter of designation.

- **Foreign Military Personnel**—These personnel and their family members, assigned through Personnel Exchange Programs or other means, are or may be eligible. Eligible members may also include
  - North Atlantic Treaty Organization (NATO) military personnel and their family members stationed in or passing through the United States
  - Crew and passengers of visiting military aircraft; and
  - Crews of ships of NATO nations that come into port
Other foreign military personnel may be eligible through Public Law or DoD agreements. As such, they will be treated IAW current service directives.

Patients in other organizations, such as Red Cross workers, Secret Service agents, Federal Aviation Administration personnel, and some non-retiree veterans are also in this category of possible beneficiaries due to agreements. Ensure current eligibility requirements are met for these personnel prior to treatment.

**TRICARE**

TRICARE is an enhancement of the Civilian Health and Medical Program of the Uniformed Services (CHAMPUS). TRICARE is a medical benefits program established to manage the care services in military MTFs. Additionally, it manages the cost sharing charges for medically necessary civilian services and supplies required in the diagnosis and treatment of illness or injury. TRICARE is utilized if the required services are not available from the direct care system of the Department of Defense treatment facilities or designated MTFs/DTFs.

Information pertaining to eligibility, extent of care, providers, cost, and claims is contained in the booklet *Sailing with TRICARE, for Sailors and Their Families*. A copy of this publication, along with the TRICARE Provider Directory and other helpful TRICARE information is available at a local TRICARE Service Center. Guidance is also available via the DoD TRICARE homepage, [http://www.tricare.osd.mil](http://www.tricare.osd.mil). Information regarding the TRICARE Dental Program can be found in the TRICARE Dental Program Benefit Booklet or the DoD TRICARE Dental Program homepage, [www.tricare.dentalprogram.com](http://www.tricare.dentalprogram.com).

**DENTAL CARE ELIGIBILITY**

There are several types of dental care including routine, emergency, and elective. The person’s eligibility will determine the type of treatment that can be provided. Active duty members and reservists recalled to active duty for a period of more than 30 days are eligible for all services. Family members are eligible to enroll in the TRICARE Dental Plan as long as the service member (active duty or reservist) has at least 12 months remaining on active duty.

**Patient Registration**

Patient Registration is an important part of the eligibility process either establishing it or confirming it. Patient registration is usually performed in outpatient medical records or in admissions and dispositions.

**Priority of Care**

Naval Dental Treatment Facilities (DTFs) and clinics will provide care to all eligible beneficiaries subject to the capabilities of the professional staff and availability of space and facilities.

In those instances when care cannot be rendered to all eligible beneficiaries, care will be prioritized based on the criteria outlined in the following list without regard to the sponsoring uniformed service.

**Priority Categories**

**Cat. 1A.**—Members of the uniformed services on active duty

**Cat. 1B.**—Members of a Reserve Component of the Armed Forces and National Guard personnel

**Cat. 2.**—Family member of active duty members of the uniformed services; family members of persons who died while in such a status

**Cat. 3.**—Members of the Senior Reserve Officers’ Training Corps

**Cat. 4.**—Retired members of the uniformed services and their family members (including family members of deceased retired members)

**Cat. 5.**—Civilian employees of the Federal Government

**Cat. 6.**—All others
The rendering of emergency dental treatment to any person when such treatment is necessary affects the above priority categorization, i.e. pediatric patient with an emergency will supersede an active duty person awaiting a routine procedure.

**ROUTINE DENTAL CARE.**—Treatment includes all the medical, surgical, and restorative treatments of oral disease, injuries, and deficiencies that come within the field of dentistry. These services are reserved for active duty members and reservists recalled to active duty beyond 30 days. Family members and retirees are treated via the current TRICARE Dental Plan or other dental insurance plan. Routine services are preventive and corrective which include:

- Dental examinations and oral health instruction (OHI)
- Restoration of lost tooth structure
- Treatment of periodontal conditions
- Surgical procedures
- Replacement of missing teeth essential to personal appearance, the performance of military duty, or the proper mastication of food

**EMERGENCY DENTAL CARE.**—Treatment is necessary to relieve pain, control bleeding, and manage acute septic conditions or injuries to the oral-facial structures. Emergency dental care is authorized worldwide for personnel of all categories.

**ELECTIVE DENTAL CARE.**—May be authorized upon evaluation by the dental officer IAW Navy policy. Examples of elective dental care are malocclusion, orthodontics, replacing amalgam fillings with gold crowns, etc.

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**NAVY MEDICINE’S QUALITY ASSURANCE PROGRAM**

**LEARNING OBJECTIVE:**

*Explain the philosophy of Navy Medicine’s Quality Assurance Program.*

The Quality Assurance Program uses various sources of data to evaluate the degree of excellence and to make improvements as needed for quality care. Quality assurance activities reflect what patients and providers expect of each other. Quality assurance activities are highly valued by The Joint Commission (TJC) and Medical Inspector General (MED IG).

Many of the principles, standards, and organizational requirements of The Joint Commission (TJC) have been adopted and are contained in OPNAVINST 6320.7 series, *Health Care Quality Assurance Policies for Operating Forces*, BUMEDINST 6010.13 series, *Quality Assurance Program*, lists the required elements for process improvement (quality assurance) programs of naval hospitals, medical clinics, and dental clinics.

The delivery of quality health care has always been a driving force in the operational and managed care of MTF’s and DTF’s. The *Navy’s Health Care Relations Program (BUMED Instruction 6300.10 series)*, provides general guidance to the establishment of this program. The program has three parts, which are Internal, External and Patient Relations.
PATIENT RELATIONS AND COMMAND PATIENT CONTACT POINT PROGRAMS

LEARNING OBJECTIVE:

Explain the philosophy of the Patient Relations Program and the Patient Contact Point Program.

Navy healthcare professionals have long understood the need for good communication between the patient and the medical department staff. The atmosphere in which care is given has a tremendous impact on the patient’s perception of the quality. The quality of medical and dental care rendered may be superb; however, the care can be perceived by the patient to be substandard due to poor interpersonal skills of those assigned to patient contact points (where the patient and healthcare professional meet). Many complaints voiced by patients would not occur if personnel consistently presented a courteous and knowledgeable attitude that reflected a genuine concern for the patient.

PATIENT RELATIONS PROGRAM

The primary goal of the Patient Relations Program is to help resolve patient complaints and problems through patient intervention and negotiations in accordance with BUMEDINST 6300.10 series. As an adjunct to this goal, the program strives to enhance the channels of communication between the hospital and the patient population.

PATIENT CONTACT POINT PROGRAM

The Patient Contact Point Program, a subset of the Patient Relations Program, ensures an effective means of resolving such issues before the patient departs the facility. All Navy treatment facilities have this program which allows patients to provide any complaints or compliments relating to the treatment received.

PATIENT CONTACT REPRESENTATIVE

Patient contact representatives are appointed in writing by the commanding officer and have their picture posted at the front desk or in the reception area visible to all patients. Patient compliments and complaints are routed through the patient contact representative to the chain of command for action and incorporation into the command’s annual assessment for the Quality Assurance (QA) Program. Follow BUMEDINST 6010.13 series and your clinic’s instruction for follow-up actions and reporting instructions.

PATIENTS’ BILL OF RIGHTS AND RESPONSIBILITIES

Patients’ Bill of Rights and Responsibilities are posted next to the Patient Contact Representative’s picture. Figure 3-1 illustrates the Patients’ Bill of Rights and Responsibilities.

PATIENT SURVEYS

Patient survey forms should be located at the front desk area. These forms originate at each clinic and ask questions regarding the patient’s visit. Completed forms are returned to the clinic staff for compilation and submission with the command’s annual assessment of the QA Program.
### A Patient's Bill of Rights and Responsibilities

#### Rights

1. **Medical Care and Dental Care.** The right to quality care, and treatment consistent with available resources and generally accepted standards. The patient has the right also to refuse treatment to the extent permitted by law and Government regulations, and to be informed of the consequences of his or her refusal. When concerned about the care received, the patient has a right to request review of the adequacy of care.

2. **Pain Management.** The right to receive information about pain and pain relief measures, a concerned staff committed to pain prevention and management, and health professionals who respond quickly to reports of pain.

3. **Respectful Treatment.** The right to considerate and respectful care, with recognition of his or her personal dignity.

4. **Privacy and Confidentiality.** The right, within law and military regulations, to privacy and confidentiality concerning medical care.

5. **Identity.** The right to know at all times the identity, professional status, and professional credentials of health care personnel, as well as the name of the health care provider primarily responsible for his or her care.

6. **Explanation of Care.** The right to an explanation concerning his or her diagnosis, treatment, procedures, and prognosis of illness in terms the patient can be expected to understand. When it is not medically advisable to give such information to the patient, the information absence, another appropriate person.

7. **Informed Consent.** The right to be advised in non-clinical terms of information needed to make knowledgeable decisions on consent or refusal for treatments. Such information should include significant complications, risks, benefits, and alternative treatments available.

8. **Research Projects.** The right to be advised if the facility proposes to engage in or perform research associated with his or her care or treatment. The patient has the right to refuse to participate in any research projects.

9. **Safe Environment.** The right to care and treatment in a safe environment.

10. **MTF and DTF Rules and Regulations.** The right to be informed of the facilities rules and regulations that relate to patient or visitor conduct. The patient should be informed about smoking rules and should expect compliance with these rules from other individuals. Patients are entitled to information about the MTF or DTF mechanism for the initiation, review, and resolution of patient complaints.

#### Responsibilities

1. **Providing Information.** The responsibility to provide, to the best of his or her knowledge, accurate and complete information about complaints, past illness, hospitalizations, medications, and other matters relating to his or her health. A patient has the responsibility to let his or her primary health care provider know whether he or she understands the treatment and what is expected of him or her.

2. **Pain Management.** The responsibility to ask your doctor or nurse what to expect regarding pain and pain management, to discuss pain relief options, and to actively participate in your pain control.

3. **Respect and Consideration.** The responsibility for being considerate of the rights of other patients and MTF or DTF health care personnel and for assisting in the control of noise, smoking, and the number of visitors. The patient is responsible for being respectful of the property of other persons and of the facility.

4. **Compliance with Medical Care.** The responsibility for complying with the medical and nursing treatment plan, including follow-up care, recommended by health care providers. This includes keeping appointments on time and notifying the MTF or DTF when appointments cannot be kept.

5. **Medical Records.** The responsibility for ensuring that medical records are promptly returned to the medical facility for appropriate filing and maintenance when records are transported by the patients for the purpose of medical appointment or consultation, etc. All medical records for patients in the facility are the property of the U.S. Government.

6. **MTF and DTF Rules and Regulations.** The responsibility for following the MTF or DTF rules and regulations affecting patient care conduct. Regulations regarding smoking should be followed by all patients.

7. **Reporting of Patient Complaints.** The responsibility for helping the MTF or DTF commander provide the best possible care to all beneficiaries. Patients' recommendations, questions, or complaints should be reported to the patient contact representative.

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Figure 3-1.—Patient's Bill of Rights and Responsibilities
MEDICAL TREATMENT RECORDS

An essential part of the administrative duties of a HM is preparing and maintaining the medical record with associated forms; guidance is found in the Manual of the Medical Department (MANMED) Chapter 16. Use of the term “medical records” includes records maintained by both medical and dental treatment facilities and to records in both paper and automated (electronic) formats.

The purpose of the medical record (paper and electronic) is to provide an individual chronological record of medical treatment afforded members of naval service. The record has significant current and long-term medical-legal value to the individual concerned, their survivors, and the U. S. Government. Medical, dental and occupational health examinations, evaluations and histories as well as evaluation of illness and subsequent treatments, are documented in this record.

FAMILY ADVOCACY PROGRAM

LEARNING OBJECTIVE:

Explain the policies and procedures pertaining to the Family Advocacy Program.

The purpose of the Family Advocacy Program is to identify and monitor spouse or child abuse/neglect (whether physical or psychological) and sexual abuse in military families. The program is guided by SECNAVINST 1752.3 series, Family Advocacy Program and BUMEDINST 6320.70 series. A Family Advocacy Representative (FAR), usually a staff member of the local treatment facility, manages the program. A base-wide committee, comprised of medical, line, chaplain, and Family Service Center personnel, reviews abuse cases and determines whether each case is established, suspected, or unfounded. Established cases are reported to the central registry at BUMED. Service statistics are compiled and the future assignment of established abusers is monitored and controlled via this registry.

If abuse is suspected by the HM there is a moral and legal obligation to report the actual or suspected abuse to the chain of command and or legal authorities as appropriate.

DRUG AND ALCOHOL ABUSE PREVENTION AND CONTROL PROGRAM

LEARNING OBJECTIVE:

Explain policies and procedures pertaining to the Drug and Alcohol Abuse Prevention and Control Program.

The policies governing the Alcohol and Drug Abuse Prevention and Control Program encompass the Navy’s approach on eliminating alcohol and drug abuse. It provides methods of deterrence and prevention along with education and treatment of individuals found guilty of abuse or in need of substance abuse treatment.

Alcohol consumption is a personal decision of each individual; however, personnel should be aware that the minimum allowable age to consume alcohol is 21. The Navy satisfies the decision of each individual by taking an approach of “Responsible Use.”

The Navy’s Policy on drug abuse is “Zero Tolerance.” Navy drug abuse is not subordinate to any foreign, state, or local regulation, which may permit the use, possession, distribution, or prescription of controlled substances. Personnel in violation of this provision are in violation of a lawful general order and shall be subjected to disciplinary and administrative action as appropriate.

The Drug and Alcohol Program Advisor (DAPA) is the command’s primary advisor for all alcohol and drug matters. Among other duties, DAPAs conduct administrative screenings, prepare required reports, provide prevention education, and monitor aftercare. Additional responsibilities of the DAPA are outlined in OPNAVINST 5350.4 series, Drug and Alcohol Abuse Prevention and Control.
PHYSICAL READINESS PROGRAM

LEARNING OBJECTIVE:

Explain the policies and procedures pertaining to the Physical Readiness Program.

The policies governing this program are outlined in OPNAVINST 6110.1 series, Physical Readiness Program. Currently, physical readiness testing is required for all personnel on a semi-annual basis. Testing, education, and training information are provided through a network of collateral duty command fitness coordinators. In addition to program implementation, specific Medical Department responsibilities include:

- Providing technical assistance to BUPERS
- Conducting lifestyle, fitness, and obesity research
- Reviewing health status and granting waivers for individuals unable to safely participate in physical fitness testing and training
- Assisting in the development of exercise prescriptions

LEGAL IMPLICATIONS IN MEDICAL CARE

LEARNING OBJECTIVE:

Explain the policies and procedures pertaining to consent for medical treatment, incident reports, and release of medical information.

There are few aspects of healthcare that do not have legal implications. Every time a patient interacts with the staff of a medical or dental treatment facility, the potential for legal entanglement exists. Although the law has become more and more involved in the operation of hospitals, the exercise of common sense combined with knowledge of those situations that require special care will protect the hospital and its staff from most legal situations.

This section addresses some of the situations that regularly occur and have legal consequences, including the policy and instructions that apply to those situations. The law is an inexact science subject to widely varying circumstances. The information in this chapter cannot substitute for the advice of an attorney; consult with hospital or area Judge Advocate General (JAG) Corps officers or Navy civil service lawyers on medical-legal issues.

CONSENT REQUIREMENTS FOR MEDICAL TREATMENT

With limited exceptions, every person has the right not to be touched without giving permission first. Consent must be obtained before medical treatment is initiated. Failure to obtain consent may result in the healthcare provider being responsible for medical malpractice and/or assault and battery upon the patient.

Informed Consent

"Consent" in the medical setting refers to a patient’s expressed or implied agreement to submit to an examination or treatment. "Informed consent" requires that the healthcare provider give the patient all the information necessary for a knowledgeable decision. In order to be considered “lawful consent” the patient must have made a knowledgeable decision with full awareness of the consequences; without it there is no lawful consent. The proposed procedure must be described in lay terms for patient understanding regarding the nature, the risk, and the alternatives of what is proposed. The higher the risk or the seriousness of the consequences requires a greater duty to disclose.

NOTE:
The duty to inform and explain rests with the provider.
THIS RESPONSIBILITY CANNOT BE DELEGATED.
For common medical procedures that are considered simple and risk free, a provider is not required to explain consequences that are generally understood to be remote. A determination of what is simple and common should be made from the perspective of appropriate medical standards.

Emergency Situations

Consent before treatment is not necessary when treatment appears to be immediately required to prevent significant deterioration or aggravation of a patient’s condition. This applies especially in life-threatening situations when it is not possible to obtain a valid consent from the patient or a person authorized to consent for the patient. The existence and scope of the emergency should be adequately documented. When the patient is unable to give consent, the appropriate course of treatment based upon a qualified medical assessment of what a “reasonable person would expect” becomes the guiding principle for continued emergent care.

Who May Consent

The determination of who has authority to consent to medical treatment is based on an evaluation of the competency of the patient. If competent, the patient alone has the authority to consent. Competency refers to the ability to understand the nature and consequences of one’s decisions. In the absence of contrary evidence, it is assumed that the patient presenting for treatment is competent. If the patient is incompetent, either by reason of statutory incompetence (e.g., a minor) or by reason of a physical or mental impairment, the inquiry must turn to whoever has the legal capacity to consent on behalf of the patient. Parents and guardians will have the authority to consent for their minor children. In many states a husband or wife may give consent for an incompetent spouse. It is the law of the state in which the hospital is located that controls the question of "substitute consent."

There may be paperwork, called an advance directive, that indicates who can provide informed consent for the patient. The form may be a healthcare surrogate designation, healthcare power of attorney, or a general power of attorney. This form is filed in the patient’s healthcare record and documented in the electronic health record (i.e. CHCS/AHLTA) for quick retrieval in order to consult with the appropriate person on behalf of the patient.

Forms of Consent

Consent for medical treatment should be obtained through an open discussion between the provider and patient during which the patient expressly agrees to the procedure. The consent should be documented by having the patient sign appropriate forms and by the provider noting any important details of the discussion in the treatment record.

In certain limited circumstances, the consent of an individual for simple medical treatment may be implied from the circumstances. Implied consent arises by reasonable inference from the conduct of the patient or the individual authorized to consent for the patient. For example, a patient who rolls up a sleeve when told it is time to draw blood is providing implied consent by this action. Reliance on this form of consent is strongly discouraged except in the most routine, risk-free examinations and procedures.

Witness to Consent

Any competent adult may witness the patient’s consent. It is a conflict of interest to have a staff member who is participating in the patient’s procedure to act as a witness; utilize a staff member of the hospital who is not participating in the procedure. It is not advisable for a relative of the patient to act as a witness.

Duration of Consent

Consent is valid as long as there has been no material change in the circumstances between the date that consent was given and the date of the procedure. It is desirable that a new consent be obtained if there is a significant time lapse (per command policy) or if the patient has been discharged and readmitted due to postponement of the procedure.
INCIDENT REPORTS

Incident reporting falls under Title 10 U.S.C. 1102, Confidentiality of Medical Quality Assurance Records. When an event occurs that harms an individual, illustrates a potential for harm, or evidences serious dissatisfaction by patients, visitors, or staff, a risk-management incident has taken place. Examples of such episodes include the following:

- A patient is helped out of bed by family despite directions to the contrary by staff members. The patient falls and is injured
- Excessive silver nitrate is put into the eyes of a newborn impairing vision
- The mother of the child complains about the care that has been given to the child and informs a staff member that the issue will be discussed with a lawyer

When a member of the staff becomes aware of an incident, there is a responsibility to make the hospital command aware of the situation. The mechanism for doing this is the quality care system. Quality Care Review (QCR) reports are designed to promptly document all circumstances surrounding an event, to alert the commanding officer, Command Risk Manager, and other involved administrators and clinicians of a potential liability situation. It also establishes an information base to monitor and evaluate the number and types of incidents that take place in the facility.

QCRs by nature contain a great deal of information that would be of interest to persons filing claims or lawsuits against the Navy for alleged substandard medical care. The law recognizes the need for hospitals to have a reliable means of discovering and correcting problems; most states have enacted laws that make incident reports confidential. A person cannot obtain a copy of an incident report to help in the legal action against the hospital.

QCRs lose their "protected" status if they are misused or mishandled. It is important to treat these reports like all confidential documents. All copies require the permission of the risk manager and the legal officer. Do not include the report in the patient’s treatment record. The report should be limited to the facts and must not contain conclusions. Reports should be addressed and forwarded directly to the risk manager of the hospital. Guidance concerning the Risk Management Program is found in BUMEDINST 6010.21 series.

RELEASE OF MEDICAL INFORMATION

Two federal statutes, the Privacy Act and the Freedom of Information Act (FOIA) combine to establish the criteria for collecting, maintaining, and releasing medical treatment records.

Freedom of Information Act (FOIA)

FOIA governs the disclosure of documents maintained by government agencies. A written request for Department of the Navy (DoN) records that refer to FOIA must be responded to IAW the provisions of the Act. DoN will make available to any person all documents provided the requester reasonably describes the records sought and promises to pay for reasonable search and photocopy costs. Each naval activity is responsible for developing procedures for ensuring the prompt handling, retrieval, and review of requested records. The official having responsibility for the records has 20 working days to respond to the requester.

A naval record will be withheld only when it is exempt from disclosure under FOIA. One basis for exempting a record from disclosure applies to personnel, medical, and similar files. The release of these files would constitute a clearly unwarranted invasion of personal privacy. This concern over clearly unwarranted privacy intrusion is reflected in the provisions of the Privacy Act while FOIA covers Protected Health Information (PHI) outside the covered entity.

Privacy Act

The public’s concern over governmental functions led to the creation of FOIA. It became obvious that a balance had to be made between the public’s right to know and the Government’s protected rights and interests. One of these
competing interests was the protection of an individual’s personal right to privacy. In response to this need, the Privacy Act of 1974 was enacted. The Privacy Act establishes safeguards concerning the right to privacy by regulating the collection, maintenance, use, and dissemination of personal information by federal agencies.

The Privacy Act requires federal agencies to:

- Permit an individual to know what records pertaining to him or her are collected, maintained, used, or disseminated by the agency.
- Permit an individual to prevent records pertaining to him or her and obtained by the agency for a particular purpose from being used or made available for another purpose without the individual’s consent.
- Permit an individual to gain access to information pertaining to him or her in federal agency records, have a copy made for all or any portion thereof, and correct or amend such records.
- Collect, maintain, use, or disseminate any record of identifiable personal information in a manner that ensures such action is for a necessary and useful purpose, that the information is current and accurate, and that adequate safeguards are provided to prevent misuse of such information.
- Permit exemptions from the requirements of the Privacy Act only in those cases where there is specific statutory authority to do so.
- Be subject to civil suits for any damages that occur as a result of willful or intentional violation of any individual’s rights under the Privacy Act.

In addition, any employee of an agency who intentionally violates certain provisions of the Privacy Act is subject to criminal prosecution and fines.

HEALTH INFORMATION PORTABILITY AND ACCOUNTABILITY ACT

The Health Information Portability and Accountability Act (HIPAA) was enacted into law in 1996. The overall goal is to provide safeguards for protected health information (PHI) to ensure patient privacy is maintained. The Privacy Rule addresses appropriate disclosure of PHI while the Security Rule addresses electronic disclosures.

HIPAA Privacy Rule

The HIPAA Privacy Rule creates business processes to protect the use and disclosure of protected health information (PHI). PHI is individually identifiable health information, including demographics, in paper, electronic, or oral form. PHI is not limited to the documents contained in the official medical record. The HIPAA Privacy Rule allows the use and disclosure of PHI for treatment, payment, and health care operations without written authorization from the patient. Other uses and disclosures require permission. The compliance date for the HIPAA Privacy rule was April 14, 2003 and is guided by DODINST 6025.18 series, DOD Health Information Privacy Regulation.

Required Uses and Disclosures

By law, treatment facilities may disclose health information to the patient unless it has been determined by a competent medical authority that it would be harmful. Treatment facilities must also disclose health information to the Secretary of the Department of Health and Human Services (HHS) for investigations or determinations of compliance with laws on the protection of the patient’s health information.
TREATMENT.—Treatment facilities use and disclose protected health information to provide, coordinate, or manage the patient’s health care with a third party. For example, the facility may disclose PHI, as necessary, to other military and or TRICARE contractors who are providing care or consultation to patients. This includes pharmacists who may be provided information on other drugs the patient was previously prescribed to identify potential interactions. In emergencies, facilities will use and disclose PHI to provide urgent treatment.

PAYMENT.—PHI will be used to obtain payment for health care services. This includes certain activities the facility undertakes before it approves or pays for the health care services recommended. For example, obtaining approval for a hospital stay might require that PHI be disclosed to obtain approval for the hospital admission.

HEALTHCARE OPERATIONS.—PHI may be disclosed to support the daily activities related to health care. These activities include, but are not limited to, quality assessment activities, investigations, oversight or staff performance reviews, training of medical students, licensing, and communications.

HIPAA Security Rule

The HIPAA Security Rule is designed to provide protection for individually identifiable health information that is maintained, transmitted, or received in electronic form—not just the information in standard transactions. All covered entities were to be in compliance with the HIPAA Security Rule no later than April 20, 2005. The safeguards in the HIPAA Security Rule are divided into three categories: Administrative Safeguards, Physical Safeguards, and Technical Safeguards. The guiding instruction for HIPAA Security is DoD 8580.02-R series, DoD Health Information Security Regulation.

Security and privacy are linked in an effort to protect the privacy of health information. The Privacy Rule sets standards for how protected health information (PHI) should be controlled by setting forth which uses and disclosures are authorized. The Security Rule defines the safeguards to protect that PHI. It is important to recognize that the Security Rule has greater limitations than the Privacy Rule, as the Security Rule only applies to PHI in electronic form.

MEDICAL CONDITIONS AND LAW ENFORCEMENT PERSONNEL

LEARNING OBJECTIVE:

Describe the policies and procedures pertaining to prisoner patients, victims of alleged sexual assault and rape, substance abuse and control, probable-cause searches, and line-of-duty and misconduct investigations.

Some medical conditions will result in the involvement of law enforcement personnel. Individuals who are injured while committing a criminal offense; victims of abuse, neglect, or assault; impaired or injured as a result of drug abuse; or injured as a result of a traffic accident will often be the subject of an official investigation. The investigators will want to question the patient or the healthcare providers treating the patient. Authorities may request the medical records of the patient as well as take the patient into custody.

Under the Posse Comitatus Act, a federal statute enacted in 1956 (18 U.S.C. § 1385), it is unlawful for the U.S. military to be used to enforce or assist in the enforcement of federal or state civil laws. There are many exemptions to this act, but the issue for healthcare providers is settled by asking the following question:

"Is the medical procedure being done on this patient for a legitimate medical reason, or is it only being performed to assist civil law enforcement?"

Provided there is a reasonable medical justification for the procedure, the results of the procedure may be shared with civil law enforcement officials under the circumstances covered below.
Cooperation with law enforcement officials, to the extent possible, is required. Provided there are no medical contraindications, patients who are suspected of having committed an offense or are presumed victims of criminal activity will be made available to speak with investigators. Access to medical treatment records is governed by the Privacy Act and FOIA.

Records of patients may be made available to U.S. Navy investigators once they have established the need to know. This determination will be made by the hospital JAG or public affairs officer (PAO). Other Department of Defense, federal, state, or local law enforcement officers may have access to treatment records if access is necessary as part of a criminal investigation and there is no unwarranted violation of the privacy rights of the individual involved. Local health and social service departments may be provided information from the record. The same guidelines for accessing treatment records apply to staff members' conversations with investigating officers.

**DELIVERY OF A PATIENT UNDER WARRANT OF ARREST**

No patient may be released from treatment before it is medically reasonable to do so. Once it is determined that the individual can be released without significant risk of harm, the following guidelines regarding release to law enforcement authorities apply.

**Non-active Duty Patients**—When a non-active duty patient is released from medical treatment, the facility no longer exercises any degree of control, and normal legal processes will occur. No official action by hospital personnel is required before local authorities take custody of the released patient. There may be occasions, however, when law enforcement officials should be notified of an imminent release of a patient.

**Active Duty Patients**—The commanding officer is authorized to deliver personnel to federal law enforcement authorities who display proper credentials and represent to the command that a federal warrant for the arrest of the individual concerned has been issued. There are circumstances in which delivery may be refused; however, guidance should be sought from a judge advocate of the Navy or Marine Corps when delivery is to be denied.

Normally, it is the responsibility of the permanent command to take custody and control of an active duty member suspected of committing an offense. If the member is an unauthorized absentee (UA) and the command to which assigned is not in the same geographic area as the treatment facility, release of the patient should be coordinated with the nearest Transient Personnel Unit (TPU) or Military Prisoner Escort Unit. Close liaison with the member’s permanent command should be established.

In cases where delivery of an active duty patient is requested by local civil authorities, and the treatment facility is located within the requesting jurisdiction or aboard a ship within the territorial waters of such jurisdiction, commanding officers are authorized to deliver the patient when a proper warrant is presented. Whenever possible, a judge advocate of the Navy or Marine Corps should be consulted before delivery. If the treatment facility is located outside the jurisdiction requesting delivery, only a General Courts-Martial authority (as defined by the Uniform Code of Military Justice, Manual for Courts-Martial and Navy Regulations) is authorized to arrange for delivery of such patient. Extradition, return agreements, and other prerequisites to delivery will have to be completed.

When disciplinary proceedings involving military offenses are pending, the treatment facility should obtain legal guidance from a judge advocate before delivering a patient to federal, state, or local authorities. When the commanding officer considers that extraordinary circumstances exist which indicate that delivery should be denied, then the Judge Advocate General of the Navy must be notified of the circumstances by message or phone.
PRISONER PATIENTS

Prisoner patients fall into three categories of eligible beneficiaries:

- Enemy prisoners of war and other detained personnel
- Non-military federal prisoners
- Military prisoners

Enemy Prisoners of War and Other Detained Personnel

Enemy prisoners of war and other detained personnel are entitled to all necessary care, subject to the availability of care and facilities.

Non-military Federal Prisoners

Non-military federal prisoners are authorized only emergency care. When such care is being provided, the institution to which the prisoner is sentenced must furnish security personnel to ensure custody of the prisoner and safety of others in the facility. Upon completion of emergency care, arrangements will be made to transfer these individuals to a non-military treatment facility or for return to the institution to which sentenced.

Military Prisoners

Status of Forces policy is to protect, to the maximum extent possible, the rights of U.S. personnel who may be subject to criminal trial by foreign courts and imprisonment in foreign prisons. Active duty members are generally separated from the service until they have completed their term of imprisonment and returned to the United States. During this confinement, they will normally retain healthcare benefits.

Military prisoners (those sentenced under the Uniform Code of Military Justice) with punitive discharges that have been executed but the sentences have not expired are authorized care. Individuals on appellate leave, awaiting execution of a punitive discharge, are entitled to care. Military prisoners with punitive discharges that have been executed and require hospitalization beyond expiration of their sentences are not eligible for care; they may be hospitalized as civilian humanitarian non-military indigents until disposition is made to some other facility.

SEXUAL ASSAULT AND RAPE

Sexual assault and rape are criminal offenses, often associated with serious physical injury. The management of cases involving sexual assault and rape must be a joint medical and legal function. A sexual assault investigation kit, supplied by the Naval Criminal Investigative Service (NCIS), is used to gather and preserve evidence of a crime. This kit includes step-by-step procedures for examination of the patient and a checklist of specimens to be collected.

To safeguard and obtain evidence to be used in legal proceedings, liaison among the naval treatment facility, military and civil investigative agencies, and state and local agencies (such as Child and Spouse Protective Services) should be established. Medical personnel are not to judge, defend, or prosecute the individuals involved. NAVMEDCOMINST 6310.3 series, Management of Alleged or Suspected Sexual Assault and Rape Cases, provides guidance for care, evaluation, and medico-legal documentation of the alleged victim.
Treat the patient with respect and courtesy and provide appropriate privacy. Careful attention to psychological factors must be given to lessen the impact of the incident. When a minor is involved, the reaction of adults may be more harmful than the actual assault itself. Tactful questioning and use of appropriate terminology are of extreme importance throughout the history taking and examination. OPNAVINST 1752.1 series, *Sexual Assault Victim Intervention (SAVI) Program*, and SECONAVINST 5800.11 series, *Victim and Witness Program*, provide guidance for the care and support of alleged victims of sexual assault.

**CHILD AND SPOUSE ABUSE AND NEGLECT**

The nature of child and spouse abuse and neglect requires a careful patient history and physical examination by a medical provider to identify or rule out past and present injuries. The policies and guidelines established by the Navy Family Advocacy Program must be followed. This program was provided earlier in this chapter and is outlined in SECONAVINST 1752.3 series and BUMEDINST 6320.70 series.

**SUMMARY**

Retaining high medical standards and quality healthcare require a robust healthcare administration support structure. DEERS management and the determination of patient eligibility are crucial components. There are numerous health-related programs established to benefit and support eligible beneficiaries. Good quality assurance creates better patient relations, thereby minimizing legal problems. Substance abuse and family advocacy programs identify problems before they become unmanageable. The physical readiness program helps build a healthier Sailor, thus eliminating needless patient visits.

This chapter provided an overview of the HM’s responsibilities in the areas of administrative and legal interaction with authorities. Legal cases are lost because of failure to adhere to the proper administrative procedures. The HM must be aware of these procedures and ensure that they are followed precisely.
CHAPTER 4

MEDICAL RECORDS

INTRODUCTION

Navy and Marine Corps personnel and DoD eligible beneficiaries utilize the U.S. Navy Medical Outpatient and Dental Treatment Record (NAVMED 6150/21-30) as the official record jacket for the chronological documentation of medical and dental evaluations, care, treatments and occupational health. The medical and dental history stored in these color coded jackets assists medical department personnel to provide care.

The health record has significant medico-legal value to the patient, the healthcare provider, the Medical Treatment Facility (MTF) and Dental Treatment Facility (DTF) and the U.S. Government. Also, various officials and boards (i.e., special duty boards and medical boards) refer to information furnished by the health record in determining physical fitness or physical disability. Accurate and complete record entries and proper record maintenance are of the utmost importance.

This chapter provides the fundamentals of effective records’ management. Opening, filing, verifying, and closing active duty and reserve personnel medical and dental records, will be outlined including the use of appropriate forms. Guidelines for record management are in Chapter 16 of the Manual of the Medical Department (MANMED P-117).

PRIMARY AND SECONDARY MEDICAL RECORDS

LEARNING OBJECTIVE:
Identify the types of primary and secondary records, and the usage of each type.

PRIMARY MEDICAL RECORDS

The primary medical records are used for the documentation of outpatient medical and dental care. A secondary medical record is established by a patient’s specialty healthcare provider and contains medical information needed by that provider for a specific need. Secondary medical records are maintained separate from the primary medical record.

The three major categories of primary medical records are:

- Health records (HRECs)
- Outpatient records (ORECs)
  - Dental records (DRECs) are part of HRECs (active duty) and ORECs (retirees and family members)
- Inpatient records (IRECs)

Health Record

The HREC is a file of continuous care given to active duty members and documents all outpatient care provided during a member’s career. While the HREC primarily documents ambulatory (outpatient) care, copies of inpatient narrative summaries and operative reports are also placed in the HREC to provide continuity of healthcare documentation.
**Dental Records**

The DREC is a file of continuous care given to active duty and reserve members and their families. It contains all documents of dental care provided during a member’s career.

**Outpatient Record**

The OREC is a file of continuous care that documents ambulatory treatment received by a person other than an active duty person, i.e. retiree and family members.

**Inpatient Record**

The IREC is a medical file that documents care provided to a patient assigned to a designated inpatient bed at an MTF or ship. Summaries of inpatient care are placed into the HREC (Active Duty) or OREC (non-active duty personnel) to maintain continuity of care.

**SECONDARY MEDICAL RECORDS**

Primary healthcare providers of active duty personnel must be aware of their personnel’s medical status at all times. Thus, temporary and ancillary records will not be opened or maintained for active duty personnel. The exceptions to this policy are records for obstetrics/gynecology (OB/GYN), family advocacy, psychology and psychiatry clinical records.

Secondary medical records are separate from the primary medical record and must follow the guidelines established by the MANMED. These records are kept in a separate file and secured in a specialty clinic or department of MTFs.

Opening a secondary medical record requires the healthcare provider to write a note on the DD Form 2766, Adult Preventive and Chronic Care Flow Sheet in the primary treatment record. Information includes: nature of the secondary record; patient’s diagnosis; and clinic or department name including address and telephone number. A note is written on the same form when the secondary record is closed.

Secondary medical records include:
- Convenience records
- Temporary records
- Ancillary records

**Convenience Record**

A convenience record contains excerpts from a patient’s primary record and is kept within the MTF by a treating clinic, service, department, or individual provider for increased access to the information. When the convenience record’s purpose has been served, the establishing clinic, service, department, or provider purges the record from its file, compares it to the primary medical record, and adds any medical documents that are not already in the primary medical record.

**Temporary Medical Record**

A temporary record is an original medical record established and retained in a specialty clinic, service, or department in addition to the patient’s primary medical record. Its purpose is to document a current course of treatment. The temporary medical record becomes a part of the primary medical record when the course of treatment is concluded. This record is most commonly established in OB/GYN for a prenatal patient.

**Temporary Dental Records**

Temporary records are required to ensure the timely availability of information that documents a current course of treatment for a patient being seen in the DTF. An example is a military member on temporary additional duty (TAD) without his or her dental record who requires emergency dental treatment.
The temporary dental record is maintained by the DTF providing the current course of treatment. When the treatment is complete or when the patient returns to the location of the permanent dental record, the patient may hand carry the record or the custodian of the temporary record must forward it to the custodian of the permanent record.

The temporary dental record must, at a minimum contain the following forms:

- Privacy Act Statement, DD 2005
- Dental Health Questionnaire, NAVMED 6600/3
- Dental Treatment Form, EZ603A

**NOTE**

If a patient is receiving dental treatment, and a dental record jacket is not used, care must be taken to securely fasten any radiographs to the forms comprising the temporary dental record.

Ancillary Record

Ancillary records consist of original healthcare documentation withheld from a patient’s primary HREC or OREC. In certain cases it may be advisable to not file original treatment information in the primary treatment record, but instead place this information into a secondary medical record, to which the patient, parent, or guardian has limited access. Examples of such instances include psychiatric treatment or instances of real or suspected child or spouse abuse, etc.

RECORDS MANAGEMENT

**LEARNING OBJECTIVE:**

Describe the fundamentals of effective records management.

All treatment records are the property of the U.S. Government and must be maintained by the responsible treatment facility (naval hospitals, health clinics, and medical/dental departments of ships, submarines, aviation squadrons, and isolated duty locations). The Commanding Officer (CO) has ultimate responsibility for all medical records. Patients are not authorized to retain or maintain their original HREC, OREC, or dental record. In addition, the hand-carrying of medical records by unauthorized individuals (e.g., spouses or siblings of the patient) without written permission is prohibited.

OPENING HEALTH RECORDS

**LEARNING OBJECTIVES:**

*Identify when a health record should be opened.*

*Identify appropriate record jacket and sequence of medical forms to be placed within a new record.*

This section covers the opening of active duty records. Health and dental records are opened when an individual becomes a member of the Navy or Marine Corps, when a member on the retired list is returned to active duty, or when the original record has been lost or destroyed.

When establishing the four-part health record, the appropriate health record jacket and required forms must be current and assembled in accordance with current directives.

OPENING HEALTH RECORDS FOR ACTIVE DUTY OFFICERS

Recruiting commands open HRECs for civilian applicants who are accepted for an officer appointment. The health record is then forwarded to the new officer’s first duty station. Midshipmen and former enlisted members appointed to commissioned officer or warrant officer grade continue to use their existing HREC. The MTF having custody of the record at the time of acceptance of appointment will make necessary entries to indicate the new grade. The record custodian will prepare summary information entries on SF 600 and NAVMED 6150/4 to include date, place, and grade to which the member was appointed.
Health records of civilian candidates selected for appointment to the Naval Academy will be prepared at the Naval Academy at the time of appointment. Health records for civilian applicants selected for officer candidate programs should be opened upon enrollment in the program.

OPENING HEALTH RECORDS FOR ACTIVE DUTY ENLISTED PERSONNEL

The HREC is opened by the activity executing the original enlistment contract in the Navy or Marine Corps. An exception to this rule involves service members who are enlisted or inducted and ordered to immediate active duty at a recruit training facility. In this instance, the HREC (Fig. 4-1) will be opened by either the Naval Training Center (NTC) or Marine Corps Recruit Depot, as appropriate. Copies of the service member’s DD 2807, Report of Medical History, and DD 2808, Report of Medical Examination are sent to the appropriate NTC or recruit depot, and added to other applicable forms in the member’s records.

OPENING HEALTH RECORDS FOR RESERVISTS

The Naval Reserve Personnel Center (NRPC), New Orleans, is the HREC custodian for inactive reserve personnel and is responsible for records’ preparation and maintenance. When inactive reservists are called to active duty and their HRECs have not been received by their duty station, a request for their records should be initiated. Requests for Navy personnel are sent to NRPC. Marine Corps personnel requests are sent to the Marine Corps Reserve Support Center.

For Navy and Marine Corps service members who were discharged before 31 January 1994, requests should be sent to the National Personnel Records Center (NPRC) for record retrieval. For service members who were discharged after 31 January 1994, requests for record retrieval are sent to the Department of Veterans Affairs (VA). Addresses of each of these activities are listed in Chapter 16 of the MANMED.

Figure 4-1.—Completed Front Cover of Medical Record

Photograph provided by HM2 Timothy Hanna of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD.
PREPARING THE MEDICAL RECORD
JACKETS: HREC, OREC, AND DREC

A new NAVMED 6150/21-30, U. S. Navy Medical Outpatient and Dental Treatment Record, will be prepared when a record is opened or when the existing jacket has been damaged or is deteriorating to the point of illegibility. The old jacket will be destroyed following replacement.

A felt-tip or permanent black-ink pen will be used to record all identifying data, except in the "Pencil Entries" block on the upper left of the outer front cover of these medical records. Information in this block should be written in pencil, so it can be updated or changed. Figure 4-1 illustrates the completed outside front cover and inside back cover of a military health record jacket.

Each health record jacket has the second to the last digit of the social security number (SSN) preprinted on it. The preprinted digit also matches the last digit of the form number (e.g., the preprinted digit on NAVMED 6150/26 is 6). The color of the treatment record jacket corresponds to the preprinted digit. In preparing a treatment record jacket, select a pre-numbered NAVMED 6150/21-30 jacket by matching the second to the last number of the member’s SSN.

Social Security Number

Enter the rest of the member’s SSN on the top of the inside back cover (Part IV) as shown in Figure 4-2. For members who do not have an SSN (e.g., foreign military personnel) use NAVMED 6150/29 as the treatment record jacket.
A “substitute” SSN should be created for these members by assigning the numbers "9999" as the last four digits of the SSN and assigning the first five digits in number sequence (e.g., first SSN 000-01-9999, the second SSN 000-02-9999). Place a piece of black cellophane tape over the number that corresponds to the last digit of the SSN in each of the two number scales on the inside back cover of the HREC.

**Family Member Prefix**

Enter the member’s family member prefix (FMP) code in the two diamonds preceding the SSN on the top of Part IV. Enter the FMP code of 20 for all Navy and Marine Corps active duty members. Enter an FMP code of 00 for all foreign military personnel. See Table 4-1 for more FMP codes.

<table>
<thead>
<tr>
<th>Family Member</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sponsor</td>
<td>20</td>
</tr>
<tr>
<td>Children</td>
<td>01-19</td>
</tr>
<tr>
<td></td>
<td>(First Child 01, Second Child 02, etc.)</td>
</tr>
<tr>
<td>Spouse</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>(First Spouse 30, Second Spouse 31, etc.)</td>
</tr>
<tr>
<td>Mother, Stepmother</td>
<td>40-44</td>
</tr>
<tr>
<td>Father, Stepfather</td>
<td>45-49</td>
</tr>
<tr>
<td>Mother-in-law</td>
<td>50-54</td>
</tr>
<tr>
<td>Father-in-law</td>
<td>55-59</td>
</tr>
<tr>
<td>Other Authorized</td>
<td>60-69</td>
</tr>
<tr>
<td>Dependents</td>
<td></td>
</tr>
<tr>
<td>Beneficiary Authorized by Statute</td>
<td>90-95</td>
</tr>
<tr>
<td>Civilian Emergencies</td>
<td>98</td>
</tr>
<tr>
<td>All Others</td>
<td>99</td>
</tr>
</tbody>
</table>

Table 4-1.—Family Member Prefix

**PREPARING THE OUTSIDE FRONT COVER**

**Patient Name**

Enter the member’s full name (last, first, middle initial, in that order) in the upper-right corner. Indicate no middle name by the abbreviation "NMN." If the member uses initials instead of first or middle names, show this by enclosing the initials in quotation marks (e.g., "J" "C"). Indicate titles, such as JR, SR, and III, at the end of the name. The name may be handwritten on the line provided or imprinted on a self-adhesive label and attached to the jacket in the patient identification box.

**Alert Box**

In the lower center area of the outside front cover; indicate in the alert box whether the member has drug sensitivities or allergies by entering an "X" in the appropriate box. If there are no allergies or sensitivities, leave it blank. If allergies and or sensitivities are listed ensure that all information is the same on the DREC and either the HREC (active duty) or OREC (non-active duty).

**Record Category**

Indicate the appropriate record category by entering an "X" in the appropriate box on the outside front cover, just below the "Pencil Entries" block. Indicate whether the record will be an Outpatient or Dental Treatment Record, attach ½-inch red cellophane tape to the record category block on the right edge of the inside back cover of the jacket; indicating an active duty record.

**Patient Service and Status**

Below the record category area is the patient service and status box. Mark an "X" in the appropriate service block.
Special Categories of Records

Identify the records of personnel assigned to special duty or medical surveillance programs (e.g., Flight Status, Radiation Exposure, or the Asbestos Medical Surveillance Program) by marking an "X" at the appropriate special category entry listed below the record category type.

Identify flag officers and general officers by stamping or printing “FLAG OFFICER” or "GENERAL OFFICER," as appropriate, on the lower portion of the patient identification box. If a patient identification label is used, print or stamp the appropriate identification below the label.

Pencil Entries

Following the instructions on the front cover, pencil in the appropriate title (i.e., grade or rate, if on active duty; preferred form of address, if retired or civilian), and include the current command if active duty.

Retired Year Tape Box

Leave the retired year tape box on the inside back cover blank unless creating a record for a retired service member.

Bar Code Label Area

Some Navy treatment facilities have bar coding capabilities. The bar code label indicates the patient’s FMP, SSN, record type, and record volume number. Affix the label to the front of the record jacket in the box to the right of the alert box. If the bar code is part of the patient identification label (such as the patient identification label produced by the Composite Health Care System (CHCS) computers), place this label in the patient identification box.

Labels

Use of a self-adhesive label with the name of the MTF, ship, or other units having custodial responsibility for the record is optional.

Ship or MTF logos are permitted as long as the necessary patient identifying information is not obscured.

Preparing Part I (Inside Front Cover)

Enter the following information in pencil on the inside front cover (Fig. 4-3) of the record jacket. Recording the information in pencil allows changes and updating throughout a member’s career.

- Date of arrival
- Projected rotation date
- Home address and telephone number
- Command UIC and telephone number

Preparing Part II (Front of Center Page)

**IMPRINT OF DD 2005, PRIVACY ACT STATEMENT.**—The imprint of DD 2005, Privacy Act Statement form is preprinted and located in front of the center page in the record jacket. It must be signed and dated in black ink by the patient, the parent, or the guardian must sign if the patient is a minor (Fig. 4-4).

Preparing Part III (Back of Center Page)

**DISCLOSURE ACCOUNTING RECORD.**—The Disclosure Accounting Record is preprinted and located on the back of the center page of the record jacket. It is self-explanatory and will be filled out as needed. Disclosure and release of information will be covered later in this chapter (Fig. 4-5).

Preparing Part IV (Inside Back Cover)

The Forensic Examination form is preprinted and located on the inside back cover of the record jacket, and should be completed if the record is going to be used for dental care (Fig. 4-6).
Part I: Summary of Care  
Record of Immunizations

Part II: Chronological documentation of care  
(including consults, inpatient care, etc.)

Part III: Overseas screening  
Boards  
Physical examinations  
Exposure forms (i.e., radiation, asbestos, etc.)

Part IV: Laboratory/Radiology/EKG, etc.  
Ancillary studies

<table>
<thead>
<tr>
<th>ARRIVAL DATE</th>
<th>PROJECTED ROTATION DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LOCAL HOME ADDRESS (OR MAILING ADDRESS)</th>
<th>LOCAL HOME TELEPHONE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COMMAND UIC (OPTIONAL)</th>
<th>WORK TELEPHONE</th>
<th>IF A FAMILY MEMBER, SPONSOR'S WORK TELEPHONE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 4-3.—Part I - Inside Front Cover

Photograph provided by HM2 Timothy Hanna of the Biomedical Photography Department of  
Navy Medicine Support Command, Bethesda, MD.
PRIVACY ACT STATEMENT - HEALTH CARE RECORDS

THIS FORM IS NOT A CONSENT FORM TO RELEASE OR USE HEALTH CARE INFORMATION PERTAINING TO YOU.

1. AUTHORITY FOR COLLECTION OF INFORMATION INCLUDING SOCIAL SECURITY NUMBER (SSN)

Sections 133, 1071-87, 3012, 5031 and 8012, title 10, United States Code and Executive Order 9397.

2. PRINCIPAL PURPOSES FOR WHICH INFORMATION IS INTENDED TO BE USED

This form provides you with the advice required by The Privacy Act of 1974. The personal information will facilitate and document your health care. The Social Security Number (SSN) of member or sponsor is required to identify and retrieve health care records.

3. ROUTINE USES

The primary use of this information is to provide, plan and coordinate health care. As prior to enactment of the Privacy Act, other possible uses are to: Aid in preventive health and communicable disease control programs and report medical conditions required by law to federal, state and local agencies; compile statistical data; conduct research; teach; determine suitability of persons for service or assignments; adjudicate claims and determine benefits; other lawful purposes, including law enforcement and litigation; conduct authorized investigations; evaluate care rendered; determine professional certification and hospital accreditation; provide physical qualifications of patients to agencies of federal, state, or local government upon request in the pursuit of their official duties.

4. WHETHER DISCLOSURE IS MANDATORY OR VOLUNTARY AND EFFECT ON INDIVIDUAL OF NOT PROVIDING INFORMATION

In the case of military personnel, the requested information is mandatory because of the need to document all active duty medical incidents in view of future rights and benefits. In the case of all other personnel/beneficiaries, the requested information is voluntary. If the requested information is not furnished, comprehensive health care may not be possible, but CARE WILL NOT BE DENIED.

This all inclusive Privacy Act Statement will apply to all requests for personal information made by health care treatment personnel or for medical/dental treatment purposes and will become a permanent part of your health care record.

Your signature merely acknowledges that you have been advised of the foregoing. If requested, a copy of this form will be furnished to you.

SIGNATURE OF PATIENT OR SPONSOR          SSN OF MEMBER OR SPONSOR          DATE

DD FORM 1 FEB 2005

PREVIOUS EDITION IS OBSOLETE

Figure 4-4.—Part II – Front of Center Page

Photograph provided by HM2 Timothy Hanna of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD.

4-9
Figure 4-5.—Part III – Back of Center Page

Photograph provided by HM2 Timothy Hanna of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD.
Figure 4-6.—Part IV - Inside Back Cover

Photograph provided by HM2 Timothy Hanna of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD.
FILING HEALTH RECORDS

LEARNING OBJECTIVE:

Identify filing and tracking procedures for health, outpatient, and dental records.

RECORD FILING SYSTEM

The Navy Medical Department uses the Terminal Digit Filing System (TDFS) to file health records. Records are filed according to the terminal digits (last two numbers) of the service member’s social security number (SSN), color coding of the record jacket, and use of a block filing system.

To understand the TDFS filing system, the SSN must be regarded in a specific manner. The nine digits of the SSN are divided into three number groups, reducing the chance of transposing numbers. In the TDFS system the SSN 123-45-6789 is visually grouped and read from right to left (instead of left to right), as follows:

<table>
<thead>
<tr>
<th>Primary Number</th>
<th>Secondary Number</th>
<th>Third Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>89</td>
<td>67</td>
<td>123-45</td>
</tr>
</tbody>
</table>

On the record jacket, the family member prefix (FMP) is added to the patient’s social security number showing a beneficiary’s relationship to the sponsor. For example, the FMP for active duty personnel is 20, while the FMP for a spouse is 30.

Under the Terminal Digit Filing System, the central files are divided into 100 approximately equal sections. Each section is identified by a maximum of 100 file guides bearing the 100 primary numbers, 00 consecutively through 99. Each of these 100 sections contains records whose last two digits correspond to the section’s primary number. For example, every record with the SSN ending in 56 is filed in section 56.

Within each of these 100 sections, records are filed in numerical sequence according to their secondary numbers. The secondary number is the pair of digits immediately left of the primary number.

To make filing of records easier, they are color-coded. The second to the last digit of the SSN is preprinted on the record jacket. The color of the record jacket corresponds to the preprinted digit as shown in Table 4-2.

<table>
<thead>
<tr>
<th>Record Color Stock Number</th>
<th>Form Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orange</td>
<td>NAVMED 6150/20</td>
</tr>
<tr>
<td>0105-LF-113-9700</td>
<td></td>
</tr>
<tr>
<td>Green</td>
<td>NAVMED 6150/21</td>
</tr>
<tr>
<td>0105-LF-113-8700</td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td>NAVMED 6150/22</td>
</tr>
<tr>
<td>0105-LF-113-8800</td>
<td></td>
</tr>
<tr>
<td>Grey</td>
<td>NAVMED 6150/23</td>
</tr>
<tr>
<td>0105-LF-113-9000</td>
<td></td>
</tr>
<tr>
<td>Tan</td>
<td>NAVMED 6150/24</td>
</tr>
<tr>
<td>0105-LF-113-9100</td>
<td></td>
</tr>
<tr>
<td>Blue</td>
<td>NAVMED 6150/25</td>
</tr>
<tr>
<td>0105-LF-113-9200</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>NAVMED 6150/26</td>
</tr>
<tr>
<td>0105-LF-113-9300</td>
<td></td>
</tr>
<tr>
<td>Almond</td>
<td>NAVMED 6150/27</td>
</tr>
<tr>
<td>0105-LF-113-9400</td>
<td></td>
</tr>
<tr>
<td>Pink</td>
<td>NAVMED 6150/28</td>
</tr>
<tr>
<td>0105-LF-113-9500</td>
<td></td>
</tr>
<tr>
<td>Red</td>
<td>NAVMED 6150/29</td>
</tr>
<tr>
<td>0105-LF-113-9600</td>
<td></td>
</tr>
</tbody>
</table>

Table 4-2.—Record Color-Coding

Centralized files having records based upon more than 200 SSNs, or a file of more than 200 records, may need to use the TERTIARY (third) NUMBER in filing. In a properly maintained terminal-digit, color-coded and block-filing system, it is almost impossible to misfile a record. A record misfiled with respect to the left digit of its primary number (for example, a 45 that has been inserted among the 55s) will attract attention because of its color difference. A record jacket misfiled in respect to the right primary number (for example, a 45 that has been inserted among the 42s) causes a break in the diagonal pattern formed by the blocking within a color group.
Internal Charge out Control

A problem that a facility can encounter is misfiled, lost, and missing treatment records. It is the responsibility of all medical and dental personnel to ensure records are accounted for and returned to the records custodian or department. Personnel responsible for maintenance and upkeep of the records can reduce this incident from occurring by filing the records in the correct order and using a charge out form/charge out guide or a computerized system for record tracking.

Charge out Form NAVMED 6150/7, Health Record Receipt also known as the pink card (Fig. 4-7), will be used for charge out control of medical records. Many commands have implemented an electronic record charge out system that will not be covered in the chapter. When a computerized system is not employed, a receipt is prepared for each record established and will be filed in the record. The following will be recorded on each health record receipt when the treatment record is received:

- Patient’s name (last, first, middle)
- Sponsor’s grade or rate
- Patient’s FMP code and sponsor’s SSN
- Ship or station to which sponsor is assigned

Use home address for retired personnel and their family members and for those family members of active duty personnel when the sponsor is assigned duty out of the area. For a patient to check a record out, specific information is required on the pink card. This information includes the date the record is checked out, location that the record will be going and the patient’s signature. The completed charge out form should be retained in the terminal digit file until the record is returned. Records charged out from the file should be returned as soon as possible after the patient’s visit, but not more than 5 working days. Commands shall develop local procedures for the recovery of delinquent treatment records.

Figure 4-7.—Charge Out Form

Charge out Guide

When open-shelf filing is used for records, a charge out guide may be used in conjunction with the charge out form. A charge out guide is a plastic folder with a pocket. The charge out form should be placed in the pocket and the charge out guide placed in the file in place of the patient’s record until the record is returned. The charge out guide also allows for loose forms to be placed in the guide where the record will be returned, reducing the risk of lost of misfiled record forms.
Part I (Inside front cover): Record of Preventive Medicine and Occupational Health

- NAVMED 6150, Summary of care form (always top form)
- SF 601, Immunization Record
- NAVMED 6000/2, Chronological record of HIV Testing
- DD 771, Eyewear Prescription
- NAVMED 6490/1, Visual Record
- NAVMED 6470/10, Record of Occupational Exposure to Ionizing Radiation
- NAVMED 6470/11, Record of Exposure to Ionizing Radiation from Internally Deposited Radionuclide
- DD 2215, Reference Audiogram
- DD 2216, Hearing Conversation Data
- NAVMED 6224/1, TB Contact converter followup
- NAVMED 6260/5, Asbestos Medical Surveillance Program
- DD 2493-1, Asbestos Exposure – Part I, Initial Medical Questionnaire
- DD 2493-1, Asbestos Exposure – Part II, Periodic Medical Questionnaire
- OPNAV 5100/15, Medical Surveillance Questionnaire

Part II: Top Forms After a Patient is Deceased

- Attestation sheet
- DD 2604, Certificate of Death
- SF 503, Autopsy Protocol
- SF 523, Authorization for Autopsy
- SF 523A, Disposition of Body
- SF 523B, Authorization for Tissue Donation

Part II: Section A (Front of Center Page)

- NAVPERS 5510/1, Record Identifier for Personnel Reliability Program (PRP)
- SF 558, Medical Record- Emergency Care and Treatment record of Ambulance Care
- SF 600, HREC – Chronological Record of Medical Care
- SF 513, Medical Record Consultation Sheet
- DD 2161, Referral for Civilian Medical Care

Part II: Section B: Inpatient Care, Ambulatory Surgeries, etc.

- NAVMED 6300/5, Inpatient Admission Disposition Record
- SF 502, Narrative Summary
- SF 539, Abbreviated Medical Record
- SF 509, Progress Notes
- SF 516, Operation Report
- SF 600, Chronological Record of Medical Care
- SF 517, Anesthesia
- SF 522, Request for Administration of Anesthesia
- SF 233, Prenatal and Pregnancy Civilian Medical Care Notes
- DD 602, Patient Evaluation Tag
Part III (Back of Center Page)

- NAVMED 1300/1, Medical and Dental Overseas Screening Review for Active Duty and Dependents
- NAVPERS 1300/16, Report of Suitability for Overseas Assignment
- NAVMED 6100/1, Medical Board Report Cover Sheet
- NAVMED 6100/2, Medical Board Statement of Patient
- NAVMED 6100/3, Medical Board Certificate
- NAVMED 6100/5, Abbreviated Temporary Limited Duty
- SF 2824C, Physician Statement for Employee Disability Retirement
- SF 47, Physical Fitness Inquiry for Motor Vehicle Operators
- SF 78, Certificate of Medical Examination
- DD 2807, Report of Medical History
- DD 2808, Report of Medical Examination
- NAVMED 6120/2, Officer Physical Examination Special Questionnaire
- NAVMED 6120/3, Annual Certificate Physical Condition
- NAVMED 6150/4, Abstract of Service and Medical History
- NAVJAG 5800/10, Injury Report
- NAVJAG Report
- NAVPERS 1754/1, Exceptional Family Member Program Application
- DD 2569, Third Party Collection Program
- Living Will or Medical Power of Attorney
- OPNAV 5211/9, Record of Disclosure, Privacy Act 1974
- DD 877, Request for Medical/Dental Records
- DD 2005, Privacy Act Statement
- Deoxyribonucleic Acid (DNA) Analysis Sample Pouch

Part IV (Inside of Back Cover)

- SF 217, Epilepsy Medical Report
- SF 515, Tissue Examination
- SF 519A, Radiographic Report
- SF 519B, Radiologic Consultation Request/Report
- SF 519, Medical Record-Radiographic Reports
- SF 518, Blood or Blood Component Transfusion
- SF 520, Electrocardiogram Request
- SF 524, Radiation Therapy
- SF 525, Radiation Therapy Summary
- SF 526, Interstitial/Intercavity Therapy
- SF 527, Group Muscle Strength, Join ROM, Girth and Length Measurements
- SF 528, Muscle Function by Nerve Distribution: Face, neck, and Upper Extremity
- SF 529, Muscle Function by Nerve Distribution: Trunk and Lower Extremity
- SF 53, Neurological Examination
- SF 531, Anatomical Figure
- SF 541, Gynecologic Cytology
- SF 545, Laboratory Report Display
- SF 546-557, Laboratory Reports
- SF 559, Allergen Extract Prescription- New and Refill
- SF 560, Electroencephalogram Request and History
- SF 511, Vital Signs Record
- SF 512, Plotting Chart
- SF 512A, Blood Pressure Plotting Chart
VERIFICATION OF ACTIVE DUTY HEALTH AND DENTAL RECORDS

LEARNING OBJECTIVES:

Describe the requirements for record verification.

Describe the requirements for the documentation of record verification.

All records are verified annually by medical and dental personnel having custody of them. Health records will be reviewed when service members report and detach from their commands, and at the time of any physical examinations.

Each record will be carefully reviewed and any errors or discrepancies corrected. Items to be reviewed during any verification include: form placement, order of forms (chronological), and completeness and accuracy of patient identification data on the record jacket and on each piece of medical documentation. In addition, verify that the Privacy Act Statement has been signed, the DD 2766 (covered later in this chapter) is updated as necessary, operational and occupational requirements updated, and currency of immunizations and accuracy of allergy documentation are complete.

Upon completion of an annual medical record verification, the HM will make an entry on the SF 600 for medical records and black-out the corresponding year block on the front leaf of the jacket with a black felt-tip pen. With this procedure, records that have not been verified during the calendar year can be identified and the annual verification accomplished. The annual verification section is located on the right-hand side of the front cover of the record jacket as a series of blocks numbered with the years 1996 thru 2014. The year of verification will be blackened out for health records once it has been verified.

For dental records, document verification on the EZ603A and as they are verified at the time of the annual exam there is no requirement to blacken the verification year. The information on the inside of the jacket front cover should be updated in pencil only for both records. This information will be entered at the time of record check-in (receipt) and will be kept current at all times by erasing previous, outdated entries.

PERMANENT CHANGE OF STATION (PCS)

At the time of a member’s PCS from a command, the medical and dental facilities that are responsible for the release of records will ensure the following steps are completed. Guidance for PCS is found in MANMED, Chapter 16.

1. Verify medical and dental records.
2. If no health, outpatient, and or dental record exist, construct a new record following the instructions in this chapter and MANMED. When re-constructing dental records have a dentist perform a T-2 dental examination.
3. Ensure member has been processed for transfer.
5. Allow active duty members to hand carry their records, unless the facility or member’s command determines it is not in the Navy’s or member’s interest to do so. If the medical and dental records are not to be hand carried, forward them via certified mail along with a DD Form 877, Request for Medical/Dental Records Information, or place medical and dental records in the custody of authorized personnel.
CLOSING HEALTH RECORDS

LEARNING OBJECTIVE:

Explain closing procedures for health records.

HEALTH RECORD CLOSURE

A member’s health records may be closed due to the following circumstances:

- Death or declared death
- Discharge
- Resignation
- Release from active duty
- Retirement
- Transfer to the Fleet Reserve or release to inactive duty
- Missing or missing in action (MIA; when officially declared as such)
- Desertion (when officially declared as such)
- Disenrollment as an officer candidate or midshipman

When closing a HREC, ensure the record is in order, there are no loose papers, and all identification data is consistent. Ensure all tests (lab, x-ray, etc.) and their reports have been printed out and placed in chronological order within the record. Record the closing entry on the NAVMED 6150/4, Abstract of Service and Medical History (Fig. 4-8). Include the date of separation, title of servicing activity, and any explanatory circumstances.

Upon final discharge or death, send the complete and verified health and dental records to the command maintaining the member’s service record (no later than the day following separation) for inclusion in and transmittal with the member’s service record. Make sure the original of the separation physical examination documents are included in the HREC before delivery to the command maintaining the member’s service record, such as the PSD, PSA, etc. In case of death, send a copy of the death certificate along with the transmitted records.

A copy of the HREC is provided free of charge to members requesting one upon their release, discharge, or retirement.

Missing or Missing-in-Action Members

Whenever a member disappears and the available information is insufficient to warrant an administrative determination of death, enter a summary of the relevant circumstances on the SF 600. Include circumstances about the presumed disappearance of the individual, status (missing or missing in action), and supporting documentation. Close the record as would be done for members being discharged from the service.

Desertion

When a member is officially declared a deserter, document the event fact on the SF 600, EZ603A and the NAVMED 6150/4. Deliver HREC and DREC to the member’s CO for inclusion in and transmittal with the service record for both Navy and Marine Corps personnel.

When a deserter is apprehended or surrenders, the CO of the activity having jurisdiction is required to submit a request for the member’s records to Bureau of Naval Personnel (BUPERS) or Commandant of the Marine Corps (CMC).

Retirement

When a member of the naval service is placed on the retired list or Fleet Reserve List, close the HREC. Upon request of the retiring member, a new medical record (OREC) is established. A copy of the retiring member’s active duty HREC may be incorporated into a new NAVMED 6150/21-30 folder. Make an entry on an SF 600 in the HREC and in the new OREC, stating the date the HREC was closed. Dental records should be verified and retired at the same time, and forwarded to the National Personnel Records Center, Military Personnel Records, St. Louis, Missouri.
Figure 4-8.—NAVMED 6150/4

**Disability Separation or Retirement**

The MTF will send a copy of the HREC of a member being separated for disability to the VA (Department of Veteran Affairs) regional officer nearest to where the member will be residing. Send the medical record directly from the MTF to the VA, so the record can be considered as a primary source of evidence in processing a claim for veteran’s benefits. A record carried by the member is considered secondary evidence and is not used to process a claim. Send the record with the VA 526, *Claim of Benefits*, so the regional office can initiate the claim.
Members separating from the service and eligible for veteran’s benefits will be provided a copy of their HREC on request. Members should be counseled to request a copy in the event they may make a claim for veteran’s benefits in the future. Always offer to send a copy of their HREC to the regional VA office for them.

HEALTH / OUTPATIENT RECORD FORMS

LEARNING OBJECTIVE:

*Describe the purpose and completion procedures for the health / outpatient record forms.*

There are many medical forms placed in the health or outpatient records. Computerized medical documentation (e.g., laboratory test results, emergency room reports, etc.) has become a common place through various computerized healthcare systems (i.e., CHCS, AHLTA); however, the Navy Medical Department continues to use many government printed forms (e.g., NAVMED, DD, and SF). This section covers selected medical forms, their purpose, and procedures for completing them.

Healthcare providers will enter their signature and identification data in the HREC in black or blue-black ink. Type, print, or stamp the provider’s name, grade or rating, and social security number below their signature. Stamped facsimile signatures are NOT to be used on any medical form in the HREC. The signing individual assumes responsibility for the correctness of the entry for which they sign.

It is imperative that all forms documenting patient care contain adequate data to identify the patient and permit filing of the forms in the record. All forms documenting patient care and filed in records will, at a minimum, contain the following data in the identification block:

- Patient’s FMP and sponsor’s SSN
- Patient’s name (last, first, middle initial)

- Sponsor’s branch of service (e.g., Army, Navy, or Air Force) and patient’s status (e.g., family member or retired)

Complete and accurate documentation of patient identification data is critical to ensure the documents are placed in the correct patient’s record. Three methods are currently used to place patient identification on medical documents:

- Embossed medical card
- Automated forms
- Handwritten entries

Embossed medical cards are used to imprint patient identification data on medical forms. Printouts of automated (computerized) forms should provide the same information as required on any medical form. Handwritten patient identification data should be entered in spaces at the bottom of the form.

DEALING WITH LOST, DESTROYED, OR ILLEGIBLE RECORDS AND FORMS

Lost or Destroyed

When a HREC or OREC is lost or destroyed, the custodian will open a replacement record. The designation "REPLACEMENT" will be prominently entered on the front of the jacket and all forms replaced. A brief explanation of the circumstances requiring the replacement and the date accomplished should be entered on SF 600, Chronological Record of Medical Care. If the missing record is recovered, the information or entries in the replacement record will be inserted in the original record.

The HREC/OREC or any part of it should be duplicated whenever it becomes illegible or deteriorates to the point that it may endanger its future use or value as a permanent record. The duplicate record or duplicate portion must reproduce as closely to the original as possible. When duplicating an entire health record, place the designation "DUPLICATE RECORD" prominently on the front of the jacket above the wording OUTPATIENT MEDICAL RECORD.
When duplicating only part of the record, identify the individual forms by printing "DUPLICATE" at the bottom of each form. Enter the circumstances necessitating the duplication and the date accomplished on an SF 600. If possible, microfiche all forms replaced for protection and preservation, and make the envelope a permanent part of the medical record. On front of the envelope, record the member’s full name, FMP (family member prefix) and SSN, date of birth, and list the original forms contained in the envelope.

If microfilming is not available, place the original health forms (except forms contaminated with mold or mildew) inside a plain envelope for preservation and make them part of the permanent record. On the front of the envelope, record the member’s identifying data (same as microfiche envelope) and list the contents of the envelope. Mark the envelope "ORIGINAL MEDICAL RECORDS PERMANENT" and file as the bottommost item in part 2 of the 4-part record jacket.

Loose Forms

When loose treatment forms are discovered, every effort should be made to determine the present location of the record. If reasonable search efforts do not locate the record, retain loose forms for a period of 1 year. Upon expiration of the retention period, destroy the forms locally according to paragraph six of the standard identification code 6150 contained in SECNAVINST 5212.5 series, Navy and Marine Corps Records Disposition Manual.

Health/Outpatient Record Forms

When assembling a medical record, arrange the forms of the same type in chronological order by date. The most current document should be placed on top, and the least current documents below it. The HREC/OREC contains dividers that partition the record into four parts. A sequential listing of medical forms to be filed in each section is provided in Table 4-3. The titles for each part of the HREC/OREC are as follows:

- Part 1 - Record of Preventive Medicine and Occupational Health
- Part 2 - Record of Medical Care and Treatment
- Part 3 - Physical Qualifications
- Part 4 - Record of Ancillary Studies, Inpatient Care, and miscellaneous forms

ADULT PREVENTIVE AND CHRONIC CARE FLOW SHEET (DD 2766)

The Adult Preventive and Chronic Care Flow Sheet (Fig. 4-9) contains a summation of relevant problems and medications that significantly affect the patient’s health status. Properly maintained, the DD Form 2766 form aids healthcare providers by allowing them quick access to pertinent medical factors that may affect how they manage a patient’s medical care. This form is a permanent part of the HREC or OREC. This form should be reviewed and revised during the patient’s visit. The DD Form 2766 should also be reviewed during annual verification and before HREC or OREC transfers.

The DD Form 2766 is divided into 4 pages: significant health problems, hospitalization/surgery, medical alert, medications, and health maintenance (immunizations, deployment readiness, etc.).

Significant health problems section: Enter only significant medical conditions in this section. Significant medical conditions include chronic diseases (such as hypertension, diabetes, arthritis, etc.) and acute recurrent illnesses (such as recurrent urinary tract infections, recurrent otitis media, recurrent bronchitis, etc.)

- Hospitalization/surgery section:
  - Enter significant surgical conditions
  - Include all procedures requiring general or regional anesthesia and any procedures likely to have long-term effects on the patient’s health status
Figure 4-9A. — DD Form 2766

- Medical alert section:
  - Allergies: Note any allergies (food, drug, latex, etc.) and significant reactions to same in the medical alert section
  - Chronic Illness: Record alcohol and tobacco use in this section along with chronic illnesses
- Medication section: Record all chronic and recently used medications
- Medical maintenance section:
  - This section of the DD Form 2766 contains a variety of medical information including health maintenance functions, such as mammograms, chest X-rays, EKGs, and pap smears
  - Enter the prospective due date of the health maintenance functions in pencil, so it can be updated
  - Include in this section occupational health surveillance activities, such as involvement in the Asbestos Program, the Hearing Conservation Program, or exposure to lead
  - Include the following laboratory tests: blood type, G6PD, and sickle cell trait
### ADULT PREVENTION AND CHRONIC CARE FLOWSHEET

**6. FAMILY HISTORY**  
M = Mother, F = Father, S = Sibling, MGM = Maternal Grandmother, MGF = Maternal Grandfather,  
PJM = Paternal Grandmother, PFG = Paternal Grandfather.  

| a. CANCER | (Specify) |
| b. CARDIOVASCULAR DISEASE | (Specify) |
| c. DIABETES | (Specify) |
| d. MENTAL ILLNESS/CHEMICAL DEPENDENCY | (Specify) |

**7. SCREENING EXAMS**  
(* = Actual Result, ** = Tricare Benefit, N = Normal, A = Abnormal, E = Done Elsewhere, R = Refused, NA = Not Indicated; (*) = Next Due)  

<table>
<thead>
<tr>
<th>a. TEST</th>
<th>b. FREQUENCY</th>
<th>c. YEAR</th>
<th>d. AGE</th>
<th>e. DATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) CLINICAL DISEASE PREV EVALUATION</td>
<td>ANNUAL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(2) WEIGHT</td>
<td>ANNUAL FOR ACTIVE DUTY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3) HEIGHT</td>
<td>ANNUAL FOR ACTIVE DUTY</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(4) BLOOD PRESSURE</td>
<td>ONCE q 2 YRS FOR BP &lt; 130/85 ANNUAL IF GREATER</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| (5) CHOLESTEROL** | q 5 YRS FOR AGE ≥ 18  
q y RF PREV ABN | | | |
| (6) HEARING | CLINICAL DISCRETION | | | |
| (7) SKIN EXAM (Cancer) | ANNUAL IF AT RISK | | | |
| (8) ORAL/ENTAL** | ANNUAL | | | |
| (9) EYELID** | ROUTINE ACUITY WITH PERIODIC ASSESSMENT DIABETES ANNUAL  
GLAUCOMA CHECK:  
Blebs q 3-5 yrs age 20-29  
All q 2-4 yrs age 40-64 | | | |
| (10) BREAST EXAM | ANNUAL ≥ 40 YRS | | | |
| (11) MAMMOGRAM** | BASELINE @ 40, q 2 YRS  
40-59, ANNUALLY ≥ 50 | | | |
| (12) PAP **(Digital Rectal Exam) | BASELINE: AGE 18 OR ONSET OF SEXUAL ACTIVITY  
AFTER 3 NL ANNUAL EXAMS, PERFORM q 1-3 YRS | | | |
| (13) FECAL OCCULT BLOOD | ANNUAL ≥ 50 yrs | | | |
| (14) SIGMOID | EVERY 3.5 YRS ≥ 50 YRS | | | |
| (15) COLONOSCOPY | HIGH RISK q 5 YRS ≥ 40 YRS | | | |
| (16) TESTICULAR | HIGH RISK ANNUAL 13-39 YRS | | | |
| (17) PROSTATE** | WITH P E ≥ 40 YRS (Presently Recommended Annually)  
**(DIGITAL RECTAL EXAM) | | | |
| (18) RUBELLA SCREEN | ONCE BETWEEN AGES 12-18 YRS  
(Except prev vaccinated) | | | |
| (19) OCCUPATIONAL SCREENING EXAMS | APPROPRIATE TO EXPOSURES | | | |
| (20) | | | | |
| (21) | | | | |
| (22) | | | | |

**Figure 4-9B. — DD Form 2766**
### 9. IMMUNIZATIONS

<table>
<thead>
<tr>
<th>IMMUNIZATION</th>
<th>(1) IMMUNIZATION Date (ddmmmyyyy)</th>
<th>(2) IMMUNIZATION Date (ddmmmyyyy)</th>
<th>(3) IMMUNIZATION Date (ddmmmyyyy)</th>
<th>(4) IMMUNIZATION Date (ddmmmyyyy)</th>
<th>(5) IMMUNIZATION Date (ddmmmyyyy)</th>
<th>(6) IMMUNIZATION Date (ddmmmyyyy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. HEP A #1</td>
<td>t. MMR #1</td>
<td>i. TD (at 10 YRS)</td>
<td>a. MMR #2</td>
<td>g. MMR #2</td>
<td>j. TD (DUE)</td>
<td>k. TD (DUE)</td>
</tr>
<tr>
<td>b. HEP A #2</td>
<td>g. MMR #2</td>
<td>k. TD (DUE)</td>
<td>b. MMR #2</td>
<td>e. MMR #2</td>
<td>l. TD (DUE)</td>
<td>m. TD (DUE)</td>
</tr>
<tr>
<td>c. HEP B #1</td>
<td>h. PNEUMOCOCCUS</td>
<td>i. YELLOW FEVER (LAST)</td>
<td>c. PNEUMOCOCCUS</td>
<td>j. PNEUMOCOCCUS</td>
<td>k. YELLOW FEVER (LAST)</td>
<td>l. YELLOW FEVER (LAST)</td>
</tr>
<tr>
<td>d. HEP B #2</td>
<td>r. POLIO OPV=O (IVV=I)</td>
<td>m. YELLOW FEVER (LAST)</td>
<td>d. POLIO OPV=O (IVV=I)</td>
<td>n. POLIO OPV=O (IVV=I)</td>
<td>o. POLIO OPV=O (IVV=I)</td>
<td>p. POLIO OPV=O (IVV=I)</td>
</tr>
<tr>
<td>n. TYPHOID (Enter numeric class in sub block)</td>
<td>1. TYPHOID USP 2</td>
<td>q. TYPHOID USP 2</td>
<td>r. TYPHOID USP 2</td>
<td>s. TYPHOID USP 2</td>
<td>t. TYPHOID USP 2</td>
<td>u. TYPHOID USP 2</td>
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<th>(4) IMMUNIZATION Date (ddmmmyyyy)</th>
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<th>(6) IMMUNIZATION Date (ddmmmyyyy)</th>
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<tbody>
<tr>
<td>o. ANTHRAX</td>
<td>(1) INITIAL DATE</td>
<td>(2) 2 WEEK DATE</td>
<td>(3) 4 WEEK DATE</td>
<td>(4) 6 MONTH DATE</td>
<td>(5) 12 MONTH DATE</td>
<td>(6) 18 MONTH DATE</td>
</tr>
<tr>
<td>p. PPD (Enter mm and date)</td>
<td>(1)(a) mm</td>
<td>(2)(a) mm</td>
<td>(3)(a) mm</td>
<td>(4)(a) mm</td>
<td>(5)(a) mm</td>
<td>(6)(a) mm</td>
</tr>
<tr>
<td>q. INFLUENZA</td>
<td>(1) DATE</td>
<td>(2) DATE</td>
<td>(3) DATE</td>
<td>(4) DATE</td>
<td>(5) DATE</td>
<td>(6) DATE</td>
</tr>
<tr>
<td>r. VARICELLA</td>
<td>(1) DATE</td>
<td>(2) DATE</td>
<td>(3) DATE</td>
<td>(4) DATE</td>
<td>(5) DATE</td>
<td>(6) DATE</td>
</tr>
<tr>
<td>s. Meningo</td>
<td>(1) DATE</td>
<td>(2) DATE</td>
<td>(3) DATE</td>
<td>(4) DATE</td>
<td>(5) DATE</td>
<td>(6) DATE</td>
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<tr>
<td>t. ADENO</td>
<td>(1) DATE</td>
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<td>(3) DATE</td>
<td>(4) DATE</td>
<td>(5) DATE</td>
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### 10. READINESS

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<th>(6) IMMUNIZATION Date (ddmmmyyyy)</th>
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<tr>
<td>a. DNA DATE</td>
<td>b. BLOOD TYPE</td>
<td>c. RESULT</td>
<td>d. G-PD</td>
<td>e. RESULT</td>
<td>f. SICKLE CELL</td>
<td>g. RESULT</td>
</tr>
<tr>
<td>f. CLASSES/GAS/MASK</td>
<td>(1) DATE</td>
<td>(2) DATE</td>
<td>(3) DATE</td>
<td>(4) DATE</td>
<td>(5) DATE</td>
<td>(6) DATE</td>
</tr>
<tr>
<td>g. DENTAL EXAM (Enter numeric class in sub block)</td>
<td>(1) DATE</td>
<td>(2) DATE</td>
<td>(3) DATE</td>
<td>(4) DATE</td>
<td>(5) DATE</td>
<td>(6) DATE</td>
</tr>
<tr>
<td>h. HIV TESTING</td>
<td>(1) DATE</td>
<td>(2) DATE</td>
<td>(3) DATE</td>
<td>(4) DATE</td>
<td>(5) DATE</td>
<td>(6) DATE</td>
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<tr>
<td>i. FITNESS (in sub block enter P=Pass, F=Fail, W=Wave)</td>
<td>(1) DATE</td>
<td>(2) DATE</td>
<td>(3) DATE</td>
<td>(4) DATE</td>
<td>(5) DATE</td>
<td>(6) DATE</td>
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### 11. PRE/POST DEPLOYMENT HISTORY

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<th>(1) IMMUNIZATION Date (ddmmmyyyy)</th>
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<tbody>
<tr>
<td>a. LOCATION</td>
<td>(1) PREDEPLOYMENT</td>
<td>(2) POSTDEPLOYMENT</td>
<td>(3) PREDEPLOYMENT</td>
<td>(4) POSTDEPLOYMENT</td>
<td>(5) PREDEPLOYMENT</td>
<td>(6) POSTDEPLOYMENT</td>
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<tr>
<td>b. LOCATION</td>
<td>(1) PREDEPLOYMENT</td>
<td>(2) POSTDEPLOYMENT</td>
<td>(3) PREDEPLOYMENT</td>
<td>(4) POSTDEPLOYMENT</td>
<td>(5) PREDEPLOYMENT</td>
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<tr>
<td>c. CHART AUDIT</td>
<td></td>
<td></td>
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**Figure 4-9C. — DD Form 2766**
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<th>DATES</th>
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<td>(d)</td>
</tr>
<tr>
<td></td>
<td>(e)</td>
<td>(f)</td>
</tr>
</tbody>
</table>

REMARKS

RECORDS MAINTAINED AT:

PATIENT'S NAME
LAST
FIRST
M.I.
SEX

RELATIONSHIP TO SPONSOR
STATUS
RANK/GRADE

SPONSOR'S NAME (Last, First, Middle initial)
DEPT/SERVICE

ORGANIZATION
SSN/ID NUMBER
DATE OF BIRTH

Figure 4-9D. — DD Form 2766
The Chronological Record of Medical Care, SF 600, provides a continuous comprehensive record of a patient’s medical history (Fig. 4-10). Use the SF 600 for all outpatient care and file in the HREC or OREC. Record all visits, including those that result in referrals to other MTFs. Each person making an entry on the SF 600 will sign the entry and include identification information (full name, grade or rate, profession [e.g., MC, NC, etc.], and SSN), either hand printed, typed, or stamped.

The SF 600 facilitates the evaluation of a patient’s condition and reduces correspondence necessary to obtain medical records. Appropriate use of the form eliminates unnecessary repetition of expensive diagnostic procedures and serves as a permanent record of medical evaluations and treatments.

Completing the SF 600

- Entries made on the SF 600 can be typewritten when practical. However, entries normally are handwritten with black or blue-black ink pens. When initiating an SF 600, patient identification data will be completed. Type or stamp the date (DD/MM/YY) and the name and address of the activity responsible for the entry.

- Use both sides of each SF 600. Preparation of a new SF 600 is not necessary each time the person is seen in a different MTF. If only a few entries are recorded on the SF 600 at the time of a PCS, stamp the designation and location of the receiving MTF below the last entry and use the rest of the page to record subsequent visits. If the back of the SF 600 is not going to be used, the back needs to be crossed out and the words "No further entries" printed in the middle of the form.

- SF 600s include the following information: complaints, duration of illness or injury, physical findings, clinical course, results of laboratory or other special examinations, treatment (including operations), physical fitness at the time of disposition, and disposition. The subjective complaint, observation, assessment, and plan (SOAP) format may be used for entries as long as the required information is included.

Record each visit and the complaint described, even if a member is returned to duty without treatment. Document if a patient leaves before being seen.

Other SF 600 entries include the following:

- Imminent hospitalization
- Special procedures and therapy
- Sick call visit
- Injuries or poisonings
- Line-of-duty inquiries
- Binnacle list and sick list
- Reservist check-in and check-out statements

IMMINENT HOSPITALIZATION—

When a patient’s admission is imminent, admission notes can be made on an SF 600. However, the use of the SF 509, Medical Record-Progress Report, is preferred. The SF 509 form is routinely used for inpatient admission notes and is filed in the patient’s IREC. Record referred or postponed inpatient admissions on the SF 600.
When patients are seen repeatedly for special procedures or therapy, such as physical and occupational therapy, renal dialysis, or radiation, note the therapy on the SF 600 and record interim progress statements. Initial notes, interim progress notes, and any summaries may be recorded on any appropriate authorized form, but should be referenced on the SF 600. Write a final summary when special procedures or therapy are ended. This summary should include the result of evaluative procedures, the treatment given, the reaction to treatment, the progress noted, condition on discharge, and any other pertinent observations.
SICK CALL VISITS— Whenever a member is evaluated at sick call, an entry will be made on a SF 600 reflecting the complaints or conditions presented, pertinent history, treatment rendered, and disposition.

INJURY OR POISONING— In the event of injury or poisoning, record the duty status of the member at the time of occurrence and the circumstances of occurrence per the guidelines in BUMEDINST 6300.3 series, Inpatient Data System.

LINE-OF-DUTY INQUIRIES— When a member of the naval service incurs an injury that might result in permanent disability or results in a physical inability to perform duty for a period exceeding 24 hours, an entry will be made concerning line-of-duty misconduct. Entries include the time of injury, date, place, names of persons involved, and the circumstances surrounding the injury.

A line-of-duty inquiry is conducted to establish whether the injuries sustained by the patient are the result of misconduct on the part of the member or others. Guidance on line-of-duty inquiries is located in the Manual of the Judge Advocate General (JAGMAN).

SERIOUSLY ILL/VERY SERIOUSLY ILL (SI/VSI) LIST— Place personnel whose illness or injuries are severe on the SI/VSI List (as defined in MILPERSMAN 421-0100), make appropriate notification, and document on the SF 600.

SPECIAL-HYPERSENSITIVITY SF 600— Indicate any Hypersensitivity to drugs or chemicals on a separate SF 600. The SF 600 will be marked "SPECIAL-HYPERSENSITIVITY" at the bottom of the page. Appropriate entries regarding the hypersensitivity should be made on the SF 601 (Immunization Record), EZ603 (Dental Examination Report), EZ603A (Dental Treatment Report), NAVMED 6150/10-19 (HREC, OREC & DREC jackets), and the DD Form 2766 (Adult Preventive and Chronic Care Flow Sheet).

Immunization Entries

The name of the medical officer or Senior Medical Department Representative (SMDR) administering the immunization, test, or determining the nature of the sensitivity reaction should be typed or written on the DD Form 2766. Signatures are not required; however, when signatures are used, make sure they are legible.

The medical officer or SMDR administering the immunization is responsible for completing entries in the appropriate sections of DD Form 2766. For smallpox, cholera, yellow fever and anthrax immunizations, record the manufacturer’s name and batch or lot number.

NOTE

The specific protocol for recording anthrax immunizations is outlined in SECNAVINST 6230.4 series, Department of the Navy (DoN) Anthrax Vaccination Implementation Program (AVIP).

Type any hypersensitivity to drugs or chemicals under "Remarks and Recommendations" in capital letters (e.g., HYPERSENSITIVITY TO ASPIRIN, HYPERSENSITIVE TO LIDOCAINE). This entry is in addition to a similar entry required on the EZ603 or EZ603A, current treatment form, the SF 600 Special-Hypersensitivity form, and the NAVMED 6150/20 retained permanently in the HREC or OREC.

For DREC’s annotate the sensitivity information on the front of the record in the free space located within the bar code label area. Additionally, document it in Box 3 of the current dental teeth assessment form and the NAVMED 6600/3 form under allergies.

When recording positive results (10 mm or more induration) of the tuberculin skin test (TST), refer to BUMEDINST 6224.8 series Tuberculosis Control Program, for guidance.
INTERNATIONAL CERTIFICATES OF VACCINATION (PHS-731)

All personnel performing international travel will be immunized in accordance with NAVMEDCOMINST 6230.15, Immunizations and Chemoprophylaxis, and Control of Communicable Diseases of Man, FM 8-33 / NAVMED P-5038. Service members should have a properly completed and authenticated PHS-731 form (International Certificates of Vaccination) in their possession. The form is issued to service members for independent international travel. This form, kept by the individual, is a personal record of immunizations.

The PHS-731 is not to be filed in the HREC at any time. Any immunizations recorded on the PHS-731 should be transcribed onto the DD Form 2766. According to international rules, entries on the PHS-731 require authentication for immunizations against smallpox (if administered), yellow fever, cholera, and anthrax.

Authentication (proof the immunization has been given) is accomplished by stamping each entry with the Department of Defense (DoD) immunization stamp and by the healthcare provider’s signature. The signature block may be stamped or typewritten and authenticated with the healthcare provider’s signature.

ABSTRACT OF SERVICE AND MEDICAL HISTORY (NAVMED 6150/4)

This form provides a chronological history of the duty stations to which a member has been assigned for duty and treatment, and an abstract of medical history for each admission to the Sick List.

A NAVMED 6150/4 (Fig. 4-11) is prepared upon opening the health record and remains with the health record regardless of changes in the member’s status. Continuation sheets are incorporated whenever an abstract is completely filled.
ADJUNCT HEALTH RECORD FORMS AND REPORTS

This section provides instruction for using certain forms in the health record instead of transcribing their data to the Chronological Record of Medical Care, SF 600.

Narrative Summary (SF 502)

The SF 502 (Fig. 4-12) is used to summarize clinical data relative to treatment received during periods of hospitalization. The narrative summary will include all procedures and diagnoses, and must match with information listed on the Inpatient Admission/Disposition Report (NAVMED 6300/5) and any information listed in the operation report.

The SF 539 may be used as a substitute for the narrative summary for those admissions of a minor nature that require less than 48 hours of hospitalization. A copy of SF 539 will be filed in the HREC. If a SF 502 or SF 539 is used, if the inpatient stay resulted from dental procedures a copy of the form used will be placed in the DREC as well.

Consultation Sheet (SF 513)

The SF 513 (Fig. 4-13) is used for outpatients who need to be referred to other healthcare providers or specialists, such as gynecologists, internists, optometrists, etc. The primary assessment and results of examinations and tests will be entered onto the form. The patient remains the responsibility of the referring provider until the specialist takes over the care. In some cases, the specialist will perform an examination or procedure and refer the patient back to the original provider for continued care. The original consultation form stays in the HREC.

Medical Board Report (NAVMED 6100/1)

Whenever a member of the naval service is reported on by a medical board, place a legible copy of the report in the health record instead of transcribing the clinical data to the SF 600. Make a notation on the current SF 600 to indicate the clinical data is contained in the copy.
of the Medical Board Report incorporated in the health record. When the Medical Board Report is forwarded to the Navy Department for review and appropriate disposition, enter a report of the departmental action on the current SF 600.

Eyewear Prescription (DD Form 771)

The DD form 771, Eyewear Prescription (Fig. 4-14) is used to order corrective prescription eyewear. Depending on its edition date (any of which are authorized), the DD Form 771 may consist of a 3- carbon copy form (for use with pen), a 2-part carbonless form (printed on a tractor-feed printer), or a computer-generated form using virtual copies. The original of the form will be sent to the optical laboratory and a copy of the form will be placed in the patient’s HREC. The DD Form 771 is frequently submitted via computer modem or fax.

Three major areas covered by the DD Form 771 are patient information, prescription information, and miscellaneous information.

- Patient Information: This information is required to establish eligibility and provide the requesting activity with an address for the patient upon receipt of the completed eyeglasses
- Prescription Information:
  - The spectacle prescription is the technical portion of the order form; ensure the prescription is transferred in its entirety
  - The essential elements of the prescription are interpupillary distance, frame size, temple length, plus and minus designators for both sphere and cylinder powers, segment powers and heights, prism, and prism base
  - It is not necessary to calculate decenteration in the single vision or multi-focal portions of the order
  - It is also unnecessary to try to transpose any prescription into plus or minus cylinder form
- Miscellaneous Information: This area is reserved for any information the HM feels the Navy Optical Laboratory may need
  - Information the laboratory may need includes special fabrication requirements such as multi-focal lenses and proof of eligibility for specialized eyewear such as aviator sunglasses
  - Standard issue items can be determined from NAVMEDCOMINST 6810.1 series, Ophthalmic Services

![DD Form 771](image-url)
The DD Form 771 should be typewritten or computer printed whenever possible. This practice eliminates any errors by misreading an individual’s handwriting. Omission of any information or entering erroneous information will result in a delay at the fabricating facility or patients receiving an incorrect pair of eyeglasses, or both.

If the Corpsman cannot read what has been written on an eyewear prescription, contact the optometrist for clarification. In the case where the optometrist cannot be contacted, send a photostatic copy of the prescription to the optical laboratory rather than transcribing information which is unclear. Make sure the copy of the prescription is accompanied by a completed DD Form 771.

**DENTAL RECORD FORMS**

**LEARNING OBJECTIVE:**

Describe the types and locations of dental record forms.

**ARRANGEMENT OF FORMS**

**Front of Dental Record Jacket Center Page**

Forms will be filed in the front of the dental record jacket center page as covered in the following paragraphs:

(NAVMED 6600/3)—Dental officers, civilian dentists, and auxiliary personnel providing direct patient care will ensure that each patient has a completed, current Dental Health Questionnaire (HQR), in the dental treatment record before performing an examination or providing dental treatment. The NAVMED 6600/3 (Fig. 4-15) will be filled out and signed by each patient. This will be reviewed, dated, and signed by the first dentist conducting the examination or dental treatment. For minors, i.e., under the age of consent or majority in the applicable jurisdiction, the parent or guardian must fill out the form and sign in the patient’s signature block of the form, using his or her name and not the child’s name.

Each dental care provider must indicate, in the dental treatment section of the EZ603A that the questionnaire has been reviewed and updated by the patient. Dentist must also annotate on the EZ603A in the “O” objective block, sections marked “HQ dated,” “Reviewed,” and “HQR Finding.”

During annual dental exams, patients need only to review, date, and sign the current questionnaire if health status has not changed. Whenever a significant change in medical history or health status occurs, a new questionnaire must be filled out, dated, and signed.

The initial and subsequent Dental HQRs are permanently maintained in the Dental Treatment Record. For conditions that require medical clarification, use the SF 513 (Consultation Sheet). Document the consultation on the EZ603-Dental Exam Form and in the Summary of Pertinent Findings section of the NAVMED 6600/3. BUMED Instruction 6600.12 series provides guidance for the Dental HQR.

**Part I (Inside Front Cover)**

Forms will be filed in the inside front cover of the dental record jacket as follows:

- Un-mounted radiographs in envelopes - Front
- Sequential bitewing radiograph - Middle
- Panographic or full-mouth radiograph - Back

**Part II (Front of Center Page)**

Place the NAVMED 6600/3, Dental Health Questionnaire (HQR) here.
Figure 4-15.—NAVMED 6600/3
Part III (Back of Center Page)

Place all Dental Exam Forms, EZ603s (Fig. 4-16) (Plan “P” side up) in reverse chronological order, i.e. newest date on top, in this area.

Part IV (Inside Back Cover)

Place all dental forms listed below in the order given. Numbered forms must be grouped together with the most recent form placed on top of each previous form.

- Record Identifier for Personnel Reliability Program, NAVPERS 5510/1 (if applicable)
- Current Status Form
- Reserve Dental Assessment and Certification Form, NAVMED 6600/12 (if applicable)
- Most current Dental Treatment Form, EZ603A
- Previous Dental Treatment Forms (EZ603As, Old SF603s and 603As)
- Narrative Summary, SF 502, Figure 4-12 (when related to dental treatment)
- Consultation Sheet, SF 513, Figure 4-13 (when related to dental treatment)
- Doctor’s Progress Notes, SF 509, (when related to dental treatment)
- Tissue Examination, SF 515 (Fig. 4-17) (if required)
- Request for the Administration of Anesthesia and for Performance of Operations and Other Procedures, SF 522 (Fig. 4-18) (if required)
MEDICAL RECORD
REQUEST FOR ADMINISTRATION OF ANESTHESIA AND FOR PERFORMANCE OF OPERATIONS AND OTHER PROCEDURES

A. IDENTIFICATION
1. OPERATION OR PROCEDURE

B. STATEMENT OF REQUEST
1. The nature and purpose of the operation or procedure, possible alternative methods of treatment, the risks involved, and the possibility of complications have been fully explained to me. I acknowledge that no guarantees have been made to me concerning the results of the operation or procedure. I understand the nature of the operation or procedure to be

(Description of operation or procedure in layman’s language)

which is to be performed by or under the direction of Dr.

2. I request the performance of the above-named operation or procedure and of such additional operations or procedures as are found to be necessary or desirable, in the judgment of the professional staff of the above-named medical facility, during the course of the above-named operation or procedure.

3. I request the administration of such anesthesia as may be considered necessary or advisable in the judgment of the professional staff of the above-named medical facility.

4. Exceptions to surgery or anesthesia, if any, are:

5. I request the disposal by authorities of the above-named medical facility of any tissues or parts which it may be necessary to remove.

6. I understand that photography and movies may be taken of this operation, and that they may be viewed by various personnel undergoing training or indoctrination at this or other facilities. I consent to the taking of such pictures and observation of the operation by authorized personnel, subject to the following conditions:
   a. The name of the patient and his/her family is not used to identify said pictures.
   b. Said pictures be used only for purposes of medical/dental study or research.

(Cross out any parts above which are not appropriate)

C. SIGNATURES
   (Appropriate items in Parts A and II must be completed before signing)

1. COUNSELING PHYSICIAN/DENTIST: I have counseled this patient as to the nature of the proposed procedure(s), attendant risks involved, and expected results, as described above.

   ____________________________
   (Signature of Counseling Physician/Dentist)

2. PATIENT: I understand the nature of the proposed procedure(s), attendant risks involved, and expected results, as described above, and hereby request that procedure(s) be performed.

   ____________________________
   (Signature of Patient)

   ____________________________
   (Date and Time)

3. SPONSOR OR GUARDIAN: When patient is a minor or unable to give consent I, ____________________________, understand the nature of the proposed procedure(s), attendant risks involved, and expected results, as described above, and hereby request that procedure(s) be performed.

   ____________________________
   (Signature of Witness, excluding members of operating team)

   ____________________________
   (Signature of Sponsor/Legal Guardian)

   ____________________________
   (Date and Time)

4. PATIENT’S IDENTIFICATION (If typewritten or self-printed give: Name, sex, first, middle, last, hospital or medical facility, rank, rate, etc.)

   ____________________________
   (Register No.)

   ____________________________
   (Ward No.)

Figure 4-18.—SF 522
ADDITIONAL DENTAL FORMS

Under the following conditions, additional dental treatment forms are approved for inclusion in the dental record.

Other health care treatment forms (e.g., Veterans Affairs, Office of Personnel Management, Compensation Act, Standard Forms, optional forms, and civilian practitioner forms) may be incorporated in the dental record when considered necessary to document care and treatment. When feasible, attach the form to the appropriate approved form (e.g., attach summaries of reports from civilian practitioners to validate the EZ603, EZ603A or old SF 603) in the proper sequential order. Those not attached to approved forms will be filed inside the back cover of the dental record jacket behind the last authorized form listed above (e.g., SF 522).

SECURITY AND SAFEKEEPING OF MEDICAL RECORDS

LEARNING OBJECTIVE:

Identify security and safekeeping procedures for medical records.

Each treatment facility develops policies to ensure that records are secure and patient’s privacy is protected. Security and safekeeping are major concerns and responsibilities of staff handling medical records. The medical record contains information that is personal, treated as privileged information, and protected by the Privacy Act of 1974. The Privacy Act permits only the patients and their legal representatives to obtain this information. Additional protection is afforded under the HIPAA Privacy Rule. As this is a federal law, there are fines and or imprisonment consequences depending upon the breach, utilization of the breached information, and the number of breaches for the person or the organization.

Treatment facilities will take precautions to avoid compromise of medical and dental information during the movement and storage of medical records. This includes correspondence concerning the medical records when protected health information (PHI) is a part of the message contents. Medical records will be handled by only authorized medical service personnel. Records must be stored in a locked area, room, or file to ensure safekeeping, unless there is a 24-hour watch in the record’s room. Refer to the MANMED Chapter 16 for detailed guidance.

RECORD CUSTODY

Records are retained in the custody of the medical officer and or dental officer on the ship, submarine, or aviation squadron to which the member is assigned. For those platforms that do not have medical/dental officers, the health record may be placed in the custody of the SMDR at the discretion of the CO. Examples of SMDRs are Independent Duty Corpsman or Squadron Corpsman. When Medical Department personnel are not assigned, the CO may assign custody of the health records to the local representatives of the Medical and Dental Departments who generally furnish medical and dental support. The custody of the record by an individual is never permitted.

Records are subject to inspection at any time by the CO, superiors in the chain of command, the fleet medical officer, or other authorized inspectors. Records are for official use only and adequate security and custodial care are required.

There are many methods of providing adequate security and custodial control of records. In general, records will be stored in a manner making them inaccessible to the crew or general public. No records or record pages should be left unattended. This precaution helps to prevent loss or misplacement of records, and ensures that a command is compliant with federal and military regulations.
Medical Department personnel will maintain a NAVMED 6150/7, Health Records Receipt, File Charge-out, and Disposition Record for each health, outpatient, and dental record in their custody. The completed charge out form must be retained in the file until the record is returned. Medical and dental officers or SMDRs are responsible for the completeness of required health record entries while the record remains in their custody.

DISPOSING OF HEALTH RECORDS DURING HOSPITALIZATION

When a patient is transferred to a treatment facility, the HREC should accompany the patient. If members are admitted to a military hospital while away from their command, their HRECs should be forwarded as soon as possible to the hospital. If a discharged member is directed to proceed home and await final action on the recommended findings of a physical evaluation board, an entry to this effect will be recorded in the HREC.

If a member is admitted to a civilian hospital for treatment involving brief periods of hospitalization, the HREC should be retained by the activity until disposition is completed. The HREC will then be forwarded to the cognizant office of medical affairs or to the activity designated by the Commandant of the Marine Corps (CMC) for Marine Corps members. In instances where the parent activity retains the HREC, a summary of the hospitalization will be entered on an SF 600 when the member returns to duty.

When a member is hospitalized at a medical facility of a foreign nation, an entry of this fact should be made in the HREC. The HREC should be retained on board and continued until the patient either returns to duty or is transferred to a U.S. military activity. Upon departure of the medical facility, the HREC will be delivered to the CO for inclusion in the member’s service record for forwarding to the nearest U.S. embassy or consulate.

CROSS-SERVICING HEALTH RECORDS

The HREC of a Navy or Marine Corps member is normally serviced by personnel of the Medical Department of the Navy. However, if a Navy or Marine Corps member is performing an assignment with the Army or the Air Force, the health record may be serviced by Army or Air Force Medical Department personnel. This management of the health record may be done if the attendant service interposes no objection and considers the procedure feasible. Reciprocal procedures for servicing the health records of Army or Air Force personnel by personnel of the Medical Department of the Navy will be maintained whenever feasible, and if requested by authorized representatives of those services.

RELEASING MEDICAL INFORMATION

LEARNING OBJECTIVE:

Identify guidelines for releasing medical information.

AUTHORITY

The Surgeon General of the Navy is the official responsible for administering and supervising the execution of SECNAVINST 5211.5 series, Department of the Navy Privacy Act Program (PAP), as it pertains to the Health Care Treatment Record System. Additionally, the Office of the Surgeon General authorizes requests for access and amendment to a naval member’s treatment records.

COs of Navy treatment facilities are designated as local systems managers for treatment records maintained and serviced within their activities. Local systems managers are authorized to release information from records located within the command if proper credentials have been established. The requesting office or individual will be advised that such information is private and must be treated with confidentiality.
In all cases where information is disclosed, an entry will be made on OPNAV Form 5211/9, Record of Disclosure-Privacy Act of 1974 to include the date, nature and purpose of the disclosure, and the name and address of the person or agency receiving the information. Maintain a copy of any such disclosure requests. Additionally, documentation of information released must also be noted in any required electronic databases.

GUIDELINES FOR RELEASING MEDICAL INFORMATION

This section will cover the policy for release of record transcripts. The appropriate rule for the release implemented depends upon the intended recipient of the record transcript.

Release to the Public

Information contained in treatment records of individuals having undergone medical or dental examination or treatment is personal and considered private and privileged in nature. Consequently, disclosure of such information to the public would constitute an unwarranted invasion of personal privacy. Such information is exempt from release under the Freedom of Information Act.

However, MTF Commanding Officers may release some information to the public or the press without the patient or patient’s next of kin’s (NOK) consent. This information is the patient’s name; grade or rate; date of admission or disposition; age; sex; component, base, station, or organization; and general condition.

Release to the Individual Concerned

Release of healthcare information to the individual concerned (patient) falls within the purview of the Privacy Act and not the Freedom of Information Act. When individuals request information from their medical record, it will be released to them unless, in the opinion of the releasing authority, it might prove injurious to their physical or mental health. In such an event, the releasing authority will request authorization from the patients to send their medical information to their personal physician.

Release to Representatives of the Individual Concerned

Upon the written request from patients, healthcare information will be released to their authorized representatives. If an individual is mentally incompetent, insane, or deceased, the NOK or legal representative must authorize the release in writing. NOK or legal representatives must submit adequate proof that the member or former member has been declared mentally incompetent or insane, or furnish adequate proof of death if such information is not on file. Legal representatives must also provide proof of appointment, such as a certified copy of a court order.
Releasing Medical Information to Federal and State Agencies

In honoring proper requests, the releasing authority should disclose only information relative to the request as listed in the “Routine Uses” section of the Medical Treatment Records System, which is annually set forth in SECNAV NOTE 5211, Systems of Personal Records Authorized for Maintenance Under the Privacy Act of 1974, 5 U.S.C. 552a (PL 93-579).

In the following three instances agencies may have a legitimate need for the information:

- Health care information is required to process a governmental action involving an individual. The Veterans Administration and the Bureau of Employees' Compensation process claims in which the claimant’s medical or dental history is relevant. If an agency requests health care information solely for employment purposes, a written authorization is required from the individual concerned.

- Health care information is required to treat an individual in the department’s custody. (Federal and state hospitals and prisons may need the medical or dental history of their patients and inmates.)

- Release to federal or state courts or other administrative bodies. The preceding limitations are not intended to prevent compliance with lawful court orders for health records in connection with civil litigation or criminal proceedings, or to prevent release of information from health records when required by law. If there are doubts about the validity of record requests, ask the Judge Advocate General (JAG) for guidance.

Releasing Medical Information for Research

COs of treatment facilities are authorized to release information from treatment records located within the command to members of their staff who are conducting research projects. When possible, the names of parties involved should be deleted. Other requests from research groups should be forwarded to Bureau of Medicine and Surgery (BUMED) for guidance.

SUMMARY

The HM will be responsible for managing medical and dental records. These records are vital tools in the healthcare delivery process. It is of the utmost importance that the HM learns and follows the guidelines for establishing, handling, maintaining, and closing medical and dental records. Well maintained treatment records furnish healthcare providers with current medical and dental data, enabling the provider to give each patient timely and comprehensive care. Confidential treatment of the patient’s PHI honors the patient’s privacy and is in keeping with legal regulations.
CHAPTER 5

MEDICAL LOGISTICS

MEDICAL/DENTAL LOGISTICS HISTORY

In 1850 the United States Navy established the Naval Medical Supply Depot in Brooklyn, New York. In 1853, Congress authorized a separate manufacturing laboratory that enabled it to "produce medical supplies for the Medical Department of the Navy." In July 1952, the Naval Medical Supply Depot, Brooklyn was transferred to the Bureau of Supplies and Accounts. For the first time in 100 years the Navy Medical Department was no longer directly involved in centrally manufacturing, warehousing, or distributing medical supplies. All supplies would be controlled centrally with other commodities by the Department of Defense (DoD).

The DoD centralized supply system has served the Navy/Marine Corps Team and Navy Medicine well. Due to budget and staffing constraints medical logisticians have continued to seek more effective ways to procure, store and issue medical/dental materiel. Today the local Medical Logistics Department continues to provide total logistic support to facilities, utilizing all facets of the Defense Logistics Agency (DLA), Naval Supply Systems Command (NAVSUP), and Naval Medical Logistics Command (NAVMEDLOGCOM).

INTEGRATED LOGISTICS SUPPORT

Logistics encompasses the acquisition, accounting, sustainment, and disposition of assets within the Department of the Navy. NAVMEDLOGCOM works to ensure proper fiscal administration by directives, principles, and policies prescribed by the Comptroller of the Navy, with the ultimate responsibility resting on each Commanding Officer. A Hospital Corpsman should become familiar with the rules and regulations that govern the supply process.

Without the proper amount of medical and dental supplies and equipment at a command, the medical and dental department’s operational readiness to treat patients would be compromised. Proper planning, inventory, and maintenance are essential for the operation of the medical and dental departments.

This chapter we will outline the proper procedures to use in estimating, procuring, and accounting for supply needs and operating funds. The last section will cover equipment technology & management and contingency supply blocks.

ORGANIZATIONAL STRUCTURE

The Chief, Bureau of Medicine and Surgery (BUMED) established a standard organizational structure for Medical Logistics Departments at all Naval Medical and Dental activities with logistics responsibilities.

The key functional areas within the organization are:

- Purchasing and contracting
- Materiel receipt, storage, and issue
- Supply inventory management
- Equipment Management Division
- Biomedical Equipment Maintenance Division
- Central processing and distribution
- Healthcare service contracting

The Medical Logistics Department will administer the in-house supply programs for the command. At some commands, additional functions such as Food Service or Linen Management may also be assigned to Medical Logistics.
The Defense Logistics Agency (DLA), via the Federal Supply System, maintains centralized inventory management and physical distribution of depot and vendor medical/dental materiel to Naval MTFs/DTFs worldwide.

Materiel managers have various methods of access available to procure medical and dental materiel from government and commercial sources. Because of rapid changes in medicine and the demand for state-of-the-art materiel, the DLA in cooperation with the Army, Navy, and Air Force has established various innovative forms of procurement to meet customer demands. Most notable is the current Defense Supply Center Philadelphia’s (DSCP) Prime Vendor Program and the International Merchant Purchase Authorization Card (I.M.P.A.C.), also known as the government-wide purchase card program.

KEY AREAS WITHIN MEDICAL LOGISTICS DEPARTMENTS

Purchasing and Contracting

- **Technical Review:** This division screens all requisitions to verify that items are available from a mandatory government source of supply or assist in determining commercial sources of supply. This section maintains vendor catalogs and Federal Supply Schedule (FSS) information.

- **Purchasing:** In this division, commercial procurement actions take place. The staff reviews purchase requests and determines the type and method of procurement.

Material Receipt, Storage, and Issue

- **Warehouse/Storeroom/Receipt Control:** This division plans and directs operations necessary to physically receive and control incoming and outgoing supplies and equipment for storage, direct turnover to the customer, or shipment to remote sites. This division maintains records of incoming receipts; prepares receipt documents; prepares government bills of lading; and processes invoices for payment.

Supply Inventory Management

- **Stock Control:** This division is responsible for the inventory management aspect of the materiel held in the warehouse or purchased for direct issue to a customer. Receipt and issue documents are processed here.

Equipment Management and Biomedical Equipment Repair Divisions

- **Equipment Management:** This division administers the command's property utilization and disposal program. Guidance on the acquisition, accounting, and survey of equipment is done here. It identifies and accounts for plant property and minor medical and non-medical equipment within the command’s control.

- **Biomedical Equipment Maintenance (BIOMED):** This division administers the medical/dental equipment preventive and corrective maintenance programs. It also oversees the following: equipment operation training; repair parts inventory; operator manual library; maintenance requests; and equipment maintenance contracts.
Central Processing and Distribution

- **Central Supply:** This division plans and directs operations necessary to order and receive materiel for working stock supplies, or PAR levels, which are predetermined stock levels maintained in the customer's working space based on established usage. Most central supply areas issue supplies to authorized outpatients who have a prescription for the materiel, i.e. dressings.

**NAVSUP & NAVMEDLOGCOM MANUALS, PUBLICATIONS, AND DIRECTIVES**

**LEARNING OBJECTIVE:**

Explain the purpose and content of key supply manuals and instructions.

**INTRODUCTION**


**NAVAL SUPPLY SYSTEMS COMMAND (NAVSUP) MANUAL, NAVSUP P-485**

The NAVSUP manual is designed to institute standardized supply procedures and consists of the following three volumes:

- Volume I: Naval Supply Procedures, Afloat
- Volume II: Naval Supply Procedures, Supply Appendices
- Volume III: Naval Supply Procedures, Ashore

The *Naval Supply Procedures, NAVSUP P-485*, establishes policies for operating and managing supply departments and activities. The procedures contained in this publication are the minimum essential for acceptable supply management and are mandatory unless specifically stated as optional.

**NAVSUP P-409, MILSTRIP/ MILSTRAP MANUAL**

The NAVSUP P-409 was published as a handy reference for personnel responsible for originating and processing MILSTRIP/ MILSTRAP documents. This small booklet contains common definitions, coding structures, and abbreviated code definitions used on a day-to-day basis.

**NAVMED P-5132, BUREAU OF MEDICINE AND SURGERY EQUIPMENT MANAGEMENT MANUAL**

The P-5132 is available via the NAVMEDLOGCOM homepage. It reiterates Department of the Navy policy and provides equipment management procedures to include budgeting, funding, acquisition, use, maintenance, repair, redistribution, and disposal of equipment.

**TERMINOLOGY**

To effectively procure and account for materials, be familiar with terminology commonly used in the supply system.

- **Procurement:** The act of obtaining materials or services.
- **Contracting Authority:** Refers to the dollar limitation and acquisition methods the command and purchasing agents are restricted to when placing government orders.
- **Commitment:** When appropriated funds have been approved and set aside by the fiscal officer for acquisition of goods and/or services.
- **Obligation:** When a qualified purchasing agent enters into a contractual agreement thereby obligating the Government with a vendor for goods and/or services.
• Unauthorized Commitment: When a government representative, lacking the authority to enter into a contract on behalf of the government, enters into an agreement with a vendor for goods and/or services. This person may be liable for paying for those goods and/or services.

• Ratification: The process in which an unauthorized commitment is reviewed by designated personnel. Appropriate contractual documentation is prepared and forwarded to the ratifying official to allow the vendor to be paid for goods and/or services rendered.

• Procurement Administrative Lead Time (PALT): The time it takes for the Purchasing Agent to place an order against a requisition. The PALT begins the day a valid requisition arrives in the procurement office and continues to the time the order is placed by the purchasing agent.

• Priority Designator: A two digit number used by the customer to determine the urgency of the requisitioned item.

• Required Delivery Date (RDD): The date the materiel is required by the customer.

• Authorized Requisitioner: A person designated in writing with signature authority to sign requisitions for supplies and services, usually the Division Officer or Department Head.

• Micro-Purchase: An acquisition of authorized supplies or services that do not exceed the current competitive threshold of $3000 (Micro-purchases are not required to be placed with a small business vendor.)

• Non-Procurement Official: A non-purchasing official who may place orders utilizing the Government-wide Commercial Purchase Card for orders less than $3000 and no more than a cumulative total of $20,000 per year.

• SERVMART: A source for the purchase of non-medical administrative materiel, including cleaning gear.

• Federal Acquisition Regulation (FAR): The primary regulation used by all Federal Executive agencies in their acquisition of supplies and services with appropriated funds.

• Defense FAR Supplement (DFARS): Regulations providing supplemental guidance to the Federal Acquisition Regulation for DoD activities.

• Navy Acquisition Procedures Supplement (NAPS): A document providing guidance to the FAR and DFARS for Navy contracting personnel in acquiring goods and/or services.

• Competitive Threshold: Requisitions exceeding the current competitive threshold of $3000 must receive quotes from a minimum of three vendors, unless a valid sole source justification is provided.

• Separation of Functions: Controls established to ensure the same person does not initiate, award, and receive materiel. If local circumstances make it impracticable for these functions to be performed by three separate individuals, at a minimum, the same individual shall not be responsible for the award and receipt of the materiel.

• Requisition: An order from an activity that is requesting material or services from another activity.

• Bulk Stock: Material in full, unbroken containers available for future use.

• Consumable: Supplies that are consumed or disposed of after use.

• Federal Supply Schedule (FSS): The collection of multiple award contracts used by Federal agencies, U.S. territories, Indian tribes and other specified entities to purchase supplies and services from outside vendors.

• Controlled Equipment: Items of equipage/equipment that require special management control because the material is essential for the mission or the protection of life, is relatively valuable, or easily converted to personal use.
- **Material**: All supplies, repair parts, and equipage/equipment.

- **Non-Consumable**: Supplies and materials that are not consumed or disposed of after their use. Buildings and equipment are non-consumable items.

- **Repair Part**: Any item that has an application and appears in an allowance parts list (APL), stock number sequence list (SNSL), integrated stock list (ISL), Naval Ship Systems Command drawings, or a manufacturer’s handbook.

- **Reserve Stock**: Items on hand and available for issue for a specific purpose, not for general use (for example, decontamination supplies).

- **Standard Stock**: Material under the control of an inventory manager and identified by a National Item Identification Number (NIIN).

### OPERATING BUDGETS

The operating budget is the annual budget of an activity and is assigned by the Chief of Naval Operations (CNO), Fiscal Management Division, to major claimants. Examples of a major claimant include BUMED and Headquarters Marine Corps. Funds are distributed as operating targets or OPTARs which are generally apportioned in four equal quarterly divisions that represent the maximum amount that can be spent for each quarter of the FY. This system prevents over expenditure of funds early in the fiscal year and helps prevent financial problems at the end. Unused quarterly funds may be carried over to the next quarter simply by adding them to the new quarterly apportionment. At the end of the fourth quarter, all accounts are balanced and closed; new expenditures are not authorized until appropriated funds are made available for the new fiscal year.

### FEDERAL SUPPLY CATALOG SYSTEM

#### LEARNING OBJECTIVES:

- Explain the terms associated with the Federal Supply System (FSS).
- Explain how to use the Federal Supply Catalog (FSC).

The Department of Defense Supply System contains more than 4 million items; of this total the Navy stocks more than 1 million items. To order supplies effectively from this system, a basic understanding of the DOD supply system terminology and structure is required. This includes the naming, description, classification, and numbering of all items carried under centralized control of the United States Government. Only one identification number is used for each item, from purchase to final disposal.

### FEDERAL SUPPLY CLASSIFICATION SYSTEM

The Federal Supply Classification (FSC) System is designed to permit the classification of all items of supply used by the federal government. Each item of supply will be included in one FSC. The FSC is made up of two two-digit numeric codes: the federal supply group and the federal supply class. The federal supply group identifies, by title, the commodity area covered by the classes within each group.

The following is an example of the 6500 series Federal Supply Group and its classes used for the majority of the Medical, Dental, and Veterinary Equipment and Supplies:

- 6505 Drugs and Biologicals – (Note-Only items specifically formulated for human use are appropriate to this class.)

- 6508 Medicated Cosmetics and Toiletries

- 6509 Drugs and Biologicals, Veterinary Use

- 6510 Surgical Dressing Materials
• 6515 Medical and Surgical Instruments, Equipment, and Supplies
• 6520 Dental Instruments, Equipment, and Supplies
• 6525 Imaging Equipment and Supplies: Medical, Dental, Veterinary
• 6530 Hospital Furniture, Equipment, Utensils, and Supplies
• 6532 Hospital and Surgical Clothing and Related Special Purpose Items
• 6540 Ophthalmic Instruments, Equipment, and Supplies
• 6545 Replenishable Field Medical Sets, Kits, and Outfits
• 6550 In Vitro Diagnostic Substances, Reagents, Test Kits and Sets

NATIONAL STOCK NUMBERS

Every item in the FSC is identified by a 13-digit stock number referred to as National Stock Number (NSN). The NSN for an item of supply consists of a four-digit federal supply classification (FSC group and class) and a nine-digit national item identification number (NIIN). The NIIN consists of a two-digit national codification bureau (NCB) code and an additional seven digits that identify each NSN item in the Federal Supply Distribution System. The National Item Identification Number is a nine-digit number that identifies each item of supply used by the Department of Defense. Although the NIIN is part of the NSN, it is used independently to identify an item within a classification. Unlike the FSC, the NIIN is assigned serially, without regard for the name, description, or classification of the item.

An example NSN is:

```
6515 -00- 123-4567
FSC NCB NIIN
```

SUPPLY MANAGEMENT

Criteria for Maintaining Stock on Hand in the Warehouse or Storeroom

The cost of keeping stock on hand includes not just the initial cost of the item, but the associated expense of storing, counting, and rotating the inventory. Each item added to the inventory must meet certain criteria. In certain, exceptional cases, a command may decide that an item must be available even if the need is infrequent.

Normally, items are added to stock based upon the demand for the materiel. Each request for an item by a customer is counted as a demand. The number of demands over a specified period is the demand frequency, i.e., 4 per quarter. Demands are categorized as recurring or non-recurring. A request for an item that is continuously used is normally a recurring demand. A non-recurring demand is generally for an item that is needed infrequently or for an exceptionally large one-time request for an item normally used in smaller quantities. Three recurring demands within one quarter are generally the minimum criteria for stocking an item in the warehouse.

The number of demands alone, however, is not the only criteria to consider. The cost of the item and its availability (how long it takes to bring it into the command) are also considered. An expensive item that can be purchased and received in a short period of time is not a good candidate for stock since buying enough to keep on hand to meet the customer's requirements would be very expensive. Additional item to consider is the shelf-life or expiration date.

Stockage Levels

Once the decision has been made to stock the item, a determination must be made as to how much of the item to keep and when to reorder. Automated software programs will calculate the stockage levels based upon the projected monthly usage. A change to any of the factors listed below will result in a change in the overall projected inventory.
Levels of Supply

There will be control over the level or quantity of supplies kept by departments. Without controls, policy changes or poor ordering procedures may result in some items being in short supply, while other items are stockpiled in quantities that would not be consumed for several years.

Supply Level Terminology

Supply levels are expressed in one of two ways: numerical terms and months of usage. Numerical is expressed as the total amount of supplies on hand. “Months of Usage” is the most common and best method to use in accounting for the amount of items used.

In expressing the supply level of any stock item, four measurements are used: operating level, safety level, storage objective, and requisitioning objective.

- **Operating Level:** This measurement indicates the quantity of materiel required to sustain operations during the interval between arrival of successive replenishment shipments, normally seven days of supply. The operating level should be based upon the length of the replenishment cycle.

- **Safety Level:** This measurement indicates the quantity of an item, over and above the operating level, that should be maintained to ensure that operations will continue if replenishment supplies are not received on time, or if there is an unpredictably heavy demand for supplies, generally 14 days of supply.

- **Stockage Objective:** This measurement indicates the minimum quantity of a stock item that is required to support current operations. It is the sum of the operating level and the safety level.

- **Requisitioning Objective:** This measurement indicates the maximum quantity of a stock item that should be kept on hand and on order to support operations. It is the sum of the operating and safety levels (a.k.a. stockage objective) and the quantity of an item that will be consumed in the interval between the submission of a requisition and the arrival of the supplies. Figure 5-1 illustrates the relationship between the various levels of supply.

![Figure 5-1.—Supply Level Relationship](image-url)
**Usage Data**

The most accurate guide in determining supply requirements is past experience, as reflected in accurate stock records. Stock record cards must be kept current to assist in the material usage notes. From this past usage data, a reasonable projection of future usage rates can be made. SAMS (SNAP Automated Medical System) is the current approved shipboard computer program used to track all aspects of medical supply.

- **Re-Order Point (ROP):** The level at which a replenishment action is indicated. If the on-hand quantity plus the quantity due-in is less than the re-order point, a replenishment action is indicated.

- **Order and Ship Time (OST):** Time elapsed between the initiation of stock replenishment action for an item of supply and the receipt of that item by the activity. OST is usually set for 30 days for items ordered under a routine priority through a federal supply depot; this time may be shorter for materiel ordered from a local source or when transportation times are shorter.

**BUMED-CONTROLLED INVENTORY ITEMS**

BUMED-controlled inventory items are essential to preserve life (medications), highly pilferable (hemostats, etc.), and/or have a high acquisition or replacement cost (CAT scan, X-Ray equipment). NAVMED FORM 6700/13 (≥$100K - <$249K) and NAVMED FORM 6700/12 (≥ $250K) respectively, are used to requisition standard stocked BUMED-controlled items. Forward the request through the chain of command to the NAVMEDLOGCOM for technical review (Figs. 5-2 and 5-3).
PROFESSIONAL BOOKS AND PUBLICATIONS

The listing of all books and publications that are required to be maintained at an activity can be found in NAVMEDCOMINST 5600.1 series, Procedures for Review of Naval Medical Command Publications, and NAVMEDCOM- INST 6820.1 series, Professional Reference Materials and Publications. GSA periodically makes open-ended contracts that cover the procurement of books. All professional books and publications are procured using a credit card purchase under the provisions of these contracts.

REQUISITIONING AND CONTRACTING DOCUMENTS

Documents used to requisition and contract for medical/dental materiel vary based upon the method of purchase. The following documents are often used and can be either hard copy or generated via a computer system such as the Defense Medical Logistics Standard Support (DMLSS) for ashore activities or SAMS for afloat activities.

**DD Form 1348**—This form is used to order standard stock items that have a National Stock Number (NSN). Most of the information needed for a DD 1348 is represented by Military Standard Requisitioning and Issue Procedure (MILSTRIP) codes (Fig. 5-4).

**DD Form 1348-6**—This form is used to requisition materiel that cannot be identified by an NSN. It is usually more descriptive in nature and requires sources of supply, manufacturers' parts code information, and applicable substitutes. Equipment items from The Defense Supply Center Philadelphia (DSCP) Shared Procurement program are requisitioned with this form (Fig. 5-5).

**DD Form 1149** (Requisition and Invoice Shipping Document)—This form is used as a requisition document and shipping document. It can be a local form for requisitioning single line or multiple line items of materiel. This is one form for ordering open market item(s) and allows for complete source and technical description of the item(s). It can also be used to document purchase card transactions, as well as provide documentation to ship materiel between activities. As a requisitioning document, use this form to procure GSA contract items such as medical books, journals, and standard and nonstandard BUMED-controlled items requiring local purchase action (Fig. 5-6).

**Figure 5-4.—DD 1348**
DD Form 1155 (Order for Supplies and Services)—This form is an official purchase order document and is required whenever an open market order is placed with a vendor. It is usually completed by the purchasing staff and includes all ordering information (Fig. 5-7).

CONTROL AND ROUTING OF PURCHASE REQUESTS

Depending on the type of order, the method of acquisition may vary once the purchase request is delivered to the purchasing agent. All purchase requests must go through the following process prior to the purchasing agent even seeing the requisition:

1. All requests must be forwarded on a standard requisition document such as the NAVCOMPT 2276, the DD 1149, or a command approved local form.

2. All requests must be signed by departmental or directorate authorized personnel.

3. All requisitions must obtain "Availability of Funds" certification. This will be automated with both DMLSS and SAMS. For hard copy requests and specialized high cost requests, this certification must be specifically obtained.

4. Certain requisitions require approval by designated approving officers prior to submission to the Medical Logistics Department. (i.e. Management Information Department (MID) approval for computer items).

5. All purchase requests must be technically reviewed and screened. Supplies and services must be described in a generic manner to encourage maximum competition and eliminate features restrictive to one supplier.

6. Once the requisition has been technically reviewed and items are determined not to be available from mandatory or other than open market sources, the requisition document is ready for procurement action.

SOURCES OF SUPPLY

The medical/dental materiel required to support a facility is normally procured through the supply system of the Navy or Department of Defense. There is a hierarchy of sources of supply and they are considered in the following order:

1. Local activity stock or local SERVMAR.

2. Federal Supply System (National Stock Number (NSN)).

3. Federal Prison Industries (FPI) - Also referred to as UNICOR. FPI is the government corporation of the District of Columbia. Commands are required to purchase available items at prices not exceeding current market prices from FPI unless a waiver has been granted or the exceptions outlined in NAVSUP 4200.85C series have been met. FPI items are typically furniture items.
4. National Industries for the Blind and Severely Handicapped (NIBINISH) - Commands are required to purchase commonly used supplies from certain non-profit organizations employing blind or severely handicapped persons. Technical review and procurement personnel should be aware of the supplies and services available from these institutions and utilize them to the fullest extent.

5. General Services Administration (GSA) Federal Supply Schedule (FSS) Contracts - There are contracts established by GSA and Veterans Affairs (VA) with commercial firms to provide supplies and services at stated prices for given periods of time. When placing orders under a FSS, purchasing agents do not seek further competition nor make a separate determination of fair and reasonable pricing. Commonly used medical and non-medical items can be obtained from Federal Supply Schedules.

6. Defense Personnel Support Center (DPSC) Shared Procurement Program for Equipment Items - These are long term requirements contracts established by DPSC for state-of-the-art equipment items at a significantly reduced price. Some items are mandatory and require a waiver from NAVMEDLOGCOM to locally purchase items other than the mandatory Shared Procurement item.

7. DoD Prime Vendor Requirements Contract - DPSC and the VA have established contracts with both pharmaceutical and medical/surgical commercial vendors to be the prime supplier for medical treatment facilities in a geographical area. If the Prime Vendor does not carry an item required by the treatment facility, Medical Logistics may request a Distribution and Pricing Agreement (DAPA) be initiated with the vendor for that item. The Prime Vendor shortens the logistics pipeline by utilizing electronic ordering methods which enables delivery of ordered materiel within 24 hours.

INVENTORY MANAGEMENT

LEARNING OBJECTIVES:

Explain specific characteristics of each type of supply inventory.

Explain how inventories are to be conducted.

Explain procedures for inventory reconciliation.

OVERVIEW

Inventory, or stock on hand, is both a valuable management asset and a considerable financial investment. The official inventory is managed by the Medical Logistics Department.

This section uses various terms to refer to inventory control procedures. NAVSUP P-485 provides definitions for all the terms used in inventory control.

Inventories

An accurate physical inventory is a prerequisite to efficient inventory control. The primary objective of a physical inventory is to ensure the on-hand inventory balance reflects the automated stock records. Inventories are initiated by the Inventory Management or Stock Control section.

Inventory Management Goals

The goal is to have the right item, at sufficient quantity, at the best price, and when the customer wants it. The most successful initiative to streamline medical/dental logistics is the Prime Vendor program. This response time allows users to order only the quantities needed and reduce the amount of money, human resources, and storage space devoted to maintaining larger quantities of materiel.
INVENTORY PROCEDURES

Proper inventory procedures mandate a complete and correct item count. Inventories are conducted to bring stock and stock records into agreement (also called reconciliation), the importance of a complete, accurate, and legible inventory is critical to an effective and efficient supply system.

1. Compare the stock number on the inventory count sheet to the stock number on the materiel.
2. Verify the unit of issue.
3. Count the item and enter the total count by unit of issue on the inventory count sheet. Be sure to count the materiel in all locations listed for the item.
4. Verify all locations listed for the stock number.
5. Turn in individual count sheets when they are complete.
6. If there is a discrepancy between the amount shown in the automated inventory system and the physical count, a second count is required. The same person should not count the item the second time. If the second count does not match either the amount in the inventory system or the first count, a third count will be conducted. Counting will continue until two counts match! If all counts do not match, be sure to re-verify the unit of issue and locations. The supervisor should review the counts to determine why they differ.

TYPES OF INVENTORIES

There are several types of inventories, each with a specific purpose. These types of inventory are controlled substances, bulkhead-to-bulkhead, specific commodity, special material, spot, velocity, random sampling, departmental, and war.

Controlled Substances

Conducted monthly, unannounced inventory done by members of the Controlled Substances Inventory Board.

Bulkhead-to-Bulkhead (Wall-to-Wall)

Conducted annually; is a physical count of all the material within a specific storeroom. It is conducted when a random sampling of that storeroom fails to meet the inventory accuracy rate of 90 percent, or upon custodian turn-over.

Specific Commodity Inventory

Physical count of all items under the same cognizance symbol or federal supply class (such as 6515/6505), or that support the same operational function (e.g., bandages, IV fluids, needles, etc.).

Special Material Inventory

Physical count of all items that, because of their physical characteristics, costs, or other reasons, are specifically designated for separate identification and inventory control. Special material inventories include but are not limited to stocked items designated as classified or hazardous. Physical inventory of such material is required on a scheduled basis, as prescribed in the NAVSUP P-485.

NOTE:
Medical supplies are examples of both the specific commodity and special material inventories.

Spot Inventory

Unscheduled type of physical inventory verifying existence of a specific item. It is conducted when a requisition is returned showing the item is not in stock but the stock records indicate the item is on hand. A spot inventory is conducted when directed by higher authority or when a specific item has been found to be defective.
**Location Surveys**

During spot check inventories the location accuracy should also be verified. Location surveys can be done as a separate action if desired. The goal is to have 98% of the actual stock locations match the recorded location in the inventory management system.

**Velocity Inventory**

Required on items with a relatively high turnover rate. It is based on the premise that the faster an item moves the greater the room for error.

**Random Sampling Inventory**

Part of the annual scheduled inventory program. It is done to measure the stock record accuracy for a segment of material on hand.

**Department Inventory**

Inventories held in departments or clinics are not carried on the Medical Logistics inventory records, but represent a considerable investment and are a valuable asset to the command. The goal is to keep enough stock on hand to meet routine and peak demands while holding the financial investment to the minimum.

**War Reserves**

Known as War Reserve Materiel Requirements or Mobilization Requirements, it is those activities that have an expanded mission during wartime will also have materiel requirements identified to support the expanded mission. War reserve materiel is counted as part of the inventory so that stock can be rotated, but it cannot be issued for routine operations. Release of war reserve materiel assets in support of operational requirements is governed by OPNAVINST 4080.1 series.

**SAFETY**

All materiel must be stored in a clean and orderly manner, maximizing space and productivity, and ensuring an accurate inventory. The storage area must be kept clean. Aisles should be wide enough (generally 1.5 times the width of the largest cart or vehicle used) to permit easy passage by materiel handling equipment and must remain clear.

Use chocks behind vehicle tires when loading or unloading to prevent movement of the vehicle; especially important when the loading ramp is on a slope or a forklift is used to unload the vehicle.

Stack boxes evenly with labels facing the front. All containers marked with "UP" should be stored accordingly. Items should be stored off the floor; pallets may be used for this purpose. Sprinkler heads must be unobstructed. Boxes must be stored 18 inches below the sprinkler heads.

Storeroom personnel working in the warehouse should wear safety shoes for personal protection.

**Issuing**

The act of pulling stock from the shelves to fill a customer's requisition. The supplies and their documents are placed on a cart or in a distribution area before they are delivered to or picked up by the customer.

**MATERIAL RECEIPT, CUSTODY, AND STOWAGE**

Once the supplies are received, they must be identified, checked, and distributed to the appropriate storeroom or department, and documentation as to their receipt, custody and stowage must be completed.
Material Receipt

In the receipt of government-owned materials, responsibility for receipts takes on an added importance because of the many types of material receipts and the required accountability.

Receipt Documentation

There are several types of receipt papers. The most commonly encountered receipt is the DoD Single Line Item Release/Receipt Document, DD Form 1348 (Fig. 5-4). Regardless of the type of receipt document, the end-use receiver must:

- Date the document upon receipt
- Circle the quantity accepted
- Sign the document to indicate receipt

Receiving Procedures

Small quantities of supplies received on a daily basis require no special preparations for receipt. Stock large quantities of supplies in a central area out of the traffic flow and hold there until preliminary identification and package count are completed. Then sort supplies according to the department or storeroom to which they will be distributed.

RECEIPT PROCESSING- CHECKING-IN MATERIEL

Checking-in materiel means making sure the materiel received is the same as the materiel ordered and it is in good condition. When a government or commercial supplier fills an order and ships the materiel, a shipping document is provided to verify what is included in the shipment.

Types of Documents Used in the Receiving Process

Some forms used for ordering supplies will be used in the receiving process. Order for Supplies or Services/Request for Quotations (DD Form 1155) Request for Contractual Procurement (NAVCOMPT Form 2276), and Materiel Inspection and Receiving Report (DD Form 250) are used for inspection and acceptance of locally procured items. Upon receipt of a shipment, the appropriate purchase order/contract will be pulled and verified with the receiving document.

Prompt receipt processing is essential in certification of the invoice. Once the invoice is verified against the shipment received, the paperwork should be processed promptly to ensure payment is made and no interest is charged. Refer to your local policy for distribution of invoice copies (Fig. 5-8).

Figure 5-8.—DD 250
Receiving Process

1. Is it yours?
   a. Verify that the shipment is for the command. Each command has a unique, six-character Unit Identifier Code (UIC) assigned for the purpose of identification. This UIC is the first part of the document number.
   b. Verify the serial number assigned to track it.
   c. If the shipment does not belong to the command and the delivery truck is still there, bring it to the driver's attention.
   d. If the shipment was received by mail or the delivery vehicle has left, consult the local SOP for guidance on misdirected shipments.
   e. If the materiel is for your command, begin the check-in process.

2. Damage
   a. One of the first checks is a visual inspection for damage: dented, crushed, or liquid stained. Follow local policies to report damaged containers. If the containers are in good condition, proceed with the check-in.

3. Compare Shipping Document to the Actual Item Received
   a. The shipper prepares a document to identify what is included in the shipment. Shipping documents are found in a plastic envelope on the outside of the exterior pack or container. Sometimes the document is placed inside the container. There may be one packing slip for several items or a separate document for each requisition in the shipment.
   b. Check the stock or catalog number. Make sure the stock or catalog number printed on the box is the same as the stock or catalog number on the shipping document.
   c. Check the unit of issue. The unit of issue on the item or container should match the unit of issue on the shipping document.

UNIT OF ISSUE.—Describes how an item is packaged for sale by the distributor. Some items are issued in boxes, bottles, packages, or tubes. Often a product will be sold by the box or package with smaller boxes, tubes, or bottles inside. The unit of measure is the smallest internal package (one Band-Aid out of a box of 100); if your activity issues materiel by the unit of measure, it will account for the materiel by both the unit of issue (the way it is packaged for sale by the distributor) and the unit of measure (the smallest distribution quantity). Sometimes the outside of the container will be marked with a two (2) character code to identify the unit of issue of the materiel inside.

Example: 12 BT.

d. Check the quantity. Make sure the quantity received is the same as the quantity printed on the shipping document. When the quantity received matches the quantity printed on the shipping document, annotate verification on the document. This can be done by circling or placing a check next to the quantity field, or writing in the quantity received. If the quantities do not match, be sure to clearly mark the discrepancy. One way to do this is, using a red pen:

- Line through the incorrect quantity printed in the quantity field of the shipping document
- Write the actual quantity received next to the quantity field
- Circle the actual quantity received
4. **Stock or Direct Turn Over (DTO)**
   a. Stocked items are stored in the warehouse until a customer orders them. These items are routinely used (another term is "demand supported"); they are kept on hand to meet the needs of customers.
   b. Direct Turn Over items are items ordered by a customer that are to be issued directly to that customer.

5. **Expiration Dated Material**
   a. Materiel that deteriorates over time has expiration date or shelf life. The manufacturer prints the expiration date on the exterior pack and on the unit pack. The abbreviation EXP is often used for expiration date.
   b. Routine shipments received by the activity should have at least six (6) months of shelf life left at the time they are received. In some cases, when a high priority requisition is submitted, materiel with a life expectancy of less than six months may be shipped with the expectation that it will be used immediately.
   c. Check the date and mark any materiel that has less than six months life remaining.

6. **Equipment**
   a. Check in equipment using steps 1-2 and following policies.
   b. Accountable equipment must have a property tag before being issued to the customer.
   c. All medical and dental equipment is inspected by the biomedical equipment department/division.
   d. Equipment check-in procedures are discussed in the biomedical equipment & technology management section.

7. **Signing the Document**
   a. After verification actions are completed, the receiving document should be signed and dated to signify completion of the check-in process.
   b. **Make sure the signature is legible!**

8. **Marking the Boxes**
   a. DTO materiel should be marked with the customer's name or identification number and then placed in a distribution area.
   b. The materiel will be delivered to the customer who will sign the receiving report or the receiving section notifies the customer that materiel is ready for pick-up and signature.
   c. The document signed by the customer will become the official file copy.

9. **Forwarding Documents**
   a. Shipments can be received as one item or a truckload. It is important to maintain control of all the receipt documents.
   b. As the check-in for each document is completed, set the document aside where it will not be confused with other paperwork.
   c. For some commercial shipments, interest is charged if the receipt is not processed and the bill paid in a timely manner.
   d. Once the entire check-in process is complete, the receipts are forwarded to the stock control section and entered into the automated inventory management system.
Report of Discrepancy (ROD)

The Report of Discrepancy (ROD), SF 364 (Fig. 5-9), is the method by which activities report shipping type (issue) discrepancies and packaging discrepancies on the part of the shipper. It is filed with the DoD Supply System when a shipping type (item or packaging) discrepancy is found. The report serves two purposes: the customer is provided an exchange of items or financial reimbursement and the shipper is made aware that a physical distribution problem exists. Discrepancies are most often discovered during the receiving process; review the information in NAVMED P-5132 and follow local procedures.

Shipping-type (issue) discrepancies are:

- Excess or shortage in quantity; if the quantity is short, look for a suffix code after the document number that identifies this as a partial shipment rather than a shortage
- Damage caused prior to shipment (damage to interior contents)
- Incorrect item pulled and shipped (be sure the item received is actually a discrepancy and not a substitute item)
- Item is not identifiable -missing paperwork, etc.

NOTE:
Some packaging discrepancies are: improper packing, marking, unit of issue, or preservation method (i.e. refrigerated or frozen).

MATERIAL STORAGE

Location

Rows of shelving and individual sections should be numbered to facilitate storage and retrieval of material. Locations are alphanumeric codes that designate a specific spot in the warehouse. Some items may require more than one storage location; the additional locations should be noted on a cross-reference card at each storage site to ensure all stock is properly inventoried.

Storerooms/Supply Lockers

GENERAL.—When in charge of a storeroom the HM is also responsible for maintaining cleanliness and organization of the space and custody of the key(s). Proper temperatures should be monitored to avoid deterioration of products. Rotation of the stock and using products before the expiration date are critical to patient care.

SHIPBOARD.—Rust is an ever-present enemy and constant vigilance is required to keep it under control. Rust spots should be chipped, wire brushed or sanded, primed, and spot painted. Tighten loose bolts promptly to prevent possible damage to the storeroom or its contents. Examine pipes, valves, electrical systems, watertight fittings, and fire-fighting equipment daily, and report any defect to the supply officer.
Before getting underway into open seas, thoroughly inspect and secure storerooms to prevent stores from shifting due to the ships motion. Lash bulk stores to bulkheads, stanchions, or battens, and secure the fronts of open bins and shelves to prevent stores from falling out on the deck.

Areas of the Warehouse

Depending upon the size of the warehouse, separate, distinct areas may be established:

- **Administration**: The space within the warehouse used for clerical or management functions.
- **Receiving**: Where incoming shipments are checked-in and data about the shipment is recorded. Materiel should remain in the receiving area until the check-in process is complete. After the physical check-in is complete, the receipt information is entered into the automated medical inventory system.
- **Storing**: The act of putting materiel into a specific area of the warehouse. The majority of the warehouse floor space is devoted to storage. Following are specific areas of storage.
  - **Bulk**: Contains large boxes stored on box pallets or racks such as solutions, toilet paper, and plastic urinals.
  - **Bin/Small Item/Loose**: Contains surgical instruments, dental materiel, and other small items.
  - **Cage**: Provides storage, under lock and key, for items that have some potential for abuse or are likely to be pilfered such as needles and syringes. Access to this area is limited.
  - **Vault**: Provides secure storage for controlled substances (i.e. morphine and codeine). These items have a high abuse or pilferage potential thus federal law requires them to be stored in an approved, secure enclosure. It may be a freestanding vault of 750 pounds or more or it may be built into the warehouse. Access to this area is restricted.
- **Shelving by Stock Number Sequence**: Used in small storage areas such as the vault and cage.
- **Creating a New Location**: Sometimes there is no room on the shelf for the new materiel. Even when a location is empty, it is still reserved while waiting for another shipment of the materiel shown on the label or placard. Do not remove the placard or cross out the existing label on an empty location. Create additional storage spaces/locations per local policy and document the new location.

Stock Rotation

To prevent deterioration of items, the oldest products should always be issued first. This is the FIFO (first in, first out) method. This is especially important when managing items marked with a shelf life code or expiration date. Non-expiration dated materiel is rotated by manufactured (MFR) date. This date can be found on the outside of the exterior pack or on the item.

In the bulk area, items are rotated from top to bottom; in other areas, materiel is pulled from front to back. For example: a box with an expiration date of 06/2011 will be placed on top, or in front of, a box with an expiration date of 11/2012. A box with a manufacture date of 04/2012 will be placed on top, or in front of another box with a manufacture date of 07/2014.

An active shelf life management program identifies stock that will expire prior to being used. A monthly surveillance check should be performed to verify the rotation of stock procedure is being implemented.

Shelf-Life Material

Shelf-life material is subject to deterioration. These items are assigned a shelf-life code listed in the Navy Management Data List (NAVSUP Publication 4100).
SPECIAL STOWAGE OF ITEMS

LEARNING OBJECTIVE:

Identify hazardous materials and how they are labeled.

This section will cover the classifications of material and discuss storage requirements for special types of material. The Naval Ships Technical Manual (NSTM) and the Hazardous Materials Information System (HMIS) outline the requirements for shipboard stowage of dangerous materials and lists the materials under each classification.

HAZARDOUS MATERIALS

Hazardous material includes all types of compressed gases and materials that present a fire hazard or are otherwise dangerous. Paint and oil constitute the bulk of material in this category. Paint and flammable liquid storerooms are normally provided with alarm and CO₂ smothering systems that can be activated by automatic temperature-sensitive devices inside storerooms and by manual controls outside storerooms. These storerooms are located, when practical, below the full-load water line, near either end of the vessel, but not adjacent to a magazine. They are equipped with watertight doors.

The Occupational Safety & Health Administration (OSHA) establishes regulations regarding the rights of employees to know the potential dangers associated with hazardous chemicals in the workplace. The goal is to reduce the risk of injury or illness caused by hazardous’ chemicals in the workplace.

Accomplishing this goal requires information and communication; therefore, OSHA issued The Hazard Communication Standard. This standard helps protect the Corpsman’s right to work in a safe and healthy environment. It requires the HM to not only be informed about hazardous chemicals in the workplace, but also to be trained to work safely with these materials. Each Medical and Dental Treatment Facility is guided by BUMED instructions to develop, implement, and maintain a written hazard communication program. This includes labeling, Material Safety Data Sheets (MSDS), and employee training.

Labeling and MSDS

Products considered hazardous should come from the manufacturer with a label identifying the chemicals and containing an appropriate hazard warning. MSDSs provide information on the hazards of potentially harmful materiel and precautions for using such materiel safely. OSHA regulations require all employers, including health facilities, to keep MSDSs on file for each hazardous chemical used. By law, chemical manufacturers, suppliers, and distributors are required to supply MSDSs with their initial shipments of hazardous chemicals. An up-to-date file of these sheets must be maintained and available to all employees.

Materiel Safety Data Sheets (MSDS)

These are maintained in the working area of the warehouse. All personnel must be able to locate the MSDS and understand each section as they provide specific information.

Hazardous Technical Information Services (HTIS): HTIS is located at Defense Supply Center, Richmond and maintains a data base of Materiel Safety Data Sheets. The helpline telephone number is 1-800-848-4847 or DSN 695-5168 and is staffed from 0730-1700 EST.

General Precautions for Handling Materials

By knowing the general precautions and following manufacturer’s instructions when handling materials, the HM can easily prevent hazardous situations or accidents. Use only proper cleanup procedures. HMs must dispose of all hazardous chemicals according to the MSDS instructions, applicable local, state, and federal regulations.
For protection, avoid skin contact with chemicals and minimize chemical vapor in the air whenever possible. Wear the appropriate protective eyewear, gloves, and a mask in order to protect from injury.

Never leave chemical bottles open. If left open, vapors can escape into the air and chemicals can be easily spilled when bottles are left open. Do not use a flame near flammable chemicals. Eating, smoking, or drinking is prohibited in areas where chemicals are used. Eating can cause chemicals to be ingested and smoking can cause chemicals to ignite or explode. Proper ventilation can eliminate hazards associated with most gases and chemicals. Storage rooms must be properly furnished and maintained.

**GAS AND CHEMICAL HAZARDS**

A variety of gases and chemicals are used or produced in medical and dental facilities. It is important to be aware of the hazards and to take the necessary precautions.

**Gases**

Ensure proper labeling, storage, and use of compressed gases, such as oxygen, nitrogen, and propane, according to published standards. The use of nitrous oxide conscious sedation requires special training and the use of Personal Protective Equipment (PPE) by personnel during the administration of the gas.

Stow compressed gases on the weather deck, or properly mounted in a shock resistant bracket, and securely fastened in a vertical position. Protect the cylinder valves from accumulations of dust, ice and snow, and screen the cylinders from direct rays of the sun. [NAVSUP P-485](#) contains more specific information concerning handling compressed gas cylinders.

**Toxic Vapors**

Toxic vapors can be generated when mixing impression and denture materials and various medical materials. Using adhesive, solvents, acids, chemical sterilizer agents; mixing radiographic processing solutions; and mixing some disinfectant agents can emit toxic vapors. Besides the danger from the vapors, direct contact with many materials, such as etchant acids, radiographic solutions, endodontic materials, or bleaching agents can cause chemical burns of the skin or eyes.

**Chemical Storage**

Proper storage of chemicals is critical for safety and guidance is located in MSDSs. The type of container and cabinet, security, and proximity to other chemicals, materials, heat, or open flame are areas that need consideration and control.

**Flammable Liquids**

Many items used in medicine and dentistry are flammable. Solvents such as acetone and alcohol are examples. When using flammable liquids, always have adequate ventilation, never use where sparks or flames are present, and have a fire extinguisher available. Store flammable liquids and bulk quantities in tightly covered containers in an approved flammable storage locker.

**Flammable Storage**

An enclosed area containing items that must be kept away from sparks or open flames. If the command is using a flammable locker, it must remain locked. Keep a fire extinguisher nearby. Acetone, methanol, paint, and isopropyl (rubbing) alcohol are examples of items stored in this area.
**Alcohol**

Stowed in a locked container in the paint and flammable liquid storeroom, to which only the supply officer (or other officer designated in writing by the commanding officer) has the key or combination.

**Corrosive Storage**

Corrosive Storage can be a special, separate room, or more commonly, a lockable storage container used to store acids. Because of the potential danger in handling acids, there should be a shower or eyewash station nearby. This storage area must have a way to contain spills. This is accomplished by a brim around the area or containers under the bottles or boxes within the locker. The area should be well ventilated to remove any vapors.

**Acid**

Unless classified as safe material, is stowed in an acid locker. Acid lockers are leak-proof and lead-lined boxes, chests, or lockers specifically designed for stowing bottles or containers of acid.

**Acid Etchants**

Acid Etchants come as solutions and gels are used for acid etch techniques used in sealants or composites. Always wear protective applicable PPE to avoid skin contact. Always handle acid-soaked items with forceps or gloves. If spills occur, use a commercial acid spill kit.

**Organic Chemicals**

Organic Chemicals include alcohols, ketones, esters, solvents, and monomers, such as methyl acrylate. After each use, clean the outside surfaces of the containers to prevent residual material from contacting the next user.

**Gypsum Products**

Gypsum Products include dental plaster and stone which are considered hazards because of the dust particles circulated. It is important to minimize exposure to the dust during handling, as it may cause respiratory problems.

**Radiographic Chemicals**

Radiographic Chemicals are used to process radiographs. Radiographic solutions and chemicals should be stored in tightly covered containers in a cool, dark place.

**SUSPENDED OR “J” STOCK**

Suspended or “J” stock is used to store material unsuitable for issue. Suspended stock must be separated from other storage areas and the area clearly marked to eliminate confusion with serviceable or “good” stock. Damaged, expired or material temporarily suspended from use by medical material recall notices is held in this area.

Suspended material that is normally kept in a special storage area for security or temperature control reasons will stay in that special storage area while suspended. The stock must be clearly marked as “SUSPENDED” to avoid accidental issue of the item. One way to do this is to tape off the shelf where suspended stock is held.

**REPAIR PARTS**

Repair parts should be stored in their original containers.

**MEDICAL WASTE**

Medical and dental departments generate and accumulate large amounts of medical waste. Medical and dental departments will cooperate fully with other departments (supply, safety, etc.) to establish and enforce appropriate command policy involved in disposal of plastic materials and medical waste. Treatment facilities have designated areas to store medical waste.
LEARNING OBJECTIVE:

Explain the responsibilities and accountability required for management of equipment.

TERMINOLOGY AND DEFINITIONS

Defense Medical Logistics Standard Support (DMLSS)

Centrally-managed automated system for use by logistics personnel to procure, maintain, and dispose of consumables and equipment. Medical/Dental Equipment—devices used in medical/dental diagnosis, therapy, and treatment of injury or disease.

Types of Maintenance Requirements (MRs)

- **Scheduled Maintenance**: Called preventive maintenance (PM) ashore and preventive maintenance system (PMS) afloat, serves to ensure inherent reliability, increase operational availability, and prevent excessive wear of moving parts.
- **Unscheduled Maintenance (UM)**: Corrective maintenance for the repair of equipment breakage or malfunctions.
- **No maintenance required (NMR)**: Equipment that normally requires no scheduled maintenance.

Navy Assets

There are three categories of Property, Plant, and Equipment (PP&E) that have been defined in SECNAVINST 7320.10 series, *Department of the Navy (DoN) Personal Property Policies and Procedures*, for accounting and reporting purposes.

Heritage Assets

Recognized to be of historical or natural significance; cultural, educational, or artistic importance; or possess significant architectural characteristics. Located in museums or registered with the Naval Historical Center or the Marine Corps Museums Branch; expected to be preserved indefinitely.

Stewardship Land

Land not acquired for, or in connection with General (PP&E).

General PP&E

Divided into two sub-categories: Real property (i.e., land, building, and structures), and Personal Property, defined below.

Personal Property is a subcategory of General PP&E, (sometimes referred to as Garrison Property) is defined as those items used, but not consumed, to produce goods or services in support of DoN’s mission. Personal Property includes: office equipment, industrial plant equipment, vehicles, material handling equipment, automated data processing (ADP) equipment, government-furnished equipment (GFE), leased assets, and military equipment (i.e. weapons, weapon systems, and weapon system components and support equipment.) Personal Property does not include: inventory items (e.g., items intended for sale), operating materials and supplies, real property (i.e., land buildings and structures), or items of an historical nature.
Categories of Personal Property include Capitalized, Minor, and Sub-minor.

**Capitalized Personal Property** must meet all of the following criteria:
- Has an acquisition cost, book value, or when applicable, an estimated fair market value equal to or greater than $250,000.
- Has an estimated recovery period equal to or greater than 24 months.
- Is not intended for sale in the ordinary course of operations.
- Has been acquired or constructed with the intention of being used or available to be used by DoN in its operations.

**Minor Personal Property** has an acquisition cost greater than $5,000 and less than $250,000, or has an acquisition cost greater than $250,000 but does not meet all the capitalization “criteria.”

**Sub-Minor Personal Property** is any asset that has an acquisition cost of $5,000 or less.

**Tracking of Equipment Data in an MTF/DTF**

All equipment is processed through the Equipment Management Division. The equipment is safety tested, assigned an equipment control number, and added to the Defense Medical Logistics Standard Support (DMLSS) System. The customer ordering the equipment is notified of the equipment receipt after these steps are completed. Accountability and acceptance of equipment should be documented on the purchase order by the signature of an authorized individual within the receiving department. Records should be maintained to adequately identify the location and person responsible for each item of equipment at any time. A custodian and sub-custodian will be assigned to each equipment item in the inventory.

**Medical & Dental Equipment with Patient Data**

The Health Insurance Portability and Accountability Act of 1996 (HIPAA) Privacy Rule provides federal protections for protected health information held by covered entities and gives patients’ rights with respect to that information. HMs are mandated to secure any equipment within the department, that may be contain patient data (Name, SSN, diagnosis, pictures, etc.) and stored on some type of media (Hard drives, Floppy Disk, etc.).

**EQUIPMENT MANAGEMENT PROGRAM**

**Equipment Manager**

The Command's Equipment Manager, appointed by the Commanding Officer, has primary responsibility for comprehensive management of medical equipment within a treatment facility. Comprehensive management includes planning, procuring, receiving, property accounting, installation, inventory, replacement, and disposal of equipment. Planning will precede all equipment acquisition.

**Equipment Manager's Responsibilities**

Scheduling, supervising and coordinating procedures to ensure complete and accurate physical inventories are some of the duties. Equipment managers process equipment custody transfers between departments and maintain documentation to support transfers between departments and outside activities. Property records kept by the equipment manager should reflect the current location and who has custody of the item of equipment. The Equipment Manager plays a key role in the Equipment Program Review Committee (EPRC).
Role of the Equipment Program Review Committee (EPRC)

This committee provides oversight of scarce equipment resources in the most cost effective manner possible. The program allows conservation of resources while enabling quality health care delivery. The committee should meet at least semi-annually to formulate and prioritize minor equipment requirements and to establish priorities for investment equipment.

Equipment Budget Call

The Equipment Manager under the direction of the EPRC will request departments to submit minor equipment requirements for the upcoming fiscal year. The EPRC will compile all requirements submitted and will prioritize the acquisition of each within locally available funding levels twice each fiscal year.

Acquisition of Equipment

Equipment should not be purchased before screening other medical/dental activities in search of available sharable or idle equipment. Published lists of excess/available equipment are managed via the Shared Procurement Program and can be obtained from NAVMEDLOGCOM.

Certain items of equipment require special approval before acquisition can take place. The EPRC screens all requirements and prioritizes them in the order in which the facility would like them purchased. Special approvals required should be obtained prior to submission to the EPRC. Some items of equipment that require special approval are:

- Filing and records keeping equipment
- Telecommunication equipment (frequency allocation)
- Federal Information Processing (FIP) Life cycle managed equipment such as computers, telephone systems, etc.
- Simulation manikins

Refer to the NAVMED P-5132 for additional references for obtaining special approvals.

After preparing a purchase request, the fiscal department will ensure funds are available. After funds availability certification is obtained, the purchase request is ready for procurement.

Funding for Minor Equipment and Investment Equipment

The Operation and Maintenance (O&M) appropriation is the source of funding for expense items such as minor equipment. O&M funding is used when the cost of equipment falls below the investment equipment threshold which is currently $250,000.

Leased Equipment

Leasing is appropriate if it is to the government's advantage and/or used as an interim measure when the following two criteria are met:

- Immediate use of the equipment is required to meet program or system goals
- Circumstances do not currently support buying the equipment. Note: If leasing is justified, a lease with option to buy is preferable in most cases
Safe Medical Devices Act (SMDA) of 1990

The SMDA of 1990 established a mandatory requirement for treatment facilities to report all incidents that reasonably suggest there is a probability that a medical/dental device has caused or contributed to the death, serious injury, or serious illness of a patient. Internal controls and reporting mechanisms must be established to ensure the Head, Biomedical Engineering, the Equipment Manager, and Command Safety Manager are notified of any incident to ensure the equipment is removed from service and thoroughly checked. A SF-380, Reporting and Processing Medical Materiel Complaints/Quality Improvement Report, is prepared and submitted to the Defense Personnel Support Center (DPSC) per the timelines outlined in the Reporting Unsatisfactory Equipment section.

Reporting Unsatisfactory Equipment

When a piece of equipment is received or used and found to be unsatisfactory or presents a hazard to the patient or operator, the below reports are to be completed. Classifications of complaints are grouped in three classes and are as follows:

- **Type I**: Materiel determined to be harmful or defective to the extent that use may or has caused serious illness or death.
- **Type II**: Materiel, other than equipment, suspected of being harmful, deteriorated, or otherwise unsuitable for use.
- **Type III**: Equipment determined to be unsatisfactory because of malfunction, design deficiency, defect, faulty materiel, workmanship, or performance. Equipment may be used unless the item presents a possible direct hazard (i.e., electrical shock, sharp edges, or other safety hazards).

Report Type I complaints immediately. Type II and III complaints are to be reported as soon as possible but not later than 10 days from the date of the incident.

Defense Personnel Support Center (DPSC) serves as the single Department of Defense (DOD) focal point for processing of medical and dental materiel/equipment complaints. Below is a summarization of equipment conditions that would require a report to be completed and forwarded to DPSC.

Inventories and Inspections

BUMED activities are responsible for completing two different types of inventories. A Master Equipment Inventory conducted annually and a Triennial Inventory to be conducted every third year. The Equipment Manager is responsible for setting up procedures to follow when conducting physical inventories.

**NAVMED P-5132** contains instructions as to the necessary data to be recorded for each item during an inventory, along with submission requirements. The collected data from the physical inventory will be used to update the current inventory in DMLSS.

Biomedical Equipment Maintenance Division (BIOMED)

The BIOMED division serves as a resource for questions and to provide preventive and corrective maintenance. It is staffed by specially trained Bio-Medical Equipment Technicians (BMET). The HM must be familiar with the equipment in the treatment facility in order to be effective in daily clinical operations.

Basic Expectations:

- Recognize the major components of each piece of equipment
- Perform routine user maintenance on equipment (Level I Maintenance)

The first rule for operating and performing user maintenance on equipment is to carefully read the manufacturer’s instructions. Copies of this literature should be in the LPO/LCPO’s office or BIOMED.
Preventive maintenance for all medical/dental equipment is a part of the Equipment Management Program. A HM may be tasked with assisting the BMET with locating equipment that belongs to the department.

**Maintenance Levels**

Proper care and use by the equipment operator, combined with regularly scheduled maintenance, ensure maximum reliability and prolongs the useful life of equipment. BIOMED is responsible for performing or coordinating, and recording preventive maintenance on all medical and dental equipment. Preventive maintenance will be performed on all medical/dental equipment utilizing a risk-based management program. NAVMEDLOGCOM is the technical manager for this program and provides training and technical guidance. All newly acquired equipment will be safety checked by a BMET before leaving the equipment management division.

The three maintenance levels are as follows:

- **Level I (Performance Testing):** Level I preventive maintenance is the responsibility of the equipment operator and consists of operator maintenance that is performed before, during, and after equipment usage. It is the basic maintenance required to keep equipment operating on a daily basis. This is performed by the personnel utilizing the equipment within the department.

- **Level II (Preventive Maintenance):** Intermediate maintenance relates to scheduled periodic (planned) technical inspection, lubrications requiring disassembly, replacement of worn or deteriorated parts, interior cleaning, calibration verification or adjustment, and verification of Level I performance. Level II maintenance is to be performed by a BMET or contracted service.

- **Level III:** Consists of maintenance requiring complete overhaul of the equipment item and is considered depot-level maintenance or equipment manufacturer service center level maintenance. At command discretion, performance of Level III is permitted. Level III maintenance will usually result in extension of service life and should be documented in the appropriate service history.

<table>
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<tr>
<th>NOTE:</th>
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<tr>
<td>If a contractor is responsible for Level II or Level III maintenance, only approved personnel may coordinate Level II and III maintenance with the contractor assigned.</td>
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Services coordinated by unapproved personnel may result in a voided warranty, voided contract, and or an unauthorized commitment.
MAINTENANCE WORK ORDERS

The Medical/Dental Maintenance Work Order (NAVMED 6700/4) shown in Figure 5-10, or DMLSS work orders are used to determine workload and assign priorities. BMETs receiving equipment not properly functioning will complete the top section of the NAVMED 6700/4. Depending upon the BIOMED departmental workload and availability of loaner equipment, they may assign a functioning piece of equipment on a loan basis until the equipment repairs are completed.

Excess Equipment

Excess equipment represents a source of materiel resources for other facilities. Redistribution of excess equipment provides the gaining facility with the opportunity to economically obtain equipment with only the cost of packing, crating and handling. Equipment identified as excess, which can be redistributed within the command to other departments, must be requested using a memorandum of transfer to the Equipment Manager. Property records will be updated to reflect a change in custodian.

PROPERTY SURVEYS

A property survey (or investigation) is the procedure used when Navy property or Defense Logistics Agency material is lost, damaged, or destroyed and must be completed in a timely manner. The purpose of a survey is to determine responsibility for the loss and to determine the actual loss to the United States Government. The forms discussed in the following paragraphs are used in connection with survey procedures.

Financial Liability Investigation of Property Loss

Missing, Lost, Stolen, or Recovered equipment that has been determined to have been lost, damaged, or destroyed must be surveyed to account for the amount of loss to the government. The Commanding Officer will report all incidents IAW NAVMED P-5132, Bureau of Medicine and Surgery, Equipment Management Manual. Upon discovery, the accountable or responsible official will initiate a Report of Survey, DD Form 200 (Fig. 5-11).

Detailed instructions for preparing DD Form 200 are found in NAVSUP Manual, Volume III, Supply Ashore. An officer will be appointed in writing by the Commanding Officer, and will be authorized to approve/disapprove Reports of

Survey when no evidence of negligence or abuse exists. The appointed officer may act as the Survey Officer. When abuse or neglect is suspected, a survey board will conduct the investigation. The survey board provides greater surveillance over lost or damaged equipment and facilitates processing actions.
CONTINGENCY SUPPLY BLOCKS

LEARNING OBJECTIVE:

Describe assemblage and management procedures for medical contingency supply blocks.

The HM may be assigned to a Health Services Augmentation Program (HSAP) team. The HSAP gives detailed information on policies, procedures, and responsibilities on the various types of teams. These specialty units require supplies and equipment that may not be available or are in limited supply in the area to which deployed; contingency supply blocks have been established to meet this need.

Contingency supply blocks consist of functionally packaged medical and dental equipment and supplies. Each block is assembled to meet the needs of a specific unit.

For example, a surgical supply block contains enough equipment to establish one operating room and sufficient supplies for 100 major surgical cases. These blocks are utilized to supply assets with the FMF and CBs.

ASSEMBLING THE BLOCK

The contents of each contingency supply block are outlined in an Authorized Medical Allowance List (AMAL) specific to that block. NAVMEDLOGCOM is responsible for developing, publishing, maintaining, and coordinating a comprehensive review of all AMALs on at least an annual basis. The AMAL is the basic source document used to sustain supply block management. The preface of the AMAL contains instructions for maintaining, packing, and marking the block.
Authorized Medical/Dental Allowance List (AMAL/ADAL)

The AMAL/ADAL is the minimum amount of medical/dental material to be maintained by an operational platform or on order at any given time. Revisions are based on changes to the Federal Supply System, professional recommendations, and Type Commanders. The amount of material as noted in an AMAL/ADAL is designated by NAVMEDLOGCOM for each specific operational platform and area covered. Submit recommendations for changes to the AMALs/ADALs to NAVMEDLOGCOM where it will be reviewed and approved through the TYCOM.

Ships no longer receive contingency supply blocks due to improved turnaround on supply requests regardless of location. Ships use the AMAL/ADAL lists to maintain individual item supply levels for overall compliance.

MANAGING THE BLOCK

Contingency supply blocks contain dated, shelf-life, or deteriorative items such as pharmaceuticals, intravenous solutions, and prepackaged items. Dated items in the block must have an expiration date sufficiently far in the future to allow for a lengthy deployment (up to 6 months). Monthly status and quarterly readiness reports ensure the designated supply blocks are ready for rapid deployment. This reporting process allows the team members to become familiar with the contents of the block and the operability of all equipment.

SUMMARY

This chapter identified Naval Supply publications; introduced the Federal Supply Catalog System; outlined procedures used to estimate supply needs, procure supplies and material; and outlined procedures to account for supplies and operating funds. Supply management affects the availability of supplies when most needed (deployment or emergency) thus application of the principles and procedures outlined will ensure operational readiness and mission satisfaction.
INTRODUCTION

Knowledge of how the human body is constructed and how it works is an important part of the training for those concerned with healing the sick or managing conditions following injury. This chapter will provide a general knowledge of the structures and functions of the body.

The human body is a combination of organ systems, with a supporting framework of muscles and bones and an external covering of skin. The study of the body is divided into two sciences:

- **Anatomy**: the study of body structures and the relation of one part to another
- **Physiology**: the study of how the body works and how the various parts function individually and in relation to each other

TERMS OF POSITION AND DIRECTION

**LEARNING OBJECTIVE:**

*Identify anatomical terms of position and direction.*

The planes of the body are imaginary lines dividing it into sections. These planes are used as reference points in locating anatomical structures. As shown in (Fig. 6-1) the **sagittal plane** divides the body into right and left halves on its vertical axis. This plane passes through the sagittal suture of the cranium; any plane parallel to it is called a **sagittal plane**. **Frontal planes** are drawn perpendicular to the sagittal lines and divide the body into anterior (front) and posterior (rear) sections.

This line passes through the coronal suture of the cranium; frontal planes are also called **coronal planes**. The **horizontal, or transverse, plane**, which is drawn at right angles to both sagittal and frontal planes, divides the body into superior (upper) and inferior (lower) sections.

Figure 6-1.—Directions and Planes of the Body

To aid in understanding the location of anatomical structures, a standard body position called the **anatomical position** is used as the point of reference. This anatomical position is assumed when the body stands erect with the arms hanging at the sides and the palms of the hands turned forward (Fig. 6-2).

Other commonly used anatomical terms include the following:

- **Anterior or Ventral**: Toward the front, or along the belly side of the body
- **Posterior or Dorsal**: Toward the back, or along the vertebral side of the body
- **Medial**: Near or toward the mid-sagittal plane of the body
- **Lateral**: Away from the mid-sagittal plane of the body
- **Internal**: Inside
- **External**: Outside
- **Proximal**: Nearest to the point of origin or towards the trunk
- **Distal**: Away from the point of origin or away from the trunk
- **Superior**: Toward the top of the body or above
- **Caudal**: Toward the lower end of the body
- **Inferior**: Toward the bottom of the body or below
- **Supine**: Lying position of the body, face up
- **Prone**: Lying position of the body, face down
- **Lateral recumbent**: Lying position of the body, on either side
- **Peripheral**: The outward part or surface of a structure

![Figure 6-2.—Anatomical Position](image)
CHARACTERISTICS OF LIVING MATTER

LEARNING OBJECTIVE:

Identify the characteristics of living matter.

All living things, animals, and plants are organisms that undergo chemical processes by which they sustain life and regenerate cells. The difference between animals and plants is that animals have sensations, the power of voluntary movement, and they require oxygen and organic food. Plants require only carbon dioxide and inorganic matter for food and have neither voluntary movement nor special sensory organs.

In man, some of the characteristic functions necessary for survival include digestion, metabolism, and homeostasis. Digestion involves the physical and chemical breakdown of food into its simplest forms. Metabolism is the process of absorption, storage, and use of these foods for body growth, maintenance, and repair. Homeostasis is the body's self-regulated control of its internal environment. It allows the organism to maintain a state of constancy or equilibrium, in spite of vast changes in the external environment.

The human body is broken down into various levels of organization, the chemical, organelle, cellular, tissue, organ, organ system, and the organism levels.

CHEMICAL LEVEL

The chemical level is the beginning level of the organization of the body. There are more than 100 different chemical building blocks of nature called atoms (tiny spheres of matter so small they are invisible). Every living thing in the universe, including the human body, is composed of atoms.

ORGANELLE LEVEL

Organelle level: Organelles consist of chemical structures organized within larger units (cells) to perform a specific function. It is within a cell and allows the cell to live; without it the cell is unable to live.

CELLULAR LEVEL

Cellular level: Cells consist of the smallest and most numerous structural unit that possess and exhibits the basic characteristics of living matter. Although all cells have certain features in common, they specialize to perform unique functions.

TISSUE LEVEL

Tissue level: Tissues are a group of many similar cells that all develop together from the same part of an embryo and all perform a certain function. Tissues are the “fabric” of the body. Epithelial and muscular are examples.

ORGAN LEVEL

Organ level: Organs are more complex than tissue. An organ is defined as a structure made up of several different kinds of tissues arranged so that, together, they can perform a special function. Each organ is unique in shape, size, appearance and placement in the body. The heart, lungs, spleen, and liver are examples of some of the organs found in the human body.

SYSTEM LEVEL

System level: Systems are the most complex of the organizational units of the body. The system level of organization involves varying numbers of kinds of organs arranged so that, together, they can perform complex functions for the body. There are 11 major systems that make up the human body: integumentary, skeletal, muscular, nervous, endocrine, circulatory, lymphatic, respiratory, digestive, urinary, and reproductive.
ORGANISM LEVEL

Organism level: Organisms, such as the human body, are a collection of interactive parts that are capable of surviving in hostile environments, with the ability to reproduce and repair damaged parts.

THE CELL

LEARNING OBJECTIVE:

Identify the characteristics of living matter.

The cell is the smallest and most numerous structural unit that possesses and exhibits the basic characteristics of living matter. A typical cell is made up of the plasma membrane, the nucleus, and the cytoplasm. Each cell is surrounded by a membrane called the plasma membrane which is a selectively permeable. It controls the exchange of materials between the cell and its environment by physical and chemical means. Gases (such as oxygen) and solids (such as proteins, carbohydrates, and mineral salts) pass through the plasma membrane through a process known as diffusion; a process during which elements achieve equilibrium by moving from an area of higher concentration to an area of lower concentration.

The nucleus is a small, dense, usually spherical body that controls the chemical reactions occurring in the cell. The substance contained in the nucleus is called nucleoplasm. The nucleus is also important in the cell's reproduction, due to the storage of genetic information. Every human cell contains 46 chromosomes, and each chromosome has thousands of genes that determine the cell's function.

Cells are composed largely of a gel-like substance, called cytoplasm, upon which depend all the vital functions of nutrition, secretion, growth, circulation, reproduction, excitability, and movement. The cytoplasm is a gelatinous substance surrounding the nucleus and is contained by the plasma membrane. The cytoplasm is made of various organelles and molecules suspended in a watery fluid called cytosol, or intracellular fluid (Fig. 6-3).

The simplest living organism consists of a single cell. The amoeba is a unicellular animal. The single cell of a one-celled organism must be able to carry on all processes necessary for life. This cell is called a simple or undifferentiated cell, one that has not acquired distinguishing characteristics.

In multi-cellular organisms, cells vary in size, shape, and number of nuclei. When stained, the various cell structures can be more readily recognized under a microscope. Many cells are highly specialized to perform special functions (e.g., muscle cells which contract and epithelial cells which protect the skin).
Figure 6-3.—Typical, or composite, cell. An Artist’s interpretation of cell structure. Note, too, the innumerable dots bordering the endoplasmic reticulum. These are ribosomes, the cell’s "protein factories."

TISSUES

LEARNING OBJECTIVE:

Identify the types of tissues in the human body and their functions.

Tissues are groups of specialized cells similar in structure and function. They are classified into four main groups: epithelial, connective, muscular, and nervous.

EPITHELIAL TISSUE

The lining tissue of the body is called epithelium. It forms the outer covering of the body known as the free surface of the skin. It also forms the lining of the digestive, respiratory, and urinary tracts; blood and lymph vessels; serous cavities (cavities which have no communication with the outside of the body, and whose lining membrane secretes a serous fluid), such as the peritoneum or pericardium; and tubules (small tubes which convey fluids) of certain secretory glands, such as the liver and kidneys. Epithelial tissues are classified according to their shape, arrangement, and the function of their cells. For example, epithelial tissues that are composed of single layers of cells are called "simple," while cells with many layers are said to be "stratified" The following paragraphs will discuss the three categories of epithelial tissue: columnar, squamous, and cuboidal (Fig. 6-4).

![Classification of epithelial tissues. The tissues are classified according to the shape and arrangement of cells. The color scheme of these drawings is based on a common staining technique used by histologists called hematoxylin and eosin (H&E) staining. H&E staining usually renders the cytoplasm pink and the chromatin inside the nucleus a purplish color. The cellular membranes, including the plasma membrane and nuclear envelope, do not generally pick up any stain and are thus transparent.](image)

Columnar Epithelial Tissue

Epithelial cells of this type are elongated, longer than they are wide. Columnar tissue is composed of a single layer of cells whose nuclei are located at the same level as the nuclei in their neighboring cells (Figs. 6-4 and 6-5). These cells can be located in the linings of the uterus, in various organs of the digestive system, and in the passages of the respiratory system.

In the digestive system, the chief function of columnar tissue is the secretion of digestive fluids and the absorption of nutrients from digested foods. In certain areas (such as the nostrils, bronchial tubes, and trachea), this tissue has a crown of microscopic hair like processes known as cilia. These cilia provide motion to move secretions and other matter along the surfaces from which they extend. They also act as a barrier by preventing foreign matter from entering these cavities.

Squamous Epithelial Tissue

Squamous epithelial tissue is composed of thin plate-like or scale-like cells forming a mosaic pattern (Fig. 6-4). This tissue is found in the tympanic membrane (eardrum) as a single layer of cells, or in the free skin surface in multiple layers. Squamous tissue is the main protective tissue of the body.

Cuboidal Epithelial Tissue

The cells of cuboidal tissue are cubical in shape (Fig. 6-4) and are found in the more highly specialized organs of the body, such as the ovary and the kidney. In the kidneys, cuboidal tissue functions in the secretion and absorption of fluids.

CONNECTIVE TISSUE

This is the supporting tissue of the various structures of the body. It has many variations and is the most widespread tissue of the body. Connective tissue is highly vascular, surrounds other cells, encases internal organs, sheathes muscles, wraps bones, encloses joints, and provides the supporting framework of the body. Structures of connective tissue differ widely, ranging from delicate tissue-paper membranes to rigid bones.

Connective tissue is composed of cells and extracellular materials (materials found outside the cells). Extracellular materials include fibers and the ground substance. The ground substance contains proteins, water, salts, and other diffusible substances. These extracellular materials give connective tissue varying amounts of elasticity and strength, depending on the type of tissue and location. The following paragraphs will discuss the three predominant types of connective tissue: areolar, adipose, and osseous.
Areolar Connective Tissue

Areolar tissue consists of a meshwork of thin fibers that interlace in all directions, giving the tissue both elasticity and tensile strength. This type of connective tissue is extensively distributed throughout the body, and its chief function is to bind parts of the body together. Areolar tissue allows a considerable amount of movement to take place because of its elasticity. It is found between muscles and as an outside covering for blood vessels and nerves. The areolar tissue layer connects the blood vessels and nerves to the surrounding structures.

Adipose Connective Tissue

Adipose tissue is "fatty tissue." The adipose cell at first appears star-shaped. When the cell begins to store fat in its cytoplasm, it enlarges losing its star shape as the nucleus is pushed to one side (Fig. 6-5). When this process occurs to many cells, the other cell types are crowded out and adipose tissue is formed. Adipose tissue is found beneath skin, between muscles, and around joints and various organs of the body. Adipose tissue acts as a reservoir for energy-producing foods; helps to reduce body heat loss (because of its poor heat conductivity); and serves as support for various organs and fragile structures, such as the kidneys, blood vessels, and nerves.

Osseous Connective Tissue

This type of tissue, known as "bone tissue" is dense fibrous connective tissue that forms tendons, ligaments, cartilage, and bones. These tissues form the supporting framework of the body.

MUSCULAR TISSUE

Muscular tissue provides for all body movement. Contracting muscles cause body parts to move. The three types of muscle tissue are skeletal, smooth, and cardiac.

Skeletal Muscle Tissue

Skeletal (voluntary) muscle fiber is striated, or striped, and is under the control of the individual's will (Fig. 6-6). For this reason, it is often called "voluntary" muscle tissue. Skeletal muscle tissues are usually attached to bones. When muscle fibers are stimulated by an action of a nerve fiber, the fibers contract and relax. This interaction between muscle and nervous fibers produces movement.

Figure 6-6.—Skeletal muscle. Note the striations of the muscle cell fibers in longitudinal section. (Dennis Strete.)

Smooth Muscle Tissue

These muscle fibers are smooth, or non-striated, and are not under the control of the individual's will (Fig 6-7). For this reason, this type of muscle tissue is called "involuntary." Smooth muscle tissue is found in the walls of hollow organs, such as the stomach, intestines, blood vessels, and urinary bladder. Smooth muscle tissues are responsible for the movement of food through the digestive system, constricting blood vessels, and emptying the bladder.

Figure 6-7.—Smooth Muscle Tissue

**Cardiac Muscle Tissue**

The cardiac muscle cells are striated and are joined end to end, resulting in a complex network of interlocking cells (Fig. 6-8). Cardiac muscles are involuntary muscles and are located only in the heart. These tissues are responsible for pumping blood through the heart chambers and into certain blood vessels.

**NERVE TISSUE**

Nerve tissue is the most complex tissue in the body. It is the substance of the brain, spinal cord, and nerves. Nerve tissue requires more oxygen and nutrients than any other body tissue. The basic cell of the nerve tissue is the neuron (Fig. 6-9). This highly specialized cell receives stimuli from and conducts impulses to all parts of the body.

THE INTEGUMENTARY SYSTEM

LEARNING OBJECTIVE:
Identify skin, its functions, structure, and appendages.

Organ systems are comprised of tissues grouped together to form organs, and groups of organs with specialized functions. Since the skin acts with hair follicles, sebaceous glands, and sweat glands, these organs together constitute the integumentary system.

SKIN FUNCTION

The skin covers almost every visible part of the human body. Even the hair and nails are outgrowths from it. It protects the underlying structures from injury and invasion by foreign organisms; it contains the peripheral endings of many sensory nerves; and it has limited excretory and absorbing powers. The skin also plays an important part in regulating body temperature. In addition, the skin is a waterproof covering that prevents excessive water loss, even in very dry climates.

SKIN STRUCTURE

The skin, or integument, consists of two layers, the epidermis and the dermis, and supporting structures and appendages (Fig. 6-10).

Epidermis

The epidermis is the outer skin layer (Fig. 6-10). It is made up of tough, flat, scale-like epithelial cells. Five sub-layers or strata of epidermal cells have been identified, and, listed from superficial to deep, they are the stratum corneum, stratum lucidum (not always present), stratum granulosum, stratum spinosum, and stratum basale.

Dermis

The dermis, or true skin, lies below the epidermis and gradually blends into the deeper tissues (Fig. 6-10). It is a wide area of connective tissue that contains blood vessels, nerve fibers, smooth muscles, and skin appendages.

BLOOD VESSELS.—The blood vessels of the dermis can dilate to contain a significant portion of the body's blood supply (Fig. 6-10). This ability, along with the actions of the sweat glands, forms the body's primary temperature-regulating mechanism. The constriction or dilation of these blood vessels also affects blood pressure and the volume of blood available to the internal organs.

NERVE FIBERS.—The skin contains two types of nerve fibers, motor and sensory, that carry impulses to and from the central nervous system (Fig. 6-10). The nerve fibers are distributed to the smooth muscles in the walls of the arteries in the dermis and to the smooth muscles around the sweat glands and hair roots. The motor nerve fiber carries impulses to the dermal muscles and glands, while the sensory type carries impulses from sensory receptors (i.e., detecting touch). Both nerve fibers send messages about the external environment to the brain.

SMOOTH MUSCLES.—Smooth involuntary muscles are found in the dermis. They are responsible for controlling the skin surface area. When dilated, these muscles allow for maximum skin surface exposure to aid heat loss. When constricted, the skin surface exposure is decreased, thus impeding heat radiation. Repeated muscle contractions (shivering) are also a rapid means of generating body heat.

Skin Appendages

The appendages of the skin are the nails, hairs, sebaceous glands, sweat glands, and ceruminous glands.
NAILS.—The nails are composed of horny epidermal scales and are found on the dorsal surfaces of the fingers and toes. They protect the many sensitive nerve endings at the ends of these digits. New formation of a nail will occur in the epithelium of the nail bed. As it is formed, the whole nail moves forward becoming longer.

HAIR.—Hair is an epithelial structure found on almost every part of the surface of the body (Fig. 6-10). Its color depends on the type of melanin present. The hair has two components: the root below the surface and the shaft projecting above the skin. The root is embedded in a pit-like depression called the hair follicle. Hair grows as a result of the division of the cells of the root. A small muscle, known as the arrector (Fig. 6-10), fastens to the side of the follicle and is responsible for the gooseflesh appearance (goose bumps) of the skin as a reaction to cold or fear. Each hair follicle is associated with two or more sebaceous glands.

SEBACEOUS GLANDS.—Sebaceous glands are found in most parts of the skin except in the soles of the feet and the palms of the hand (Fig. 6-10). Their ducts open most frequently into the hair follicles and secrete an oily substance that lubricates the skin and hair, keeping them soft and pliable and preventing bacterial invasion.

SWEAT GLANDS.—Sweat glands are found in almost every part of the skin (Fig. 6-10). They are a control mechanism to reduce the body's heat by evaporating water from its surface. The perspiration secreted is a combination of water, salts, amino acids, and urea. Normally, about one liter of this fluid is excreted daily. However, the amount varies with atmospheric temperature and humidity and the amount of exercise. When the outside temperature is high, or upon exercise, the glands secrete large amounts of perspiration to cool the body through evaporation. When evaporation does not remove all the sweat that has been excreted, the sweat collects in beads on the surface of the skin.

CERUMINOUS GLANDS.—Ceruminous glands are modified sweat glands found only in the auditory canal. They secrete a yellow waxy substance called cerumen that protects the eardrum.
Figure 6-10.—Diagram of skin structure. A, Thick skin, found on surfaces of the palms and soles of the feet. B, Thin skin, found on most surface areas of the body. In each diagram, the epidermis is raised at one corner to reveal the papillae of the dermis.

THE SKELETAL SYSTEM

LEARNING OBJECTIVE:

Identify the parts of bone and their functions.

The skeleton, the bony framework of the body, is composed of 206 bones (Figures 6-11A-C). It supports and gives shape to the body; protects vital organs; and provides sites of attachment for tendons, muscles, and ligaments. The skeletal bones are joined members that make muscle movement possible. It is important to understand the relationship of the bones and muscles as they work together to provide support and movement for the human body.

ANATOMY OF BONES

Osteology is the study of the structure of bone. Bone is made up of inorganic mineral salts (calcium and phosphorus being the most prevalent) and an organic substance called ossein. Inorganic mineral salts give bone its strength and hardness.

The bones of the human skeleton provide rigid support for muscles and skin, and serve to protect the easily injured organ systems of the body. Bone itself is a living, highly vascular tissue, which is made up of both inorganic (minerals) and organic (cells & connective tissue fiber) elements. The inorganic component of bone serves as a warehouse for calcium and phosphorous, two essential minerals for the body.

Bone consists of a hard outer shell, called compact bone, and an inner spongy, porous portion, called cancellous tissue (Fig. 6-12). In the center of the bone is the medullary canal, which contains marrow. There are two types of marrow, yellow and red. Yellow marrow is ordinary bone marrow in which fat cells predominate. It is found in the medullary canals and cancellous tissue of long bones. Red marrow is one of the manufacturing centers of red blood cells and is found in the articular ends of long bones and in cancellous tissue.

At the ends of the long bones is a smooth, glossy tissue that forms the joint surfaces. This tissue is called articular cartilage because it articulates (or joins) with, fits into, or moves in contact with similar surfaces of other bones. The thin outer membrane surrounding the bone is called the periosteum. An important function of the periosteum is to supply nourishment to the bone. Capillaries and blood vessels run through the periosteum and dip into the bone surface, supplying it with blood and nutrients. The periosteum is the pain center of the bone.
When a bone fractures, the pain that is felt comes from the periosteum, not the bone proper. Periosteum also forms new bone. The **diaphysis** is the elongated, cylindrical portion (or "shaft") of the bone that is between the **epiphyses** (sing. epiphysis) or ends of bone.

**BONE CLASSIFICATIONS**

Bones are classified according to their shape. The four bone classifications and examples of each are as follows:

- **Long bones**: Femur and humerus
- **Short bones**: Wrist and ankle bones
- **Flat bones**: Skull, sternum, and scapula
- **Irregular bones**: Vertebrae, mandible, and pelvic bones
DIVISIONS OF SKELETON

The human skeleton is divided into two main divisions, the axial skeleton and the appendicular skeleton.

Axial Skeleton

The axial skeleton consists of the skull, the vertebral column, and the thorax.

SKULL.—The skull consists of 28 bones (Figs. 6-13 and 6-14), 22 of which form the framework of the head and provide protection for the brain, eyes, and ears; six are ear bones. With the exception of the lower jaw bone and the ear bones, all skull bones are joined together and fixed in one position. The bones of the face are a complex framework that helps to form facial features, the upper jaw (maxilla) and lower jaw (mandible). With the exception of the mandible and the bones of the inner ear, all skull bones are joined together firmly along seams. The seams where they join are known as sutures. The bones of the skull are classified as either cranial or facial bones.

Cranial Bones. The cranium is formed by eight major bones, most of which are in pairs.

Frontal Bone. The frontal bone forms the front part of the skull above the eyes, which includes the forehead and part of the nasal cavity. In children, the frontal bone develops as two parts. They are usually fused together by age 5 or 6. The two frontal sinuses (air spaces in the bone) are located above each eye socket.

Parietal Bones. The two parietal bones are located behind the frontal bone. These bones form the greater part of the right and left sides and the roof of the skull. They each have four borders and are shaped like a curved plate.

Temporal Bones. The temporal bones form the sides and part of the base of the skull in the area of the ear. One temporal bone is located on each side. It is readily recognized as “fan-shaped.” Each encloses the internal ear structures and has depressions called glenoid fossae that form the articulation with the mandible. The zygomatic process of the temporal bone projects out into the zygomatic arch. Both the glenoid fossae and zygomatic process can be seen in Figure 6-14.

Occipital Bone. The occipital bone forms the back part of the skull and the base of the cranium. It joins with the parietal and temporal bones. In the center, underside (inferior) portion of the cranium, there is a large opening called the foramen magnum (Fig. 6-14), through which nerve fibers from the brain pass and enter into the spinal cord.
The ethmoid bone is situated in front of the sphenoid bone in the front part of the cranium (Fig. 6-13). Through small openings in this bone pass nerves to the roof of the mouth that are responsible for sense of smell.

Sphenoid Bone. The sphenoid bone is posterior to the ethmoid bone providing for the front base of the cranium and forming the floor and sides of the orbits (Fig. 6-13).
BONES OF THE FACE.—The facial skeleton consists of 14 stationary bones and a mobile lower jawbone (mandible). These 14 bones form the basic shape of the face, and are responsible for providing attachments for muscles that make the jaw move and control facial expressions. Figures 6-13 and 6-14 show the bones of the face.

The maxillary bones form the upper jaw, the anterior roof of the mouth, the floors of the orbits, and the sides and floor of the nasal cavity. The small holes on each side of the nasal opening are called the **infraorbital foramina** (sing. foramen). The maxillary bones contain large cavities called **maxillary sinuses**.

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Figure 6-14.—Skull viewed from the right side. (Courtesy Vidic B, Suarez FR: Photographic atlas of the human body, St Louis, 1984, Mosby.)

The **palatine bones** are L-shaped bones located behind the maxillary bones. They form the posterior section of the hard palate and the floor of the nasal cavity.

The **zygomatic bones** are responsible for the prominence of the cheeks. The zygomatic bones serve as part of the posterior section of the hard palate and the floor of the nasal cavity.

The **lacrimal bones** provide a pathway for a tube that carries tears from the eye to the nasal cavity. The lacrimal bone is a thin, scale-like structure located in the medial wall of each orbit.

The **nasal bones** have cartilaginous tissues attached to them. These tissues contribute significantly to the shape of the nose. The nasal bones are long, thin, and nearly rectangular in shape. They lie side by side and are fused together to form the bridge of the nose.

The **inferior nasal conchae** are curved, fragile, scroll-shaped bones that lie in the lateral walls of the nasal cavity. They provide support for mucous membranes within the nasal cavity.

The **vomer bone** is connected to the ethmoid bone, and together they form the nasal septum (the wall separating the two nasal cavities).

The **mandible** is horseshoe-shaped, with an upward sloping portion at each end called the ramus. The rami are divided into two different processes:

- **Condyloid process**—Also called mandibular condyle, located posterior on the ramus and forms the head of the mandible. It is knuckle-shaped, and articulates in the glenoid fossa of the temporal bone to form the temporal mandibular joint.

- **Coronoid process**—Located anterior of the condyle, and provides attachment for the temporal’s muscle, which helps lift the mandible to close the mouth.

Other important anatomical landmarks of the mandible that the HM should be able to recognize are as follows:

- **Alveolar process**—Supports the teeth of the mandibular arch.

- **Mental protuberance**—Also referred to as the chin and is located at the midline of the mandible.

- **Mental foramen**—Located on the facial surfaces of the mandible on both the right and left sides, just below the second premolars. This opening contains the mental nerve and blood vessels.

- **Body**—The heavy, horizontal portion of the mandible below the mental foramen extending to the angle.

- **Angle**—Juncture where the body of the mandible meets with the ramus.

- **Mandibular foramen**—Located near the center of each ramus on the medial side (inside), through this opening passes blood vessels and the interior alveolus nerve, which supply the roots of the mandibular teeth. This is a common area where the dental officer will inject anesthetic to block the nerve impulses and make the teeth on that side insensitive (numb).

**BONES OF THE EAR**

In each middle ear (Fig. 6-15) and located in the auditory ossicles are three small bones named the malleus (hammer), incus (anvil), and stapes (stirrup). Their function is to transmit and amplify vibrations to the ear drum and inner ear.
VERTEBRAL (SPINAL) COLUMN

The vertebral column consists of 24 movable or true vertebrae, the sacrum, and the coccyx or tail bone (Fig. 6-16). The vertebrae protect the spinal cord and the nerves that branch out from the spinal cord. Each vertebra has an anterior portion, called the body, which is the large solid segment of the bone. This vertebral body supports not only the spinal cord but other structures of the body as well. At the bottom of the spinal column are the sacrum and the coccyx. Many of the main muscles are attached to the vertebrae.

The vertebral foramen is a hole directly behind the body of the vertebrae that forms the passage for the spinal cord. The vertebral projections are for the attachments of muscles and ligaments and for facilitating movement of one vertebra over another. The spinal column is divided into five regions in the following order: cervical (neck), thoracic (chest), lumbar (lower back), and sacral and coccygeal (pelvis).

Cervical

There are seven cervical vertebrae in the neck. The first is called the atlas and resembles a bony ring. It supports the head. The second is the highly specialized axis. It has a bony prominence that fits into the ring of the atlas, thus permitting the head to rotate from side to side. The atlas and the axis are the only named vertebrae; all others are numbered (Fig. 6-16). Each cervical vertebra has a transverse (or intervertebral) foramen (Fig. 6-16A) to allow passage of nerves, the vertebral artery, and a vein. The seventh cervical vertebra has a prominent projection that can easily be felt at the bottom of the neck. This landmark makes it possible for physicians to count and identify the vertebrae above and below it.

Thoracic

There are 12 vertebrae in the thoracic region. The thoracic vertebrae articulate with the posterior portion of the 12 ribs to form the posterior wall of the thoracic region (chest) or rib cage.
Lumbar

There are five lumbar vertebrae. Located in the small of the back, these vertebrae are the larger and stronger segments of the vertebral column.

Sacrum

The sacrum is the triangular bone immediately below the lumbar vertebrae. It is composed of five separate vertebrae that gradually fuse together between 18 and 30 years of age. The sacrum is connected on each side with the hip bone and with the coccyx to form the posterior wall of the pelvis.

THORAX

This cone-shaped bony cage is about as wide as it is deep (Fig. 6-17). The thorax is formed by 12 ribs on each side and articulates posteriorly with the thoracic vertebrae. The first set of ribs are attached to the manubrium, a flat irregular bone atop the sternum. The first seven pairs of ribs are called true ribs. The remaining five pairs are called false ribs. They are called false ribs because their cartilages do not reach the sternum directly. The eighth, ninth, and tenth ribs are united by their cartilages and joined to the rib above. The last two rib pairs, also known as floating ribs, have no cartilaginous attachments to the sternum. The sternum is an elongated flat bone, forming the middle portion of the upper half of the chest wall in front. The xiphoid process, located at the inferior aspect of the sternum.
APPENDICULAR SKELETON

The appendicular skeleton consists of the bones of the upper and lower extremities.

Upper Extremity

The upper extremity consists of the bones of the shoulder, arm, forearm, wrist, and hand.

Clavicle. The clavicle (commonly called the “collar bone”) lies nearly horizontally above the first rib and is shaped like a flat letter S. The clavicle is a thin brace bone that fractures easily. Its inner end is round and attached to the sternum; its outer end is flattened and fixed to the scapula.

The clavicle forms the anterior portion of the pectoral girdle (Fig. 6-18). The pectoral girdle is composed of the two clavicles and two scapulae (shoulder blades). It functions as a support for the arms and serves as an attachment for several muscles.

Scapula. The scapula is a triangular bone that lies in the upper part of the back on both sides, between the second and seventh ribs, forming the posterior portion of the pectoral girdle (Fig. 6-18). Its lateral corner forms part of the shoulder joint, articulating with the humerus.

Figure 6-17.—Thoracic cage. Note the costal cartilages and their articulations with the body of the sternum.
Figure 6-18.— Right scapula. A, Anterior view. B, Posterior view. C, Lateral view. D, Posterior view showing articulation of the right scapula with the clavicle. (The inset shows the relative position of the right scapula within the entire skeleton.) (D: Courtesy Vidic B, Suarez FR: Photographic atlas of the human body, St Louis, 1984, Mosby.)

**Humerus.** The humerus is the longest bone of the upper extremity and is often called the arm bone (Fig. 6-19). It articulates with the pectoral girdle to form the shoulder joint, and with the bones of the forearm to form the elbow. Its anatomical portions include a head (a rounded portion that fits into a recess of the scapula) called the *glenoid fossa*; the **shaft**, which is the main part of the humerus; and the **distal end**, which includes the prominence (called an **epicondyle**) and these surfaces articulate with the bones of the forearm.

**Radius and Ulna.** When the arm is in the anatomical position with the palm turned forward, the **radius** is on the lateral (thumb) side and the **ulna** is on the medial (little finger) side of the forearm (Fig. 6-19). When the hand is pronated (with the palm turned downward), the bones rotate on each other and cross in the middle. This pronation makes it possible to turn the wrist and hand (as when opening doors). The ulna and the radius articulate at their proximal ends with the humerus, at their distal ends with some of the carpal bones, and with each other at both ends.

**Carpal.** There are eight carpal bones, arranged in two rows, forming the wrist (Figure 6-20).

**Metacarpal.** The metacarpal bones are numbered one to five, corresponding with the five fingers, or digits, with which they articulate. The fingers are named as follows: 1st thumb; 2nd index; 3rd middle; 4th ring; and 5th little (Fig. 6-20).

**Phalanges.** The small bones of the fingers are called phalanges and each one of these bones is called a **phalanx**. Each finger has three phalanges, except the thumb (which has two). The phalanges are named for their anatomical position: The proximal phalanx is the bone closest to the hand; the distal phalanx is the bone at the end of the finger; and the middle phalanx is the bone located between the proximal and distal phalanges (Fig. 6-20).
Lower Extremity

The lower extremity includes the bones of the hip, thigh, leg, ankle, and foot. The bones that form the framework of the lower extremities are listed in Table 6-1.

Innominate. The innominate bone, commonly known as the hip, is a large, irregularly shaped bone composed of three parts: the ilium, ischium, and pubis (Fig. 6-21). In children these three parts are separate bones, but in adults they are firmly united to form a cuplike structure, called the acetabulum, into which the head of the femur fits.

<table>
<thead>
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<th>BONE COMMON NAME</th>
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<td>foot bones</td>
</tr>
<tr>
<td>phalanges</td>
<td>toe bones</td>
</tr>
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Table 6-1.—Bones of the Lower Extremity
The ilium forms the outer prominence of the hip bone (the crest of the ilium, referred to as the iliac crest, provides an anatomical landmark above the ilium); the ischium forms the hard lower part; and the pubis forms the front part of the pelvis.

**Symphysis Pubis.** The area where the two pubic bones meet is called the symphysis pubis and is often used in anatomical measurements. The largest foramen, or opening, is located in the hip bone, between the ischium and the pubis, and is called the obturator foramen (Fig. 6-21).

The crest of the ilium is used in making anatomical and surgical measurements (e.g., location of the appendix, which is approximately halfway between the crest of the ilium and the umbilicus).

**Femur.** The femur, or thigh bone, is the longest bone in the body (Fig. 6-22). The proximal end is rounded and has a head supported by a constricted neck that fits into the acetabulum. Two processes called the greater and lesser trochanters are at the proximal end for the attachment of muscles.
The neck of the femur, located between the head and the trochanters, is the site on the femur most frequently fractured. At the distal end are two bony prominences, called the lateral and medial condyles, which articulate with the tibia and the patella.

**Patella.** The patella is a small oval-shaped bone overlying the knee joint. It is enclosed within the tendon of the quadriceps muscle of the thigh. Bones like the patella that develop within a tendon are known as sesamoid bones (Fig. 6-22D).

![Figure 6-22.— Bones of the thigh and leg. A, Right femur, anterior surface. B, Right femur, posterior view. C, Right tibia and fibula, anterior surface. D, Anterior aspect of the right knee skeleton. E, Right tibia and fibula, posterior aspect. (The inset shows the relative position of the bones of the thigh and leg within the entire skeleton.) (D-E: Courtesy Vidic B, Suarez FR: Photographic atlas of the human body, St Louis, 1984, Mosby.)](image-url)
Tibia. The tibia, or shin bone, is the larger of the two leg bones and lies at the medial side. The proximal end articulates with the femur and the fibula. Its distal end articulates with the talus (one of the foot bones) and the fibula (Fig. 6-22C). A prominence easily felt on the inner aspect of the ankle is called the medial malleolus.

Fibula. The fibula, the smaller of the two leg bones, is located on the lateral side of the leg, parallel to the tibia (Fig. 6-22C). The prominence at the distal end forms the outer ankle and is known as the lateral malleolus.

Tarsus. The tarsus, or ankle, is formed by seven tarsal bones: medial cuneiform, intermediate cuneiform, lateral cuneiform, cuboid, navicular, talus, and calcaneus. The strongest of these is the heel bone, or the calcaneus (Fig. 6-23).

Metatarsus. The sole and instep of the foot is called the metatarsus and is made up of five metatarsal bones (Fig. 6-23). They are similar in arrangement to the metacarpals of the hand.

Phalanges. The phalanges are the bones of the toes and are similar in number, structure, and arrangement to the bones of the fingers (Fig. 6-23).

Figure 6-23.— The foot. A, Bones of the right foot viewed from above. The tarsal bones consist of the cuneiforms, navicular, talus, cuboid, and calcaneus. B, Posterior aspect of the right ankle skeleton and inferior aspect of the right foot skeleton. C, X-ray film of the left foot showing prominent sesamoid bones (arrows) near the distal end (head) of the first metatarsal bone of the great toe. (B: Courtesy Vidic B, Suarez FR: Photographic atlas of the human body, St Louis, 1984, Mosby.)

JOINTS

LEARNING OBJECTIVES:

Identify joint classifications.

Identify joint movements for the key joints in the body.

Wherever two or more bones meet a joint is formed. A joint binds various parts of the skeletal system together and enables body parts to move in response to skeletal muscle contractions.

JOINT CLASSIFICATIONS

Joints are classified according to the amount of movement they permit. Joint classifications are as follows (Fig. 6-24):

Immovable (synarthroses)

Bones of the skull are an example of an immovable joint. Immovable joints are characterized by the bones being in close contact with each other and little or no movement occurring between the bones.

Slightly movable (amphiarthroses)

In slightly movable joints, the bones are held together by broad flattened disks of cartilage and ligaments (e.g., vertebrae and symphysis pubis).

Figure 6-24.—Joint Classifications
Freely movable (diarthroses)

Most joints in the body are freely movable joints. The joint consists of the joint capsule, articular cartilage, synovial membrane, and synovial (joint) cavity. There are six classifications of freely movable joints: ball-in-socket, condyloid, gliding, hinge, pivot, and saddle joints (Fig. 6-25). These joints have much more complex structures than the immovable and slightly movable joints. The ends of the bones in this type of joint are covered with a smooth layer of cartilage.

The whole joint is enclosed in a watertight sac or membrane containing a small amount of lubricating fluid. This lubrication enables the joint to work with little friction. Ligaments (cords or sheets of connective tissue) reach across the joints from one bone to another and keep the bone stable. When ligaments are torn, the injury is called a sprain. When bones are out of place, it is called a dislocation. When bones are chipped or broken, the injury is called a fracture.

Figure 6-25.—Types of synovial joints. Uniaxial: A, hinge, and B, pivot. Biaxial: C, saddle, and D, condyloid. Multiaxial: E, ball and socket, and F, gliding.

TYPES OF JOINT MOVEMENTS

Joint movements are generally divided into four types: gliding, angular, rotation, and circumduction (Table 6-2).

Gliding

Gliding is the simplest type of motion. It is one surface moving over another without any rotary or angular motion. This motion exists between two adjacent surfaces.

Angular

Angular motion decreases or increases the angle between two adjoining bones. The more common types of angular motion are as follows:

- **Flexion**: Bending the arm or leg.
- **Extension**: Straightening or unbending, as in straightening the forearm, leg, or fingers.
- **Abduction**: Moving an extremity away from the body.
- **Adduction**: Bringing an extremity toward the body.
- **Rotation**: A movement in which the bone moves around a central point without being displaced, such as turning the head from side to side.
- **Circumduction**: The movement of the hips and shoulders.

Other Types of Movement

- **Supination**: Turning upward, as in placing the palm of the hand up.
- **Pronation**: Turning downward, as in placing the palm of the hand down or placing sole of the foot to the outside.
- **Inversion**: Turning inward, as in turning the sole of the foot inward.
- **Eversion**: Turning outward, as in turning the sole of the foot outward.
<table>
<thead>
<tr>
<th>NAME</th>
<th>ARTICULATING BONES</th>
<th>TYPE</th>
<th>MOVEMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atlantoaxial</td>
<td>Anterior arch of the atlas rotates about the dens of the axis (epistropheus)</td>
<td>Synovial (pivot)</td>
<td>Pivoting or partial rotation of the head</td>
</tr>
<tr>
<td>Vertebral</td>
<td>Between bodies of vertebrae</td>
<td>Cartilaginous (sympyeses)</td>
<td>Slight movement between any two vertebrae but considerable mobility for the column as a whole</td>
</tr>
<tr>
<td></td>
<td>Between articular processes</td>
<td>Synovial (gliding)</td>
<td>Gilding</td>
</tr>
<tr>
<td>Sternohyoides</td>
<td>Medial end of the clavicle with the manubrium of the sternum</td>
<td>Synovial (gliding)</td>
<td>Gilding</td>
</tr>
<tr>
<td>Acromioclavicular</td>
<td>Distal end of the clavicle with the acromion of the scapula</td>
<td>Synovial (gliding)</td>
<td>Gilding; elevation, depression, protraction, and retraction</td>
</tr>
<tr>
<td>Thoracic</td>
<td>Heads of ribs with bodies of vertebrae</td>
<td>Synovial (gliding)</td>
<td>Gilding</td>
</tr>
<tr>
<td></td>
<td>Tubercles of ribs with transverse processes of vertebrae</td>
<td>Synovial (gliding)</td>
<td>Gilding</td>
</tr>
<tr>
<td>Shoulder</td>
<td>Head of the humerus in the glenoid cavity of the scapula</td>
<td>Synovial (ball and socket)</td>
<td>Flexion, extension, abduction, adduction, rotation, and circumduction of the upper part of the arm</td>
</tr>
<tr>
<td>Elbow</td>
<td>Trochlea of the humerus with the semilunar notch of the ulna; head of the radius with the capitulum of the humerus</td>
<td>Synovial (hinge)</td>
<td>Flexion and extension</td>
</tr>
<tr>
<td></td>
<td>Head of the radius in the radial notch of the ulna</td>
<td>Synovial (pivot)</td>
<td>Supination and pronation of the lower part of the arm and hand; rotation of the lower part of the arm on the upper extremity</td>
</tr>
<tr>
<td>Wrist</td>
<td>Scaphoid, lunate, and triquetal bones articulate with the radius and articular disk</td>
<td>Synovial (condyloid)</td>
<td>Flexion, extension, abduction, and adduction of the hand</td>
</tr>
<tr>
<td>Carpal</td>
<td>Between various carpal bones</td>
<td>Synovial (gliding)</td>
<td>Gilding</td>
</tr>
<tr>
<td>Hand</td>
<td>Proximal end of the first metacarpal bone with the trapezium</td>
<td>Synovial (saddle)</td>
<td>Flexion, extension, abduction, adduction, and circumduction of the thumb and opposition to the fingers</td>
</tr>
<tr>
<td></td>
<td>Distal end of the metacarpal bones with the proximal end of the phalanges</td>
<td>Synovial (hinge)</td>
<td>Flexion, extension, limited abduction, and adduction of the fingers</td>
</tr>
<tr>
<td></td>
<td>Between phalanges</td>
<td>Synovial (hinge)</td>
<td>Flexion and extension of finger sections</td>
</tr>
<tr>
<td>Sacroiliac</td>
<td>Between the sacrum and two ilia</td>
<td>Synovial (gliding)</td>
<td>None or slight</td>
</tr>
<tr>
<td>Pubic symphysis</td>
<td>Between two pubic bones</td>
<td>Cartilaginous (symphysis)</td>
<td>Slight, particularly during pregnancy and delivery</td>
</tr>
<tr>
<td>Hip</td>
<td>Head of the femur in the acetabulum of the coxal bone</td>
<td>Synovial (ball and socket)</td>
<td>Flexion, extension, abduction, adduction, rotation, and circumduction</td>
</tr>
<tr>
<td>Knee</td>
<td>Between the distal end of the femur and proximal end of the tibia</td>
<td>Synovial (hinge)</td>
<td>Flexion and extension; slight rotation of the tibia</td>
</tr>
<tr>
<td>Tibiofibular (proximal)</td>
<td>Head of the fibula with the lateral condyle of the tibia</td>
<td>Synovial (gliding)</td>
<td>Gilding</td>
</tr>
<tr>
<td>Ankle</td>
<td>Distal end of the tibia and fibula with the talar</td>
<td>Synovial (hinge)</td>
<td>Flexion (dorsiflexion) and extension (plantar flexion)</td>
</tr>
<tr>
<td>Foot</td>
<td>Between tarsal bones</td>
<td>Synovial (gliding)</td>
<td>Gilding; inversion and eversion</td>
</tr>
<tr>
<td></td>
<td>Between metatarsal bones and phalanges</td>
<td>Synovial (hinge)</td>
<td>Flexion, extension, slight abduction, and adduction</td>
</tr>
<tr>
<td></td>
<td>Between phalanges</td>
<td>Synovial (hinge)</td>
<td>Flexion and extension</td>
</tr>
</tbody>
</table>

Table 6-2.—Synovial Joints.

TEMPORAL MANDIBULAR JOINT

The right and left temporal mandibular joints (TMJs) are formed by the articulation of the temporal bone and the mandible. This is where TMJs connect with the rest of the skull. Figure 6-26 illustrates the TMJ.

The mandible is joined to the cranium by ligaments of the temporal mandibular joint.

The TMJ consists of three bony parts:

- **Glenoid fossa**: Oval depression in the temporal bone that articulates with the mandibular condyle.

- **Articular eminence**: Ramp-shaped segment of the temporal bone located anterior to the glenoid fossa.

- **Condyle**: The knuckle-shaped portion of the mandibular ramus found on the end of the condyloid process. It is positioned underneath the glenoid fossa and makes up the hinge joint of the TMJ.

MUSCLES

**LEARNING OBJECTIVES:**

- Identify primary muscle functions.
- Identify muscle characteristics.
- Identify types of muscle tissue.
- Identify important functional muscles.

Muscles are responsible for many different types of body movements. The action of the muscle is determined mainly by the kind of joint it is associated with and the way the muscle is attached to the joint. At one end of some muscles are long white **tendons** that attach the muscles to bone. The point of fixed attachment of a muscle to bone is called the **origin**. The more flexible attachments, especially attachments to a movable bone, are termed **insertions**.

Muscles seldom act alone; they usually work in groups held together by sheets of a white fibrous tissue called **fascia**. Muscles make up about one-half of the total body weight. Their main functions are threefold:

- **Providing movement** including internal functions such as peristalsis (rhythmic waves of muscular contraction within the intestines)

- **Maintaining body posture** through muscle tone, as in the muscles of the head, neck and shoulders, which keep the head up

- **Providing heat** through chemical changes that take place during muscle activity, such as exercise that warms the body

- In addition, muscles are involved in such essential bodily functions as respiration, blood circulation, digestion, and other functions such as speaking and seeing
MUSCLE CONTRACTION

Muscle tissue has a highly developed ability to contract. **Contractibility** enables a muscle to become shorter or thicker, and this ability, along with interaction with other muscles, produces movement of internal and external body parts. Muscle contraction in a tissue or organ produces motion and provides power and speed for body activity. A contracting muscle is referred to as a prime mover. A muscle that is relaxing while a prime mover is contracting is called the antagonist.

STIMULUS FOR CONTRACTION

All muscles respond to stimulus. This property is called **excitability** or **irritability**. The mechanical muscular action of shortening or thickening (also called contraction) is activated by a stimulus sent through a motor nerve. All muscles are linked to nerve fibers that carry messages from the central nervous system.

CONTRACTION AND RECOVERY

The chemical action of muscle fibers consists of two stages, **contraction** and **recovery**. In the contraction stage, two protein substances (actin and myosin) react to provide energy through the breakdown of glycogen into lactic acid. In the recovery stage, oxygen reacts with lactic acid to release carbon dioxide and water.

MUSCLE FATIGUE

When a muscle contracts, it produces chemical waste products (carbon dioxide, lactic acid, and acid phosphate) which make the muscle more irritable. If contraction is continued, the muscle will cramp and refuse to move. This condition is known as **fatigue**. If it is carried too far, the muscle cells will not recover and permanent damage will result. Muscles, therefore, need rest to allow the blood to carry away the waste materials and bring in fresh glucose, oxygen, and protein to restore the muscle protoplasm and the energy that was used.

TONICITY

Tonicity, or muscular tone, is a continual state of partial contraction that gives the muscle firmness. **Isometric** muscle contraction occurs when the muscle is stimulated and shortens, but no movement occurs, as when a person tenses his or her muscles against an immovable object. **Isotonic** muscle contraction occurs when the muscle is stimulated. The muscle shortens and movement occurs. An example would be lifting an object.

EXTENSIBILITY AND ELASTICITY

Muscles are also capable of stretching when force is applied (**extensibility**) and regaining their original form when that force is removed (**elasticity**).

MAINTENANCE OF MUSCLE TISSUE

During exercise, massage, or ordinary activities, the blood supply of muscles is increased. This additional blood brings in fresh nutritional material, carries away waste products more rapidly, and enables the muscles to build up and restore their efficiency and tone. The importance of exercise for normal muscle activity is clear, but excessive muscle strain is damaging. For example, if a gasoline motor stands idle, it eventually becomes rusty and useless. Similarly, a muscle cell that does not work atrophies, becoming weak and decreasing in size. On the other hand, a motor that is never allowed to stop and is forced to run too fast or to do too much heavy work soon wears out so that it cannot be repaired. In the same way, a muscle cell that is forced to work too hard without proper rest will be damaged beyond repair.

When a muscle dies, it becomes solid and rigid and no longer reacts. This stiffening, which occurs from 10 minutes to several hours after death, is called **rigor mortis**.
MUSCLE TISSUES

There are three types of muscle tissue: skeletal, smooth, and cardiac. Each is designed to perform a specific function.

Skeletal

Skeletal, or striated, muscle tissues are attached to the bones and give shape to the body. They are responsible for allowing body movement. This type of muscle is sometimes referred to as striated because of the striped appearance of the muscle fibers under a microscope (Figs. 6-27 and 6-28). They are also called voluntary muscles because they are under the control of a person’s conscious will.

Smooth

Smooth, or non-striated, muscle tissues are found in the walls of the stomach, intestines, urinary bladder, and blood vessels, as well as in the duct glands and in the skin. Under a microscope, the smooth muscle fiber lacks the striped appearance of other muscle tissue. This tissue is also called involuntary muscle because it is not under conscious control.

Cardiac

The cardiac muscle tissue forms the bulk of the walls and septa (or partitions) of the heart, as well as the origins of the large blood vessels. The fibers of the cardiac muscle differ from those of the skeletal and smooth muscles in that they are shorter and branch into a complicated network (Fig. 6-8). The cardiac muscle has the most abundant blood supply of any muscle in the body, receiving twice the blood flow of the highly vascular skeletal muscles. Cardiac muscles contract to pump blood out of the heart and through the cardiovascular system. Interference with the blood supply to the heart can result in a heart attack.

MAJOR SKELETAL MUSCLES

In the following section, the location, actions, origins, and insertions of some of the major skeletal muscles are covered. In Figures 6-27 and 6-28 the superficial skeletal muscles are illustrated. Also note, the names of some of the muscles provides clues to their location, shape, and number of attachments.
Figure 6-27.—Anterior View of Superficial Skeletal Muscles

Figure 6-28.—Posterior View of Superficial Skeletal Muscles
MUSCLES OF THE HEAD

The muscles of the head can be classified into two groups, muscles of facial expression and muscles of mastication. How muscles work and function depends on the action of each muscle (movement), the type of joint it is associated with, and the way the muscle is attached on either side of the joint. Muscles are usually attached to two places: one end being joined to an immovable or fixed portion, and the other end being joined to a movable portion on the other side of a joint. The immovable portion is called the origin of the muscle, and the movable portion is called the insertion. When muscles of the head contract, the insertion end is pulled toward the origin.

MUSCLES OF FACIAL EXPRESSION

The muscles underneath the skin of the face are responsible for helping communicate feelings through facial expression. The muscles of the mouth express surprise, sadness, anger, fear, and pain. Table 6-3 lists the muscles of facial expression and Figure 6-27 illustrates these muscles.

MUSCLES OF MASTICATION

Mastication is defined as the process of chewing food in preparation for swallowing and digestion. Four pairs of muscles in the mandible make chewing movements possible. These muscles can be grouped into two different functions. The first group includes three pairs of muscles that elevate the mandible to close the mouth as in biting down. The last group includes one pair that can depress the mandible (open the mouth), make grinding actions side to side, and can make the mandible go forward in a protruding motion. Table 6-4 lists the muscles of mastication and Figure 6-27 illustrates these muscles.

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Origin</th>
<th>Insertion</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orbicularis oris</td>
<td>Encircles the mouth (no attachment to bone)</td>
<td>Corners of the mouth</td>
<td>Located between the skin and mucous membranes of the lips. Makes lips close and pucker.</td>
</tr>
<tr>
<td>Buccinator</td>
<td>Alveolar process of maxilla and mandible</td>
<td>Orbicularis oris at the corner of the mouth</td>
<td>Located in the walls of the cheeks, holds food in contact with teeth when chewing, and assists in blowing air out of the mouth.</td>
</tr>
<tr>
<td>Mentalis</td>
<td>Mandible</td>
<td>Skin of chin</td>
<td>Raises and wrinkles the skin of the chin and decreases and protrudes the lower lip.</td>
</tr>
<tr>
<td>Zygomaticus Major</td>
<td>Zygomatic bone</td>
<td>Orbicularis oris (angle of the mouth)</td>
<td>Raises the corner of the mouth when smiling.</td>
</tr>
</tbody>
</table>

Table 6-3.—Muscles of Facial Expression

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Origin</th>
<th>Insertion</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Masseter</td>
<td>Zygomatic arch</td>
<td>Mandible (external surface)</td>
<td>Closes jaw; flat, thick muscle</td>
</tr>
<tr>
<td>Temporalis</td>
<td>Temporal bone</td>
<td>Coronoid process at the anterior border of the ramus</td>
<td>Closes jaw; fan-shaped</td>
</tr>
<tr>
<td>Medial pterygoid</td>
<td>Sphenoid, palatine, and maxillary bones</td>
<td>Inner (medial) surface of the ramus</td>
<td>Closes jaw; parallels masseter muscle</td>
</tr>
<tr>
<td>Lateral pterygoid</td>
<td>Sphenoid bone</td>
<td>Anterior surface of mandibular condyle</td>
<td>Opens jaw; allows grinding action side to side, and protrudes the mandible</td>
</tr>
</tbody>
</table>

Table 6-4.—Muscles of Mastication
CHEEKS

The cheeks are the side walls of the mouth. They are made up of layers of skin, a moist inner lining called mucosa, fat tissue, and certain muscles. The buccinator muscle of the cheeks prevents food from escaping the chewing action of the teeth.

LIPS

The lips are covered externally by skin and internally by the same mucous membranes that line the oral cavity. They form the anterior border of the mouth. The area of the external lips where the red mucous membrane ends and normal outside skin of the face begins is known as the vermilion border. Figure 6-29 illustrates the anatomy of the lips.

The lips are very sensitive and act as sensory receptors, allowing food and liquids to be placed in the mouth but guarding the oral cavity against the ingestion of excessively hot or cold substances. They also provide a seal for the mouth to keep food and saliva from escaping. The lips help to maintain the position of the teeth and are very important in speech.

TONGUE

The tongue (Fig. 6-30) is a vascular, thick solid mass of voluntary muscle surrounded by a mucous membrane (epithelium tissue). Located on the underneath side of the tongue is the lingual frenulum, which anchors the tongue in the midline to the floor of the mouth. The tip of the tongue is free moving and can readily change size, shape, and position.
Surface (Dorsal Aspect)

On the surface of the tongue are rough projections called papillae. They provide the tongue with friction in handling food and also act as taste buds.

Taste Buds

The four types of taste sensations are sweet, sour, bitter, and salty—all resulting from stimulation of the taste buds. Most are located on the tongue and the roof of the mouth. Figure 6-31 illustrates taste buds of the tongue.

Figure 6-31.—Taste Buds of the Tongue

Tongue and Digestion

The tongue is an important muscle in the chewing process. It crushes food against the palate; it deposits food between the chewing surfaces of the teeth for mastication; it transfers food from one area of the mouth to another; it mixes food with saliva, which assists in the digestive process; assists in swallowing; and cleans the mouth of residue.

MYLOHYOID AND GENIOHYOID

The mylohyoid muscles anatomically and functionally form the floor of the mouth (Fig. 6-30). They elevate the tongue and depress the mandible. Their origin is the mandible and insertion is the upper border of the hyoid bone. The geniohyoid muscles are found next to each other, on each side of the midline, directly on top of the mylohyoid muscle, and have the same origin and function as the mylohyoid muscle.
PALATE

The palate (Fig. 6-32) forms the roof of the mouth and is divided into two sections:

- **Hard palate**: This section is formed by the palatine process of the maxillary bones and is located in the anterior portion of the roof of the mouth. It has irregular ridges or folds behind the central incisors called rugae.

- **Soft palate**: This section forms a soft muscular arch in the posterior part of the palate. The uvula is located on the back portion of the soft palate. When swallowing, the uvula is drawn upward and backward by the muscles of the soft palate. This process blocks the opening between the nasal cavity and pharynx, not allowing food to enter the nasal cavity. The soft palate must function properly to allow good speech quality.

Located in the posterior part of the mouth, on both sides of the tongue, are two masses of lymphatic tissue called the palatine tonsils. They assist the body to protect against infections.

Figure 6-32.—Anatomy of the Palate


TEETH

The teeth are located in the alveolar process of the maxillae and the mandible. They serve important functions of tearing and masticating food, assisting in swallowing, speaking, and in appearance. The health of the teeth affects the health of the entire body.

SALIVARY GLANDS

The functions of the three major salivary glands are to keep the lining of the mouth moist and to bond with food particles creating a lubricant effect that assists in the swallowing process of food. They act as a cleaning agent to wash away food particles that accumulate in the mouth and on the teeth. Figure 6-33 illustrates the salivary glands.

The salivary glands produce two to three pints of saliva daily, which greatly aids in the digestion process. Enzymes are present in saliva; they act on food, and start the breakdown process. In dentistry, knowing exactly where the saliva glands and ducts (openings) are located is important in keeping the mouth dry during certain dental procedures. Table 6-5 lists the three major salivary glands.

Figure 6-33.—Salivary Glands

Mastication and deglutition

The mastication process includes the biting and tearing of food into manageable pieces. This usually involves using the incisors and cuspid teeth. The grinding of food is usually performed by the molars and premolars. During the mastication process, food is moistened and mixed with saliva.

Deglutition is the swallowing of food and involves a complex and coordinated process. It is divided into three phases; the first phase of swallowing is voluntarily; phases two and three are involuntary.

- **Phase One:** The collection and swallowing of masticated food.
- **Phase Two:** Passage of food through the pharynx into the beginning of the esophagus.
- **Phase Three:** The passage of food into the stomach.

<table>
<thead>
<tr>
<th>Gland</th>
<th>Location</th>
<th>Duct</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sublingual</td>
<td>On each side underneath the tongue, in the floor of the mouth</td>
<td>Multiple separate ducts</td>
<td>Smallest of salivary glands, secretes, thick stringy mucus.</td>
</tr>
<tr>
<td>Submandibular</td>
<td>Posterior portion of mandible, lingual to mandibular incisors</td>
<td>Opens under the tongue, close to the frenulum</td>
<td>Walnut sized. Secretes watery fluid with some mucus. More viscous (thick) than parotid secretion.</td>
</tr>
<tr>
<td>Parotid</td>
<td>Inside cheek, opposite maxillary second molar</td>
<td>Parotid ducts go through the buccinator muscles and enter the mouth opposite maxillary second molars</td>
<td>Largest of salivary glands. Secretes clear watery fluid.</td>
</tr>
</tbody>
</table>

Table 6-5.—Major Salivary Glands

**Temporalis**

The temporalis muscle is a fan-shaped muscle located on the side of the skull, above and in front of the ear. This muscle's fibers assist in raising the jaw and pass downward beneath the zygomatic arch to the mandible (Fig. 6-27). The temporalis muscle's origin is the temporal bone. It is inserted in the coronoid process (a prominence of bone) of the mandible.

**Sternocleidomastoid**

The sternocleidomastoid muscles are located on both sides of the neck. Acting individually, these muscles rotate the head left or right (Figs. 6-27 and 6-28). ACTING TOGETHER, they bend the head forward toward the chest. The sternocleidomastoid muscle originates in the sternum and clavicle and is inserted in the mastoid process of the temporal bone. When this muscle becomes damaged, the result is a common condition known as a “stiff neck.”
Trapezius

The trapezius muscles are a broad, trapezium-shaped pair of muscles on the upper back, which raise or lower the shoulders (Figs. 6-27 and 6-28). They cover approximately one-third of the back. They originate in a large area which includes the 12 thoracic vertebrae, the seventh cervical vertebra, and the occipital bone. They have their insertion in the clavicle and scapula.

Pectoralis Major

The pectoralis major is the large triangular muscle that forms the prominent chest muscle (Fig. 6-27). It rotates the arm inward, pulls a raised arm down toward the chest, and draws the arm across the chest. It originates in the clavicle, sternum, and cartilages of the true ribs, and the external oblique muscle. Its insertion is in the greater tubercle of the humerus.

Deltoid

The deltoid muscle raises the arm and has its origin in the clavicle and the spine of the scapula (Figs. 6-27 and 6-28). Its insertion is on the lateral side of the humerus. It fits like a cap over the shoulder and is a frequent site of intramuscular injections.

Biceps Brachii

The biceps brachii is the prominent muscle on the anterior surface of the upper arm (Fig. 6-27). Its origin is in the outer edge of the glenoid cavity, and its insertion is in the tuberosity of the radius. This muscle rotates the forearm outward (supination) and, with the aid of the brachial muscle, flexes the forearm at the elbow.

Triceps Brachii

The triceps brachii is the primary extensor of the forearm (the antagonist of the biceps brachii) (Fig. 6-28). It originates at two points on the humerus and one on the scapula. These three heads join to form the large muscle on the posterior surface of the upper arm. The point of insertion is the olecranon process of the ulna.

Latissimus Dorsi

The latissimus dorsi is a broad, flat muscle that covers approximately one-third of the back on each side (Figs. 6-27 and 6-28). It rotates the arm inward and draws the arm down and back. It originates from the upper thoracic vertebrae to the sacrum and the posterior portion of the crest of the ilium. Its fibers converge to form a flat tendon that has its insertion in the humerus.

Gluteus

The gluteus (maximus, medius, and minimus—not shown), are the large muscles of the buttocks, which extend and laterally rotate the thigh, as well as abduct and medially rotate it (Fig. 6-28). They arise from the ilium, the posterior surface of the lower sacrum, and the side of the coccyx. Their points of insertion include the greater trochanter and the gluteal tuberosity of the femur. The gluteus maximus is the site of choice for intramuscular injections.
Quadriceps

The quadriceps is a group of four muscles that make up the anterior portion of the thigh. The four muscles of this group are the rectus femoris that originates at the ilium; and the vastus (v.) lateralis, v. medialis, v. intermedius (not shown), that originate along the femur (Fig. 6-27). All four are inserted into the tuberosity of the tibia through a tendon passing over the knee joint. The quadriceps serves as a strong extensor of the leg at the knee and flexes the thigh. Additionally located in the quadriceps area is the adductor longus that adducts, rotates, and flexes the thigh.

Biceps Femoris

The biceps femoris (often called the hamstring muscle) originates at the tuberosity of the ischium (the lowest portion of the innominate or coxal bone, part of the pelvic girdle) and the middle third of the femur (Fig. 6-28). It is inserted on the head of the fibula and the lateral condyle of the tibia. It acts, along with other related muscles, to flex the leg at the knee and to extend the thigh at the hip joint.

Gracilis

The gracilis is a long slender muscle located on the inner aspect of the thigh (Figs. 6-27 and 6-28). It adducts the thigh, and flexes and medially rotates the leg. Its origin is in the symphysis pubis, and its insertion is in the medial surface of the tibia, below the condyle.

Sartorius

The sartorius is the longest muscle in the body. It extends diagonally across the front of the thigh from its origin at the ilium, down to its insertion near the tuberosity of the tibia (Fig. 6-28). Its function is to flex the thigh and rotate it laterally, and to flex the leg and rotate it slightly medially.

Gastrocnemius and Soleus

The gastrocnemius and soleus (together commonly called the calf muscles) extend the foot at the ankle (Figs. 6-27 and 6-28). The gastrocnemius originates at two points on the femur; the soleus originates at the head of the fibula and the medial border of the tibia. Both are inserted in a common tendon called the calcaneus, or Achilles tendon.

Tibialis Anterior

The tibialis anterior originates at the upper half of the tibia and inserts at the first metatarsal and cuneiform bones (Fig. 6-27). It flexes the foot.

Diaphragm

The diaphragm (not shown) is an internal (as opposed to superficial) muscle that forms the floor of the thoracic cavity and the ceiling of the abdominal cavity. It is the primary muscle of respiration, modifying the size of the thorax and abdomen vertically. It has three openings for the passage of nerves and blood vessels.
THE CIRCULATORY SYSTEM

LEARNING OBJECTIVES:

Identify the parts of the circulatory system.

Explain the major components and functions of the circulatory system.

The circulatory system called the **vascular system** consists of blood, heart, and blood vessels. The circulatory system is close circuited (i.e., there is no opening to external environment of the body). The function of this system is to move blood between the cells and the organs of the integumentary, digestive, respiratory, and urinary systems that communicate with the external environment of the body. This function is facilitated by the heart pumping blood through blood vessels. The blood travels throughout the body transporting nutrients and wastes, and permitting the exchange of gases (carbon dioxide and oxygen).

**BLOOD**

Blood is fluid tissue composed of formed elements (i.e. cells) suspended in plasma. It is pumped by the heart through arteries, capillaries, and veins to all parts of the body. Total blood volume of the average adult is 5 to 6 liters.

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**Plasma**

Plasma is the liquid part of blood (Fig. 6-34). Plasma constitutes 55 percent of whole blood (plasma and cells). It is a clear, slightly alkaline, straw-colored liquid consisting of about 92 percent water. The remainder is made up mainly of proteins. One of these proteins, fibrinogen, contributes to coagulation.

**Blood Cells**

The blood cells suspended in the plasma constitute 45 percent of whole blood. Its cells, which are formed mostly in red bone marrow, include red blood cells (RBCs) and white blood cells (WBCs). The blood also contains cellular fragments called blood platelets. When blood components are separated, the WBCs and platelets form a thin layer, called the **buffy coat**, between the layers of plasma and RBCs. These layers are illustrated in Figure 6-34.

![Figure 6-34.—Blood Sample Illustrating Blood Components](image)
**RED BLOOD CELLS.**—Red blood cells (RBC), or erythrocytes, are small, biconcave, non-nucleated disks, formed in the red bone marrow (Fig. 6-35). Blood of the average man contains 5 million red cells per cubic millimeter. Women have fewer red cells, 4.5 million per cubic millimeter. Emotional stress, strenuous exercise, high altitudes, and some diseases may cause an increase in the number of RBCs.

During the development of the red blood cell, a substance called hemoglobin is combined with it. Hemoglobin is the key of the red cell's ability to carry oxygen and carbon dioxide. The main function of erythrocytes is the transportation of respiratory gases. The red cells deliver oxygen to the body tissues, holding some oxygen in reserve for an emergency. Carbon dioxide is picked up by the same cells and discharged via the lungs.

The color of the red blood cell is determined by the hemoglobin content. Bright red (arterial) blood is due to the combination of oxygen and hemoglobin. Dark red (venous) blood is the result of hemoglobin combining with carbon dioxide.

Red blood cells live only about 100 to 120 days in the body. There are several reasons for their short life span. These delicate cells have to withstand constant knocking around as they are pumped into the arteries by the heart. These cells travel through blood vessels at high speed, bumping into other cells, bouncing off the walls of arteries and veins, and squeezing through narrow passages. They must adjust to continual pressure changes. The spleen is the graveyard where old, worn out cells are removed from the blood stream. Fragments of red blood cells are found in the spleen and other body tissues.

**WHITE BLOOD CELLS.**—White blood cells (WBC), or leukocytes, are almost colorless, nucleated cells originating in the bone marrow and in certain lymphoid tissues of the body (Fig. 6-35). There is only one white cell to every 600 red cells. Normal WBC count is 6,000 to 8,000 per cubic millimeter. The number of white cells may be 15,000 to 20,000 or higher during infection.
Leukocytes are important for the protection of the body against disease. Leukocytes can squeeze between the cells that form blood cell walls. This movement, called diapedesis, permits them to leave the blood stream through the capillary wall and attack pathogenic bacteria. They can travel anywhere in the body and are often named the wandering cells. They protect the body tissues by engulfing disease-bearing bacteria and foreign matter, a process called phagocytosis. When white cells are undermanned, more are produced, causing an increase in their number and a condition known as leukocytosis. Another way WBC's protect the body from disease is by producing bacteriolysins that dissolve the foreign bacteria. The secondary function of WBCs is to aid in blood clotting.

**BLOOD PLATELETS.** — Blood platelets, or thrombocytes, are irregular- or oval-shaped discs in the blood that contain no nucleus, only cytoplasm (Fig. 6-35). They are smaller than red blood cells and average about 250,000 per cubic millimeter of blood. Blood platelets play an important role in the process of blood coagulation, clumping together in the presence of jagged, torn tissue.

**Blood Coagulation**

To protect the body from excessive blood loss, blood has its own power to coagulate, or clot. If blood components and linings of vessels are normal, circulating blood will not clot. Once blood escapes from its vessels, however, a chemical reaction begins that causes it to become solid. Initially a blood clot is a fluid, but soon it becomes thick and then sets into a soft jelly that quickly becomes firm enough to act as a plug. This plug is the result of a swift, sure mechanism that changes one of the soluble blood proteins, fibrinogen, into an insoluble protein, fibrin, whenever injury occurs.

Other necessary elements for blood clotting are calcium salts; a substance called prothrombin, which is formed in the liver; blood platelets; and various factors necessary for the completion of the successive steps in the coagulation process.

Once the fibrin plug is formed, it quickly enmeshes red and white blood cells and draws them tightly together. Blood serum, a yellowish clear liquid, is squeezed out of the clot as the mass shrinks. Formation of the clot closes the wound, preventing blood loss. A clot also serves as a network for the growth of new tissues in the process of healing. Normal clotting time is 3 to 5 minutes, but if any of the substances necessary for clotting are absent, severe bleeding will occur.

**Hemophilia** is an inherited disease characterized by delayed clotting of the blood and consequent difficulty in controlling hemorrhage. Hemophiliacs can bleed to death as a result of minor wounds.

**THE HEART**

The heart is a hollow, muscular organ, somewhat larger than the closed fist, located anteriorly in the chest and to the left of the midline. It is shaped like a cone, its base directed upward and to the right, the apex down and to the left. Lying obliquely in the chest, much of the base of the heart is immediately posterior to the sternum.
**Heart Composition**

The heart is enclosed in a membranous sac, the **pericardium**. The smooth surfaces of the heart and pericardium are lubricated by a serous secretion called **pericardial fluid**. The inner surface of the heart is lined with a delicate serous membrane, the **endocardium**, similar to and continuous with that of the inner lining of blood vessels.

The interior of the heart (Fig. 6-36) is divided into two parts by a wall called the **interventricular septum**. In each half is an upper chamber, the **atrium**, which receives blood from the veins, and a lower chamber, the **ventricle**, which receives blood from the atrium and pumps it out into the arteries. The openings between the chambers on each side of the heart are separated by flaps of tissue that act as valves to prevent backward flow of blood. The valve on the right has three flaps, or cusps, and is called the **tricuspid valve**. The valve on the left has two flaps and is called the **mitral**, or **bicuspid**, valve. The outlets of the ventricles are supplied with similar valves. In the right ventricle, the **pulmonary valve** is at the origin of the pulmonary artery. In the left ventricle, the **aortic valve** is at the origin of the aorta. See Figure 6-36 for valve locations.

The heart muscle, the **myocardium**, is **striated** like the skeletal muscles of the body, but involuntary in action, like the smooth muscles. The walls of the atria are thin with relatively little muscle fiber because the blood flows from the atria to the ventricles under low pressure.

However, the walls of the ventricles, which comprise the bulk of the heart, are thick and muscular. The wall of the left ventricle is considerably thicker than that of the right because more force is required to pump the blood into distant or outlying locations of the circulatory system than into the lungs located only a short distance from the heart.

**Heart Functions**

The heart acts as four interrelated pumps. The right atrium receives deoxygenated blood from the body via the **superior** and **inferior vena cava**. It pumps the deoxygenated blood through the tricuspid valve to the right ventricle. The right ventricle pumps the blood past the pulmonary valve through the **pulmonary artery** to the lungs, where it is oxygenated. The left atrium receives the oxygenated blood from the lungs through four **pulmonary veins** and pumps it to the left ventricle past the mitral valve. The left ventricle pumps the blood to all areas of the body via the aortic valve and the **aorta**.

The heart's constant contracting and relaxing forces blood into the arteries. Each contraction is followed by limited relaxation or dilation. Cardiac muscle never completely relaxes: It always maintains a degree of tone. Contraction of the heart is called **systole** or "the period of work." Relaxation of the heart is called **diastole** or "the period of rest." A complete cardiac cycle is the time from onset of one contraction, or heart beat, to the onset of the next.
Figure 6-36.— Chambers and valves of the heart. A, During atrial contraction cardiac muscle in the atrial wall contracts, forcing blood through the atrioventricular (AV) valves and into the ventricles. Bottom illustration shows superior view of all four valves, with semilunar (SL) valves closed and AV valves open. B, During ventricular contraction that follows, the AV valves close and the blood is forced out of the ventricles through the SL valves and into the arteries. Bottom illustration shows superior view of SL valves open and AV valves closed.

Cardiac Cycle

The cardiac cycle is coordinated by specialized tissues that initiate and distribute electrical (cardiac) impulses (Fig. 6-37). The contractions of the heart are stimulated and maintained by the sinoatrial (SA) node, commonly called the pacemaker of the heart. The SA node is an elongated mass of specialized muscle tissue located in the upper part of the right atrium. The SA node sets off cardiac impulses, causing both atria to contract simultaneously. The normal heart rate, or number of contractions, is about 80 beats per minute.

This same cardiac impulse continues to travel to another group of specialized tissues called the atrioventricular (AV) node. The AV node is located in the floor of the right atrium near the septum that separates the atria. The cardiac impulse to the AV node is slowed down by junctional fibers. The junctional fibers conduct the cardiac impulse to the AV node; however, these fibers are very small in diameter, causing the impulse to be delayed. This slow arrival of the impulse to the AV node allows time for the atria to contract and the ventricles to fill with blood.

Figure 6-37.— Conduction system of the heart. Specialized cardiac muscle cells (boldface type) in the wall of the heart rapidly initiate or conduct an electrical impulse throughout the myocardium. Both the sketch of the conduction system (A) and the flowchart (B) show the origin and path of conduction. The signal is initiated by the SA node (pacemaker) and spreads to the rest of the right atrial myocardium directly, to the left atrial myocardium by way of a bundle of interatrial conducting fibers, and to the AV node by way of three internodal bundles. The AV node then initiates a signal that is conducted through the ventricular myocardium by way of the AV bundle (of His) and subendocardial branches (Purkinje fibers).

Once the cardiac impulse reaches the far side of the AV node, it quickly passes through a group of large fibers which make up the AV bundle (also called the bundle of His). The AV bundle starts at the upper part of the interventricular septum and divides into right and left branches. About halfway down the interventricular septum, the right and left branches terminate into Purkinje fibers. The Purkinje fibers spread from the interventricular septum into the papillary muscles, which project inward from the ventricular walls. As the cardiac impulse passes through the Purkinje fibers, these fibers in turn stimulate the cardiac muscle of the ventricles. This stimulation of the cardiac muscles causes the walls of the ventricles to contract with a twisting motion. This action squeezes the blood out of the ventricular chambers and forces it into the arteries. This is the conclusion of one cardiac cycle.

Blood Pressure

Blood pressure is the pressure the blood exerts on the walls of the arteries. The highest pressure is called systolic pressure, because it is caused when the heart is in systole, or contraction. A certain amount of blood pressure is maintained in the arteries even when the heart is relaxed. This pressure is the diastolic pressure, because it is present during diastole, or relaxation of the heart. The difference between systolic and diastolic pressure is known as pulse pressure.

Normal blood pressure can vary considerably with an individual's age, weight, and general condition. For young adults, 120 systolic 80 diastolic is the average normal blood pressure, women have lower blood pressure than men.

BLOOD VESSELS

Blood vessels form a closed circuit of tubes that transport blood between the heart and body cells. The several types of blood vessels include arteries, arterioles, capillaries, venules, and veins.

Blood Vessel Classifications

The blood vessels of the body fall into three classifications:

- **Arteries and Arterioles**: Distributors
- **Capillaries**: Exchangers
- **Veins and Venules**: Collectors

Arteries and Arterioles

Arteries are elastic tubes constructed to withstand high pressure. They carry blood away from the heart to all parts of the body. The smallest branches of the arteries are called arterioles. The walls of arteries and arterioles consist of layers of endothelium, smooth muscle, and connective tissue. The smooth muscles of arteries and arterioles constrict and dilate in response to electrical impulses received from the autonomic nervous system.

Capillaries

At the end of the arterioles is a system of minute vessels that vary in structure, but which are spoken of collectively as capillaries. It is from these capillaries that the tissues of the body are fed. There are approximately 60,000 miles of capillaries in the body. As the blood passes through the capillaries, it releases oxygen and nutritive substances to the tissues and takes up various waste products to be carried away by venules. Venules continue from capillaries and merge to form veins.
Veins and Venules

Veins and venules form the venous system. The venous system is comprised of vessels that collect blood from the capillaries and carry it back to the heart. Veins begin as tiny venules formed from the capillaries. Joining together as tiny rivulets, veins connect and form a small stream. The force of muscles contracting adjacent to veins aids in the forward propulsion of blood on its return to the heart. Valves, spaced frequently along the larger veins, prevent the backflow of blood. The walls of veins are similar to arteries, but are thinner and contain less muscle and elastic tissue.

Arterial System

Arterial circulation is responsible for taking freshly oxygenated blood from the heart to the cells of the body (Fig. 6-38). To take this oxygenated blood from the heart to the entire body, the arterial system begins with the contraction of blood from the left ventricle into the aorta and its branches.

AORTA.—The aorta, largest artery in the body, is a large tube-like structure arising from the left ventricle of the heart. It arches upward over the left lung and then down along the spinal column through the thorax and the abdomen, where it divides and sends arteries down both legs (Fig. 6-38).

KEY BRANCHES OF THE AORTA.—Key arterial branches of the aorta are the coronary, innominate (brachiocephalic), left common carotid, and left subclavian. The coronary arteries are branches of what is called the ascending aorta. The coronary arteries supply the heart with blood. There are three large arteries that arise from the aorta as it arches over the left lung. First is the innominate artery, which divides into the right subclavian artery to supply the right arm, and the right common carotid to supply the right side of the head. The second branch is the left common carotid, which supplies the left side of the head. The third branch is the left subclavian, which supplies the left arm.

ARTERIES OF THE HEAD, NECK, AND BRAIN.—The carotid arteries divide into internal and external branches. The external supplies the muscle and skin of the face and the internal supplies the brain and the eyes.

ARTERIES OF THE UPPER EXTREMITIES.—The subclavian arteries are so named because they run underneath the clavicle. They supply the upper extremities, branching off to the back, chest, neck, and brain through the spinal column (Fig. 6-38).

The large artery going to the arm is called the axillary. The axillary artery becomes the brachial artery as it travels down the arm and divides into the ulnar and radial arteries. The radial artery is the artery at the wrist that is felt when taking the patient’s pulse (Fig. 6-38).

ARTERIES OF THE ABDOMEN.—In the abdomen, the aorta gives off branches to the abdominal viscera, including the stomach, liver, spleen, kidneys, and intestines. The aorta later divides into the left and right common iliacs, which supply the lower extremities (Fig. 6-38).

ARTERIES OF THE LOWER EXTREMITIES.—The left and right common iliacs, upon entering the thigh, become the femoral arteries. At the knee, this same vessel is named the popliteal artery (Fig. 6-38).
Figure 6-38.—Principal arteries of the body.

Venous System

Venous circulation is responsible for returning the blood to the heart after exchanges of gases, nutrients, and wastes have occurred between the blood and body cells (Fig. 6-39). To return this blood to the heart for reoxygenation, the venous system begins with the merging of capillaries into venules, venules into small veins, and small veins into larger veins. The blood vessel paths of the venous system are difficult to follow, unlike the arterial system. However, the larger veins are commonly located parallel to the course taken by their counterpart in the arterial system. For instance, the renal vein parallels the renal artery; the common iliac vein parallels the common iliac artery, and so forth.

THREE PRINCIPAL VENOUS SYSTEMS.—The three principal venous systems in the body are the pulmonary, portal, and systemic.

- The pulmonary system is composed of four vessels, two from each lung, which empty into the left atrium. These are the only veins in the body that carry freshly oxygenated blood.

- The portal system consists of the veins that drain venous blood from the abdominal part of the digestive tract the spleen, pancreas, and gallbladder, but not the lower rectum and deliver it to the liver. There, it is distributed by a set of venous capillaries. The blood in the portal system conveys absorbed substances from the intestinal tract to the liver for storage, alteration, or detoxification. From the liver the blood flows through the hepatic vein to the inferior vena cava.

- The systemic system is divided into the deep and superficial veins. The superficial veins lie immediately under the skin, draining the skin and superficial structures. The deep veins, usually located in the muscle or deeper layers, drain the large muscle masses and various other organs. Deep veins commonly lie close to the large arteries that supply the various organs of the body and typically have the same name as the artery they accompany.

VEINS OF THE HEAD, NECK, AND BRAIN.—The superficial veins of the head unite to form the external jugular veins. The external jugular veins drain blood from the scalp, face, and neck, and finally empty into the subclavian veins.

The veins draining the brain and internal facial structures are the internal jugular veins. These combine with the subclavian veins to form the innominate veins, which empty into the superior vena cava (Fig. 6-39).
VEINS OF THE UPPER EXTREMITIES.—The veins of the upper extremities begin at the hand and extend upward. A vein of great interest is the median cubital, which crosses the anterior surface of the elbow. It is the vein most commonly used for venipuncture. Also found in this area are the basilic and cephalic veins, which extend from the midarm to the shoulder.

The deep veins of the upper arm unite to form the axillary vein, which unites with the superficial veins to form the subclavian vein. This vein later unites with other veins to form the innominate and eventually, after union with still more veins, the superior vena cava (Fig. 6-39).

VEINS OF THE ABDOMEN AND THORACIC REGION.—The veins from the abdominal organs, with the exception of those of the portal system, empty directly or indirectly into the inferior vena cava, while those of the thoracic region eventually empty into the superior vena cava (Fig. 6-39).

VEINS OF THE LOWER EXTREMITIES.—In the lower extremities (Fig. 6-39) a similar system drains the superficial areas. The great saphenous vein originates on the inner aspect of the foot and extends up the inside of the leg and thigh to join the femoral vein in the upper thigh. The great saphenous vein is used for intravenous injections at the ankle.

The veins from the lower extremities unite to form the femoral vein in the thigh, which becomes the external iliac vein in the groin. Higher in this region, external iliac unites the internal iliac (hypogastric) vein from the lower pelvic region to form the common iliac veins. The right and left common iliac veins unite to form the inferior vena cava.
Figure 6-39.—Principal veins of the body.

THE LYMPHATIC SYSTEM

LEARNING OBJECTIVE:

Identify the parts of the lymphatic system and their function.

All tissues of the body are continuously bathed in interstitial fluid. This fluid is formed by leakage of blood plasma through minute pores of the capillaries. There is a continual interchange of fluids of the blood and tissue spaces with a free interchange of nutrients and other dissolved substances. Most of the tissue fluid returns to the circulatory system by means of capillaries, which feed into larger veins. Large protein molecules that have escaped from the arterial capillaries cannot reenter the circulation through the small pores of the capillaries. However, these large molecules, as well as white blood cells, dead cells, bacterial debris, infected substances, and larger particulate matter, can pass through the larger pores of the lymphatic capillaries and, thus, enter the lymphatic circulatory system with the remainder of the tissue fluid.

The lymphatic system helps defend the tissues against infections by supporting the activities of the lymphocytes, which give immunity, or resistance, to the effects of specific disease-causing agents.

PATHWAYS OF THE LYMPHATIC SYSTEM

The lymphatic pathway begins with lymphatic capillaries. These small tubes merge to form lymphatic vessels, and the lymphatic vessels in turn lead to larger vessels that join with the veins in the thorax.

Lymphatic Capillaries

Lymphatic capillaries are closed-ended tubes of microscopic size (Fig. 6-40). They extend into interstitial spaces, forming complex networks that parallel blood capillary networks. The lymphatic capillary wall consists of a single layer of squamous epithelial cells. This thin wall makes it possible for interstitial fluid to enter the lymphatic capillary. Once the interstitial fluid enters the lymphatic capillaries, the fluid is called lymph.
Figure 6-40.— Circulation plan of lymphatic fluid. This diagram outlines the general scheme for lymphatic circulation. Fluids from the systemic and pulmonary capillaries leave the bloodstream and enter the interstitial space, thus becoming part of the IF (interstitial fluid). The IF also exchanges materials with the surrounding tissues. Often, because less fluid is returned to the blood capillary than had left it, IF pressure increases—causing IF to flow into the lymphatic capillary. The fluid is then called lymph (lymphatic fluid) and is carried through one or more lymph nodes and finally to large lymphatic ducts. The lymph enters a subclavian vein, where it is returned to the systemic blood plasma. Thus fluid circulates through blood vessels, tissues, and lymphatic vessels in a sort of "open circulation."

Lymphatic Vessels

Lymphatic vessels are formed from the merging of lymphatic capillaries. Lymphatic vessels, also known simply as lymphatics, are similar to veins in structure. The vessel walls are composed of three layers: an inner layer of endothelial tissue, a middle layer of smooth muscle and elastic fibers, and an outer layer of connective tissue.

Like a vein, the lymphatic vessel has valves to prevent backflow of lymph. The larger lymphatic vessels lead to specialized organs called lymph nodes. After leaving these structures, the vessels merge to form still larger lymphatic trunks (Fig. 6-41).

Figure 6-41.— Structure of a typical lymphatic capillary. Notice that interstitial fluid enters through clefts between overlapping endothelial cells that form the wall of the vessel. Valves ensure one-way flow of lymph out of the tissue. Small fibers anchor the wall of the lymphatic capillary to the surrounding ECM (extracellular matrix) and cells, thus holding it open to allow entry of fluids and small particles.

**Lymphatic Trunks and Ducts**

Lymphatic trunks drain lymph from large regions in the body. The lymphatic trunks are usually named after the region they serve, such as the subclavian trunk that drains the arm. There are many lymphatic trunks throughout the body. These lymphatic trunks then join one of two collecting ducts, the **thoracic duct** or the **right lymphatic duct** (Fig. 6-42).

Lymphatic trunks from the upper half of the right side of the body converge to form the right lymphatic duct, which empties into the right subclavian vein. Drainage from the remainder of the body is by way of the thoracic duct, which empties into the left subclavian vein.

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**Figure 6-42.**—Lymphatic drainage. The right lymphatic duct drains lymph from the upper right quadrant (dark blue) of the body into the right subclavian vein. The thoracic duct drains lymph from the rest of the body (green) into the left subclavian vein. The lymphatic fluid is thus returned to the systemic blood just before entering the heart.

LYMPH NODES

Lymph nodes, which are frequently called glands but are not true glands, are small bean-shaped bodies of lymphatic tissue found in groups of two to fifteen along the course of the lymph vessels (Fig. 6-43). Major locations of lymph nodes are in the following regions: cervical, axillary, inguinal, pelvic cavity, abdominal cavity, and thoracic cavity. Lymph nodes vary in size and act as filters to remove bacteria and particles from the lymph stream. Lymph nodes produce lymphocytes, which help defend the body against harmful foreign particles, such as bacteria, cells, and viruses. Lymph nodes also contain macrophages, which engulf and destroy foreign substances, damaged cells, and cellular debris.

Figure 6-43.—Principal organs of the lymphatic system.

IMMUNE SYSTEM

LEARNING OBJECTIVE:

Identify how the immune system works.

“First, it is important to recognize that cells, viruses, and other particles have unique molecules and groups of molecules on their surfaces that can be used to identify them. These molecular markers visible to the immune system are called antigens. Human cells have unique cell markers embedded in our plasma membranes that identify each of our cells as self—that is, belonging to us as an individual. Foreign cells or particles have nonself molecules that serve as recognition markers for our immune system. The ability of our immune system to attack abnormal or foreign cells but spare our own normal cells is called self-tolerance.

“The body takes a number of measures to prevent infection. The body’s primary defenses against infection include the skin, tears, stomach acid, urine, sweat, mucus, and saliva. By having this range of both physical and chemical defenses, the body is able to defend against a range of pathogens.

Secondary defenses bring about inflammation. The swelling, redness, and warmth of the infected area cause the body to call in macrophages and neutrophils to consume the bacteria [see chap 10 for more details]. If the pathogen is a virus, interferon (interferon proteins interfere with the ability of viruses to cause diseases) is produced so that other cells in that region of the body can block the virus from attacking any healthy cells.

The body’s third line of defense is the way the body remembers specific pathogens and their structures. If the pathogen enters the body again, the body’s response will be much quicker than the first time the pathogen invaded the body. Antibodies, specific to each pathogen, are ready to respond should this occur.

The memorization and production of antibodies is called active immunity. In passive immunity the antibodies have been obtained from outside the body, either from another animal or person.

A number of cells are involved in combating the invasion of viruses and bacteria. B cells have antigen receptors and antibodies, and they work to fight off bacteria. B cells can form plasma cells and memory cells. The plasma cells produce antibodies that bind to antigens, whereas the memory B cells form new plasma cells if the bacteria enter the body again. T cells are responsible for recognizing nonself cells. On engagement with nonself cells, they produce killer T cells and memory T cells. The killer T cells have the task of binding to cells that have been infected by viruses. The memory T cells are ready to produce more killer T cells if the virus enters the body again. In both cases, bacterial and viral infections, helper T cells are available to recognize the antigens that have been ingested and displayed by macrophages.”

THE NERVOUS SYSTEM

LEARNING OBJECTIVES:

Identify the components and function of a neuron.

Identify the process of impulse transmission.

Identify the components and functions of the central and peripheral nervous systems.

The activity of widely diverse cells, tissues, and organs of the body must be monitored, regulated, and coordinated to effectively support human life. The interaction of the nervous and endocrine systems provides the needed control through communication.

The nervous system is specifically adapted to the rapid transmission of impulses from one area of the body to another. On the other hand, the endocrine system, working at a far slower pace, maintains body metabolism at a fairly constant level.
This section will cover the study of the glia and neuron, the two main types of cells of the nervous system. It will discuss the components and functions of the different categories of the nervous system: the central nervous system (CNS) and the peripheral nervous system (PNS). Another division of the nervous system is the autonomic nervous system (ANS), which is further subdivided into the sympathetic and parasympathetic nervous systems (Fig. 6-44).

GLIA

Glia cells do not usually conduct information themselves but support the functions of the neurons in various ways. Unlike neurons, glia cells retain their capacity for cell division throughout adulthood. This characteristic gives them the ability to replace themselves and it makes them susceptible to abnormalities of cell division – such as cancer.

There are five major types of Glia cells, Astrocytes, Microglia, Ependymal cells, Oligodendrocytes, and Schwann cells. The first four types of glia are located in the CNS and the Schwann cells are located in the PNS. Astrocytes help feed the brain and make up the Blood Brain Barrier. Microglia enlarge, engulf, and destroy microorganisms and cellular debris. Ependymal cells have two functions in the CNS; they help produce the fluid and some have cilia that help move the fluid around. The Oligodendrocytes produce the fatty myelin sheath around the nerve fibers in the CNS.

Figure 6-44.— Organizational plan of the nervous system. Diagram summarizes the scheme used by most neurobiologists in studying the nervous system. Both the somatic nervous system (SNS) and the autonomic nervous system (ANS) include components in the CNS and PNS. Somatic sensory pathways conduct information toward integrators in the CNS, and somatic motor pathways conduct information toward somatic effectors. In the ANS, visceral sensory pathways conduct information toward CNS integrators, whereas the sympathetic and parasympathetic pathways conduct information toward autonomic effectors.

THE NEURON

The structure and functional unit of the nervous system is the nerve cell, or neuron, which can be classified into three types. The first is the sensory neuron, which conveys sensory impulses inward from the receptors towards the spine and brain. The second is the motor neuron, which carries command impulses from a central area to the responding muscles or organs. The third type is the interneuron, which links the sensory neurons to the motor neurons. All pathways do not have an interneuron.

The neuron is composed of dendrites, a perikaryon (cell body), and an axon (Fig. 6-45). The dendrites are thin receptive branches, and vary greatly in size, shape, and number with different types of neurons. They serve as receptors, conveying impulses toward the cell body. The perikaryon (literally, means surrounding the nucleus) is the cell body containing the nucleus. The single, thin extension of the cell outward from the cell body is called the axon. It conducts impulses away from the cell body to its terminal branches at the synaptic knobs, which transmit the impulses to the dendrites of the next neuron.

Axons of the peripheral nerves are commonly enclosed in a sheath, called neurilemma, composed of Schwann cells (Figs. 6-45 and 6-46). Schwann cells wrap around the axon and act as an electrical insulator. The membranes of the Schwann cell are composed largely of a lipid-protein called myelin, which forms a myelin sheath called myelinated fibers, or white fibers on the outside of an axon. The myelin sheath has gaps between adjacent Schwann cells called nodes of Ranvier. Nerve cells without Schwann cells also lack myelin and neurilemma sheaths which are called unmyelinated fibers, or gray fibers. Myelin is important as it aids in conduction of the electrical impulse (Fig. 6-46).

Figure 6-45.—Structure of a typical neuron. The inset is a scanning electron micrograph of a neuron. (Alan Peters.)

Figure 6-46.— Development of the myelin sheath. A Schwann cell (neurolemmocyte) migrates to a neuron and wraps around an axon. The Schwann cell's cytoplasm is pushed to the outer layer, leaving a dense multilayered covering of plasma membrane around the axon. Because the plasma membrane of the Schwann cell is mostly the phospholipid myelin, the dense wrapping around the axon is called a myelin sheath. The outer layer of cytoplasm is called the neurilemma. The extensions of oligodendrocytes also wrap around axons to form a myelin sheath.


IMPULSE TRANSMISSION

When dendrites receive a sufficiently strong stimulus, a short and rapid change in electrical charge, or polarity, of the neuron is triggered. Sodium ions rush through the plasma membrane into the cell, potassium ions leave, and an electrical impulse is formed, which is conducted toward the cell body. The cell body receives the impulse and transmits it to the terminal filaments of the axon. At this point a chemical transmitter such as acetylcholine is released into the synapse, a space between the axon of the activated nerve and the dendrite receptors of another neuron. This chemical transmitter activates the next nerve. In this manner, the impulse is passed from neuron to neuron down the nerve line to a central area of up to speeds of 300 miles per hour being the fastest. It depends on the diameter, the bigger the diameter the faster the speed, along with that if it is myelinated it also moves faster.

Almost immediately after being activated, the chemical transmitter in the synapse is neutralized by the enzyme acetylcholinesterase, and the first neuron returns to its normal state by pumping out the sodium ions and drawing potassium ions back in through the plasma membrane. When these actions are completed, the nerve is ready to be triggered again. A particularly strong stimulus will cause the nerve to fire in rapid succession, or will trigger many other neurons, thus giving a feeling of intensity to the perceived sensation.

NERVES

A nerve is a cordlike bundle of fibers held together with connective tissue. Each nerve fiber is an extension of a neuron. Nerves that conduct impulses into the brain or the spinal cord are called sensory nerves, and those that carry impulses to muscles and glands are termed motor nerves. Most nerves, however, include both sensory and motor fibers, and they are called mixed nerves.
The central nervous system (CNS) consists of the brain and spinal cord. The brain is almost entirely enclosed in the skull, but it is connected with the spinal cord, which lies in the canal formed by the vertebral column.

Brain

The brain has six major divisions, the medulla oblongata, pons, midbrain, diencephalon, cerebrum and the cerebellum. The cerebrum is the largest and most superiorly situated portion of the brain. It occupies most of the cranial cavity. The outer surface is called the cortex. This portion of the brain is also called "gray matter" because the nerve fibers are unmyelinated (not covered by a myelin sheath), causing them to appear gray. Beneath this layer is the medulla, often called the white matter of the brain because the nerves are myelinated (covered with a myelin sheath), giving them their white appearance.

CEREBRUM.—The cortex of the cerebrum is irregular in shape. It bends on itself in folds called convolutions, which are separated from each other by grooves, also known as fissures. The deep sagittal cleft, a longitudinal fissure, divides the cerebrum into two hemispheres. Other fissures further subdivide the cerebrum into lobes, each of which serves a localized, specific brain function (Fig. 6-47). For example, the frontal lobe is associated with the higher mental processes such as memory, the parietal lobe is concerned primarily with general sensations, the occipital lobe is related to the sense of sight, and the temporal lobe is concerned with hearing (Fig. 6-47).

CEREBELLUM.—The cerebellum is situated posterior to the brainstem and inferior to the occipital lobe. The cerebellum is concerned chiefly with bringing balance, harmony, and coordination to the motions initiated by the cerebrum.

Figure 6-47.—Left hemisphere of cerebrum, lateral surface. Note the highlighted lobes of the cerebrum.


BRAINSTEM.—It is made up of the medulla oblongata which forms the lowest part, the pons which forms the mid portion, and the midbrain which forms the uppermost part of the brainstem. The brainstem also acts as a connection to the rest of the brain.

The medulla oblongata is the inferior portion of the brain, the last division before the beginning of the spinal cord. It connects to the spinal cord at the upper level of the first cervical vertebra (C-1). In the medulla oblongata are the centers for the control of heart action, breathing, circulation, and other vital processes such as blood pressure.

The midbrain deals with certain auditory functions, contains the visual centers, and it is involved in muscular control.
MENINGES. The outer surface of the brain and spinal cord is covered with three layers of membranes called the meninges. The *dura mater* is the strong outer layer; the *arachnoid membrane* is the delicate middle layer; and the *pia mater* is the vascular innermost layer that adheres to the surface of the brain and spinal cord. Inflammation of the meninges is called meningitis. The type of meningitis contracted depends upon whether the brain, spinal cord, or both are affected, as well as whether it is caused by viruses, bacteria, protozoa, yeasts, or fungi.

CEREBROSPINAL FLUID.—Cerebrospinal fluid is formed by a *plexus*, or network, of blood vessels in the central ventricles of the brain. It is a clear, watery solution similar to blood plasma. The total quantity of spinal fluid bathing the spinal cord is about 75 ml. This fluid is constantly being produced and reabsorbed. It circulates over the surface of the brain and spinal cord and serves as a supportive protective cushion as well as a means of exchange for nutrients and waste materials. It monitors for changes in the internal environment.

**Spinal Cord**

The spinal cord is continuous with the medulla oblongata and extends from the foramen magnum, through the atlas, to the lower border of the first lumbar vertebra, where it tapers to a point (Fig. 6-48). The spinal cord is surrounded by the bony walls of the vertebral canal. Ensheathed in the three protective meninges and surrounded by fatty tissue and blood vessels, the spinal cord does not completely fill the vertebral canal, nor does it extend the full length of it. The nerve matter is shaped roughly like the letter H. It establishes sensory communication between the brain and the spinal nerves, conducting sensory impulses from the body parts.

Figure 6-48.—The central nervous system. Details of both the brain and the spinal cord are easily seen in this Figure.

The spinal cord may be thought of as an electric cable containing many wires (nerves) that connect parts of the body with each other and with the brain. Sensations received by a sensory nerve are brought to the spinal cord, and the impulse is transferred either to the brain or to a motor nerve. The majority of impulses go to the brain for action. However, a system exists for quickly handling emergency situations. It is called the reflex arc (Fig. 6-49).

![Figure 6-49.—Patellar reflex. Neural pathway involved in the patellar (knee jerk) reflex.](image)


If a person touches a hot stove, the person must remove the hand from the heat source immediately or the skin will burn very quickly.

The passage of a sense impulse to the brain and back again to a motor nerve takes too much time. The reflex arc responds instantaneously to emergency situations (like the one described). The sensation of heat travels to the spinal cord on a sensory nerve. When the sensation reaches the spinal cord, it is picked up by an interneuron in the gray matter. This reception triggers the appropriate nerve to stimulate a muscle reflex drawing the hand away. An illustrated example of the reflex arc is shown in Figure 6-50.

![Figure 6-50.—Functional classification of neurons in a reflex arc. Neurons can be classified according to the direction in which they conduct impulses. Notice that the most basic route of signal conduction follows a pattern called the reflex arc.](image)


The reflex arc works well in simple situations requiring no action of the brain. Consider what action is involved if the individual touching the stove pulls back and, in so doing, loses balance and has to grab a chair to regain stability. Then the entire spinal cord is involved.

Additional impulses must travel to the brain, down to the muscles of the legs and arms to enable the individual to maintain balance and to hold on to a steadying object. As this activity takes place, the stimulus is relayed through the sympathetic autonomic nerve fibers to the adrenal glands, causing adrenalin to flow, and stimulating heart action. The stimulus moves to the brain making the individual conscious of pain. In this example, the spinal cord has functioned not only as a center for spinal relaxes, but also as a conduction pathway for other areas of the spinal cord to the autonomic nervous system and to the brain.
PERIPHERAL NERVOUS SYSTEM

The **peripheral** nervous system (PNS) consists of the nerves that branch out from the CNS and connects it to the other parts of the body. The PNS includes 12 pairs of cranial nerves (Fig. 6-51) and 31 pairs of spinal nerves (Fig. 6-52).

While the cranial nerves are numbered in a specific order, the spinal nerves are merely numbered according to where they emerge from the spinal cord. Cranial and spinal nerves carry both voluntary and involuntary impulses.

Figure 6-51.—Cranial nerves. Ventral surface of the brain showing attachment of the cranial nerves.

Figure 6-52.—Spinal nerves. Each of 31 pairs of spinal nerves exits the spinal cavity from the intervertebral foramina. The names of the vertebrae are given on the left and the names of the corresponding spinal nerves on the right. Note that after leaving the spinal cavity, many of the spinal nerves interconnect to form networks called plexuses. The inset shows a dissection of the cervical region, showing a posterior view of cervical spinal nerves exiting intervertebral foramina on the right side. (Courtesy Vidian B, Suarez RF: Photographic atlas of the human body, St Louis, 1984, Mosby.)

Cranial Nerves

The 12 pairs of cranial nerves (Table 6-6) are sensory, motor, or mixed (sensory and motor). The following saying helps in the memorization of the nerves: On Old Olympus Tower Tops A Famous Vocal German Viewed Some Hops or I-Olfactory, II-Optic, III-Oculomotor, IV-Trochlear, V-Trigeminal, VI-Abducens, VII-Facial, VIII-Vestibulocochlear (Auditory), IX-Glossopharyngeal, X-Vagus, XI-Spinal (Accessory), and XII-Hypoglossal (Fig. 6-51). The figure below shows the 12 cranial nerves and parts of the body they service.

![Table 6-6.—Cranial Nerves](image-url)

The cranial nerves are the 12 pairs of nerves emerging from the cranial cavity through various openings in the skull. Beginning with the most anterior (front) on the brain stem, they are appointed Roman numerals. An isolated cranial nerve lesion is an unusual finding in decompression sickness or gas embolism, but deficits occasionally occur.

1. **Olfactory**: The olfactory nerve provides the sense of smell.

2. **Optic**: The optic nerve is for vision. It functions in the recognition of light and shade and in the perception of objects. Blurring of vision, loss of vision, spots in the visual field or peripheral vision loss (tunnel vision) are also indicative of nerve involvement.

3. **Oculomotor**, 4. **Trochlear**, 5. **Abducens**: These three nerves control eye movements in the six directions (fields) and eye movement towards the tip of the nose (giving a “crossed-eyed” look). The oculomotor nerve is responsible for movement of the pupils.

6. **Trigeminal**: The Trigeminal Nerve governs sensation of the forehead and face and the clenching of the jaw. It also supplies the muscle of the ear (tensor tympani) necessary for normal hearing.

7. **Facial**: The Facial Nerve controls the face muscles. It stimulates the scalp, forehead, eyelids, muscles of facial expression, cheeks, and jaw. Symmetry of the nasolabial folds (lines from nose to outside corners of the mouth) should be observed.


9. **Glossopharyngeal**: The Glossopharyngeal Nerves transmit sensation from the upper mouth and throat area. It supplies the sensory component of the gag reflex and constriction of the pharyngeal wall when saying “aah.”

10. **Vagus**: The Vagus Nerve has many functions, including control of the roof of the mouth, vocal cords, and tone of the voice; hoarseness may also indicate vagus nerve involvement.

11. **Spinal Accessory**: The Spinal Accessory Nerve controls the turning of the head from side to side and shoulder shrug against resistance.

12. **Hypoglossal**: The Hypoglossal Nerve governs the muscle activity of the tongue. An injury to one of the hypoglossal nerves causes the tongue to twist to that side when stuck out of the mouth.”
Spinal Nerves

There are 31 pairs of spinal nerves that originate from the spinal cord. Although spinal nerves are not named individually, they are grouped according to the level from which they arise, and each nerve is numbered in sequence. Thus, there are 8 pairs of cervical nerves, 12 pairs of thoracic nerves, 5 pairs of lumbar nerves, 5 pairs of sacral nerves, and 1 pair of coccygeal nerves (Fig. 6-53).

Spinal nerves (mixed) send fibers to sensory surfaces and muscles of the trunk and extremities. Nerve fibers are also sent to involuntary smooth muscles and glands of the gastrointestinal tract, urogenital system, and cardiovascular system.

AUTONOMIC NERVOUS SYSTEM

The autonomic nervous system (ANS) is the portion of the PNS that functions independently, automatically, and continuously, without conscious effort. It helps to regulate the smooth muscles, cardiac muscle, digestive tract, blood vessels, sweat and digestive glands, and certain endocrine glands. The autonomic nervous system is not directly under the control of the brain but usually works in harmony with the nerves that are under the brain's control. The autonomic nervous system includes two subdivisions (the sympathetic and parasympathetic nervous systems) that act together.

The sympathetic nervous system's primary concern is to prepare the body for energy-expending, stressful, or emergency situations, also known as fight or flight. On the other hand, the parasympathetic nervous system is most active under routine, restful situations. The parasympathetic system also counterbalances the effects of the sympathetic system, and restores the body to a resting state. For example, during an emergency the body's heart and respiration rate increases. After the emergency, the parasympathetic system will decrease heart and respiration rate to normal. The sympathetic and parasympathetic systems work together to preserve a harmonious balance of body functions and activities.
THE SENSORY SYSTEM

LEARNING OBJECTIVES:

Identify the senses of the body.

Describe their physical characteristics.

The sensory system informs areas of the cerebral cortex of changes that are taking place within the body or in the external environment. The special sensory receptors respond to special individual stimuli such as sound waves, light, taste, smell, pressure, heat, cold, pain, or touch. Positional changes, balance, hunger, and thirst sensations are also detected and passed on to the brain.

SMELL

Odor is perceived upon stimulation of the receptor cells in the olfactory membrane of the nose. The olfactory receptors are very sensitive, but they are easily fatigued. This tendency explains why odors that are initially very noticeable are not sensed after a short time. Smell is not as well developed in man (350 odorant receptors) as it is in other mammals such as mice, which have 1,000 receptors.

TASTE

The taste buds are located in the tongue (Fig. 6-30). The sensation of taste is limited to sour, sweet, bitter, savory, and salty. It does not matter where on the tongue an object is placed; it can detect different tastes everywhere on the tongue. Many foods and drinks tasted are actually smelled, and their taste depends upon their odor. (This interdependence between taste and smell can be demonstrated by pinching the nose shut when eating onions.) Sight can also affect taste. Several drops of green food coloring in a glass of milk will make it all but unpalatable, even though the true taste has not been affected.

SIGHT

The eye, the organ of sight, is a specialized structure for the reception of light. It is assisted in its function by accessory structures, such as the eye brows, eyelashes, eyelids, and lacrimal apparatus. The lacrimal apparatus consists of structures that produce tears and drains them from the surface of the eyeball (Fig. 6-54).

![Lacrimal apparatus diagram]

Figure 6-54.—Lacrimal apparatus. Fluid produced by lacrimal glands (tears) streams across the eye surface, enters the canals, and then passes through the lacrimal sac and nasolacrimal duct to enter the nose.

Structure of the Eye

Approximately five-sixths of the eyeball lies recessed in the orbit, protected by a bony socket. Only the small anterior surface of the eyeball is exposed. The eye is not a solid sphere but contains a large interior cavity that is divided into two cavities, anterior and posterior. The anterior cavity is further subdivided into anterior and posterior chambers (Fig. 6-55).

The anterior cavity of the eye lies in front of the lens. The anterior chamber of the anterior cavity is the space anterior to the iris, but posterior to the cornea. The posterior chamber of the anterior cavity consists of a small space directly posterior to the iris, but anterior to the lens.

Both chambers of the anterior cavity are filled with a clear, watery fluid called aqueous humor. Aqueous humor helps to give the cornea its curved shape (Fig. 6-55). The aqueous humor drains out of the anterior chamber at the same rate it enters the posterior chamber. When there is a pressure increase inside the eye, and the level exceeds 25 mm Hg, damage will occur and may cause blindness; this condition is called glaucoma.

Figure 6-55.— Eye Structure Horizontal section through the eyeball. The eye is viewed from above.

The **posterior cavity** of the eye is larger than the anterior cavity, occupying the entire space posterior to the lens to include suspensory **ligaments** and ciliary body. The posterior cavity contains a substance, with the consistency similar to soft gelatin, called **vitreous humor**. Vitreous humor and aqueous humor help maintain sufficient pressure inside the eye to prevent the eyeball from collapsing (Figs. 6-55 and 6-56).

The eyeball is composed of three layers; sclera, choroid, and retina (Fig. 6-56).

**Figure 6-56.—Lens, cornea, iris, and ciliary body. Note the suspensory ligaments that attach the lens to the ciliary body.**


**OUTER LAYER.**—The outer layer of the eye is the **sclera**. It is the tough, fibrous, protective portion of the globe, called the white of the eye. The anterior outer layer of the sclera is transparent and called the **cornea**, or the window of the eye. It permits light to enter the globe. The exposed sclera is covered with a mucous membrane, the conjunctiva, which is a continuation of the inner lining of the eyelids. The **lacrimal gland** produces tears that constantly wash the front part of the eye and the conjunctiva. Excess secretions flow toward the inner angle of the eye (canthus) and drain down ducts into the nose.

**MIDDLE LAYER.**—The middle layer of the eye is the **choroid**. It is a highly vascular, pigmented tissue that provides nourishment to the inner structures. Continuous with the choroid is the **ciliary body**. The ciliary body is formed by a thickening of the choroid and fits like a collar into the area between the retina and iris. Attached to the ciliary body are the **suspending ligaments**, which blend with the elastic capsule of the lens and holds it in place (Fig. 6-56).

**Iris.**—The iris is continuous with the ciliary body. It is a circular, pigmented muscular structure that gives color to the eye. The iris separates the anterior cavity into anterior and posterior chambers. The opening in the iris is called the **pupil**. The amount of light entering the pupil is regulated through the constriction of radial and circular muscles in the iris. When strong light is flashed into the eye, the circular muscle fibers of the iris contract, reducing the size of the pupil decreasing the amount of light. If the light is dim, the pupil dilates to allow as much of the light in as possible. The size and reaction of the pupils of the eyes are an important diagnostic tool.

**Lens.**—The lens is a transparent, biconvex (having two convex surfaces) structure suspended directly behind the iris. The optic globe posterior to the lens is filled with a jellylike substance called vitreous humor to maintain the shape of the eyeball by maintaining intraocular pressure. The lens separates the eye into anterior and posterior cavities.
INNER LAYER.—The inner layer of the eye is the retina (Fig. 6-57). It contains layers of nerve cells, rods, and cones, which are the receptors of the sense of vision. The retina is continuous with the optic nerve, entering the back of the globe carrying visual impulses received by the rods and cones to the brain. The area where the optic nerve enters the eyeball contains no rods and cones and is called the optic disc (blind spot).

Figure 6-57.—Ophthalmoscope View of the Eye

Rods.—Rods respond to low intensities of light and are responsible for night vision. They are located in all areas of the retina, except in the small depression called the fovea centralis, where light entering the eye is focused, and has the clearest vision. If a person looks slightly to the side (where most of the cones are at) it will be clearer at night.

Cones.—Cones require higher light intensities for stimulation and are most densely concentrated in the fovea centralis. The cones are responsible for color vision and vision in very bright light.

Vision Process

The vision process begins with rays of light from an object passing through the cornea. The image is then received by the lens, by way of the iris. Leaving the lens, the image falls on the rods and cones in the retina. The image is then sent by the optic nerve to the brain for interpretation (Fig. 6-58). Note the image received by the retina is upside down, but the brain turns it right-side up.

Figure 6-58.—The Vision Process

REFRACTION.—Deflection or bending of light rays results when light passes through substances of varying densities in the eye (cornea, aqueous humor, lens, and vitreous humor). The deflection of light in the eye is refraction.

ACCOMMODATION. —Accommodation is the process by which the lens increases or decreases its curvature to refract light rays into focus on the fovea centralis.

CONVERGENCE.—The movement of the globes toward the midline causes a viewed object to come into focus on corresponding points of the two retinas. This process produces clear, three-dimensional vision.
HEARING

The ear is the primary organ of hearing and the sense organ for balance. Its major parts are illustrated in Figure 6-59. The ear is divided into three parts: the external, middle, and inner ear.

External Ear

The external (outer) ear is composed of two parts, the **auricle** and the **external auditory canal** (see Fig. 6-15). The auricle, or pinna, is a cartilaginous structure located on each side of the head.

The auricle collects sound waves from the environments that are conducted by the external auditory canal (about 3cm long) to the eardrum. The lining of the external auditory canal contains glands that secrete a wax-like substance called **cerumen**. Cerumen aids in protecting the eardrum against foreign bodies and microorganisms.

The **tympanic membrane**, or eardrum, is an oval sheet of fibrous epithelial tissue that stretches across the inner end of the external auditory canal (Fig. 6-59). The eardrum separates the outer and middle ear. Sound waves cause the eardrum to vibrate, and this vibration transfers the sounds from the external environment to the auditory ossicles.

![Diagram of the ear](image)

Figure 6-59.— Effect of sound waves on cochlear structures. A, Sound waves strike the tympanic membrane and cause it to vibrate. This causes the membrane of the oval window to vibrate, which causes the perilymph in the bony labyrinth of the cochlea and the endolymph in the membranous labyrinth of the cochlea, or cochlear duct, to move. This movement of endolymph causes the basilar (spiral) membrane to vibrate, which in turn stimulates hair cells on the organ of Corti (spiral organ) to transmit nerve impulses along the cranial nerve. Eventually, nerve impulses reach the auditory cortex and are interpreted as sound. B, High-frequency (high-pitch) waves stimulate hair cells nearer the stapes (oval window) and low-frequency (low-pitch) waves stimulate hair cells nearer the distal end of the cochlea. The location of peak stimulation of the hair cells allows the brain to interpret the pitch of the sound. (B: Adapted from Guyton A, Hall J: *Textbook of medical physiology*, ed 11, Philadelphia, 2006, Saunders.)

Middle Ear

The middle ear is a cavity in the temporal bone, lined with epithelium. It contains three auditory ossicles the malleus (hammer), the incus (anvil), and the stapes (stirrup) which transmit vibrations from the tympanic membrane to the fluid in the inner ear (Fig. 6-59). The malleus is attached to the inner surface of the eardrum and connects with the incus, which in turn connects with the stapes. The base of the stapes is attached to the oval window, the membrane-covered opening of the inner ear. These tiny bones, which span the middle ear, are suspended from bony walls by ligaments. This arrangement provides the mechanical means for transmitting sound vibrations to the inner ear.

The eustachian tube, or auditory tube, connects the middle ear with the nasopharynx. It is lined with a mucous membrane and is about 36 mm long. Its function is to equalize internal and external air pressure. For example, while riding an elevator in a tall building, a person may experience a feeling of pressure in the ear. This condition is usually relieved by swallowing, which opens the eustachian tube and allows the pressurized air to escape and equalize with the area of lower pressure. Divers who ascend too fast to allow pressure to adjust may experience rupture of their eardrums. The eustachian tube can also provide a pathway for infection of the middle ear.

Inner Ear

The inner ear is filled with a fluid called endolymph. Sound vibrations cause the stapes to move against the oval window create internal ripples that run through the endolymph. These pressurized ripples move to the cochlea, a small snail-shaped structure where the cochlear duct (the only part of the inner ear concerned with hearing) is located housing the organ of Corti, the hearing organ (Fig. 6-60).

The cells protruding from the organ of Corti are stimulated by the ripples to convert these mechanical vibrations into nerve impulses, and these impulses are relayed through the vestibulocochlear (8th cranial) nerve to the auditory area of the cortex in the temporal lobe of the brain. There they are interpreted as the sounds a person hears (Fig. 6-59).

The vestibule constitutes the central section of the bony labyrinth. The bony labyrinth opens to the oval window as well as the three semicircular canals which are situated at right angles to each other (Fig. 6-60). Movement of the endolymph within the canals, caused by general body movements, stimulates nerve endings, which report these changes in body position to the brain, which in turn uses the information to maintain equilibrium.

The sense of organs located in the utricle and saccule function in static equilibrium, a function needed to sense the position of the head relative to gravity or sense acceleration or deceleration of the body. “The sense organs associated with semicircular ducts function in dynamic equilibrium – a function needed to maintain balance when the head or body itself is rotated or suddenly moved.”

The round window is another membrane-covered opening of the inner ear. It is the opening for the auditory tube.

6-78
Figure 6-60.—The inner ear. A, The bony labyrinth (bone colored) is the hard outer wall of the entire inner ear and includes semicircular canals, vestibule, and cochlea. Within the bony labyrinth is the membranous labyrinth (purple), which is surrounded by perilymph and filled with endolymph. Each ampulla in the vestibule contains a crista ampullaris that detects changes in head position and sends sensory impulses through the vestibular nerve to the brain. B, The inset shows a section of the membranous cochlea. Hair cells in the organ of Corti (spiral organ) detect sound and send the information through the cochlear nerve. The vestibular and cochlear nerves join to form the eighth cranial nerve.

TOUCH

Until the beginning of the last century, touch (feeling) was treated as a single sense. Thus, warmth or coldness, pressure, and pain, were thought to be part of a single sense of touch or feeling. It was discovered that different types of nerve ending receptors are widely and unevenly distributed in the skin and mucous membranes. For example, the skin of the back possesses relatively few touch and pressure receptors while the fingertips have many. The skin of the face has relatively few cold receptors, and mucous membranes have few heat receptors. The cornea of the eye is sensitive to pain, and when pain sensation is abolished by a local anesthetic, a sensation of touch can be experienced.

Receptors are considered to be sensory organs. They provide the body with the general senses of touch, temperature, and pain. In addition, these receptors initiate reactions or reflexes in the body to maintain homeostasis. For example, receptors in the skin perceive cold, resulting in goose bumps. This reaction is the body’s attempt to maintain internal warmth.

Receptors are classified according to location, structure, and types of stimuli activating them. Classified according to location, the three types of receptors are as follows: superficial receptors (exteroceptors), deep receptors (proprioceptors), and internal receptors (visceroceptors). See Table 6-7 for receptor locations and the senses resulting from the stimulation of these receptors.

<table>
<thead>
<tr>
<th>TYPES</th>
<th>LOCATIONS</th>
<th>SENSES</th>
</tr>
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<tbody>
<tr>
<td>Superficial receptors</td>
<td>At or near surface of body</td>
<td>Touch, pressure, heat, cold, and pain</td>
</tr>
<tr>
<td>Deep receptors</td>
<td>In muscles, tendons, and joints</td>
<td>Sense of position and movement</td>
</tr>
<tr>
<td>Internal receptors</td>
<td>In the internal organs and blood vessel walls</td>
<td>Usually none (except hunger, nausea, pain from stimuli such as chemicals (e.g., aspirin) and distension (e.g., stomach expansion from gas))</td>
</tr>
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Table 6-7.—Types of Receptors, Their Locations, and Affected Senses

THE ENDOCRINE SYSTEM

LEARNING OBJECTIVES:

Identify endocrine glands and the hormone(s) they produce.

Summarize the effect each hormone has on the body.

Homeostasis, the self balancing of the body’s internal environment, is achieved and maintained by the endocrine system and the nervous systems. These systems work in concert to perform similar functions in the body: communication, integration, and control. Their communication capabilities provide the means for controlling and integrating the many different functions performed by organs, tissues, and cells. The endocrine system performs these functions by different mechanisms than the nervous system.

The endocrine system sends messages by way of chemical messengers called hormones. Minute amounts of these hormones are secreted from endocrine gland cells into the blood and distributed by the circulatory system.
Cells that are affected by the hormone are referred to as **target organ cells**. Endocrine glands secrete hormones directly into the blood, because they have no duct system. The glands of this system are often called **ductless glands** unlike exocrine glands that secrete their products into ducts.

Many hormones can be extracted from the glands of animals or produced synthetically. Medical Officers may prescribe these naturally derived or synthetic hormones for patients deficient in them or might otherwise benefit from their use. Oxytocin (the hormone which stimulates uterine contractions during pregnancy) has been synthesized and is used during the delivery process for women who are deficient in this hormone.

The hormone-producing glands include the hypothalamus (Fig. 6-61), pituitary, pineal, thyroid, parathyroids, adrenals, pancreas, gonads (the testes and ovaries), placenta, and thymus (Fig. 6-62).

**HYPOTHALAMUS**

The hypothalamus, a structure in the brain, synthesizes chemicals that are secreted to the pituitary gland to release hormones and to help regulate body temperature (Fig. 6-61).
PITUITARY GLAND

The pituitary is a small, pea-sized gland located at the base of the brain in the sella turcica, the Turkish saddle-shape depression of the sphenoid bone. The pituitary is connected to the hypothalamus by the stalk called infundibulum. (Fig. 6-61). It is often called the master gland of the body as it influences many other endocrine glands. Although the pituitary looks like just one gland, it actually consists of two separate glands, the anterior pituitary gland and the posterior pituitary gland (Fig. 6-62).

Anterior Pituitary Gland

The anterior pituitary gland plays the more important role in influencing body functions. The five main secretions produced by the anterior pituitary gland have a broad and significant range of effects.

SOMATOTROPHS.—Somatotropin, the growth hormone, influences body growth and development. During the growth years, an overproduction of somatotropin causes Gigantism, while the lack of it causes Dwarfism. An overproduction after the growth years causes acromegaly, which is characterized by the development of abnormally large hands, feet, and jaw.
THYROTROPHS.—Thyrotropin, or the thyroid-stimulating hormone (TSH), influences the growth, development, and secreting activities of the thyroid gland.

GONADOTROPHS.—Gonadotropin influences the gonads and is essential for the normal development and functioning of both male and female reproductive systems.

CORTICOTROPHS.—The adrenocorticotropin hormone (ACTH) acts primarily on the adrenal cortex (the outer portion of the adrenal glands), stimulating its growth and its secretion of corticosteroids. Corticosteroid hormones affect every cell in the body.

LACTOTROPHS.—Prolactin (PRL): “during pregnancy, a high level of PRL promotes the development of the breasts in anticipation of milk secretion. At the birth of an infant, PRL in the mother stimulates the mammary glands to begin milk secretion.”

Posterior Pituitary Gland

The posterior pituitary gland stores two hormones, antidiuretic hormone (ADH) and oxytocin.

ANTIDIURETIC.—The ADH hormone, promotes the conservation of water by the kidney. ADH stimulates contraction of muscles in the wall of small arteries thus increasing blood pressure by retaining fluids in the vasculature. When ADH is not produced in adequate amounts, the daily urine volume increases to 10 and 15 liters instead of the normal 1.5 liters. This condition is known as diabetes insipidus.

OXYTOCIN.—Oxytocin stimulates contraction of the muscles of the uterus, particularly during delivery of a baby. It also plays an important role in the secretion of milk in the mammary glands of nursing mothers.

PINEAL GLAND

The pineal gland, or pineal body, is a tiny structure resembling a pine nut located on the dorsal aspect of the brain’s diencephalons region. It produces small amounts of different hormones with melatonin being the main one. It is known as the biological clock; melatonin levels rise when sunlight is absent triggering sleepiness.

THYROID GLAND

The thyroid gland, shaped like a butterfly, lies in the anterior part of the neck, below the larynx (Figs. 6-63 and 6-64). It consists of two lobes, one on each side of the upper trachea, connected by a strip of tissue called the isthmus. The thyroid secretes the iodine containing hormone thyroxin (TSH), which controls the rate of cell metabolism. Excessive secretion of thyroxin raises the metabolic rate and causes hyperthyroidism. This condition is characterized by a fast pulse rate, dizziness, increased basal metabolism, profuse sweating, tremors, nervousness, and a tremendous appetite coupled with weight loss.

Iodine is essential for the formation of thyroxin. Simple goiter, a diffuse and painless enlargement of the thyroid gland, was common in areas of the United States where the iodine content of the soil and water was inadequate. In simple goiter, the gland enlarges to compensate for the lack of iodine. To prevent formation of a simple goiter, iodine-containing foods, such as vegetables, iodized salt, and seafood, should be eaten.

A condition known as hypothyroidism is caused by an insufficient secretion of thyroxin. The patient exhibits a decrease in basal metabolism, and sweating is almost absent. There may be a weight gain and constant fatigue. The heart rate may be slow, and a simple goiter may form. There may also be personality changes characterized by slow, lethargic mental functioning. Hypothyroidism during childhood can lead to the development of cretinism. Cretinism is a condition characterized by retarded mental and physical development.
Figure 6-63.—Thyroid gland. A, In this drawing, the relationship of the thyroid to the larynx (voice box) and to the trachea is easily seen. B, In this photo of a dissected cadaver, the location of the thyroid relative to the carotid arteries and jugular veins is seen. (B: From Jacob S: Atlas of human anatomy, Edinburgh, 2002, Churchill Livingstone.)


Figure 6-64.—Parathyroid gland. A, In this drawing from a posterior view, note the relationship of the parathyroid glands to each other, to the thyroid gland, to the larynx (voice box), and to the trachea. B, Photo of a cadaver dissection (also from a posterior view) showing several parathyroid glands on the posterior surface of the lateral lobes of an isolated thyroid gland. (B: From Abrahams P, Marks S, Hutchings R: McMinn's color atlas of human anatomy, ed 3, Philadelphia, 2003, Mosby.)

PARATHYROID GLANDS

Parathyroid glands are four small round bodies located just posterior to the thyroid gland (Fig. 6-64). Their hormone, parathormone (PTH), regulates the calcium and phosphorus content of the blood and bones. The amount of calcium is important in certain tissue activities, such as bone formation, coagulation of blood, maintenance of normal muscular excitability, and milk production in the nursing mother. Diminished function or removal of the parathyroid glands results in a low calcium level in the blood. In extreme cases death may occur, preceded by strong contraction of the muscles (tetany) and convulsions.

Hyperparathyroidism, an excess of parathyroid hormone in the blood, causes calcium levels in the blood to become elevated by the withdrawal of calcium from the bones, leaving the skeleton demineralized and subject to spontaneous fractures. The excess calcium may be deposited as stones in the kidneys.

ADRENAL GLANDS

The adrenal glands are located on the superior surface of each kidney, fitting like a cap (Fig. 6-65). They consist of an outer portion, the cortex, and an inner portion, the medulla.

Adrenal Cortex

Specialized cells in the outer layer of the adrenal cortex produce three types of steroid hormones that are of vital importance.

MINERALOCORTICOIDS.—
Mineralocorticoids are regulators of fluid and electrolyte balance. Sometimes called salt and water hormones because they regulate the excretion and absorption of sodium, chlorine, potassium, and water. In humans, aldosterone is the only physiologically important mineralocorticoid. Its primary function is the maintenance of sodium homeostasis in the blood. Aldosterone accomplishes this by increasing sodium reabsorption in the kidneys.

Figure 6-65.—Structure of the adrenal gland. The zona glomerulosa of the cortex secretes aldosterone. The zona fasciculata secretes abundant amounts of glucocorticoids, chiefly cortisol. The zona reticularis secretes minute amounts of sex hormones and glucocorticoids. A portion of the medulla is visible at lower right at the bottom of the drawing.

GLUCOCORTICOIDs.—Glucocorticoids are essential to metabolism. They increase certain liver functions and have an anti-inflammatory effect. Clinically, they are used to suppress inflammatory reactions, to promote healing, to treat rheumatoid arthritis, and maintain normal blood pressure. One of the main glucocorticoids secreted in significant amounts is cortisol.

GONADOCORTICOIDs.—The adrenal cortex also produces sex hormones, some with male characteristics (androgens), others with female characteristics (estrogens). These hormones appear in different concentrations in both men and women.

Adrenal Medulla

The adrenal medulla secretes epinephrine (adrenalin) in the presence of emotional crises, hypoglycemia (low blood sugar), or low blood pressure. Epinephrine causes powerful contractions of many arterioles (especially in the skin, mucous membranes, and kidneys), but it dilates other arterioles (such as those of the coronary system, skeletal muscles, and lungs). Heart rate, respiration rate and depth, blood pressure, blood sugar levels, and metabolism are all increased by epinephrine. It stimulates the production of other adrenal cortical hormones.

Norepinephrine is produced in the adrenal medulla and a chemical precursor to epinephrine. Its effects are similar to those of epinephrine, but its action differs.

Despite these marked influences, the medullary tissue of the adrenal gland is not essential to life, because its various functions can be assumed by other regulatory mechanisms.

PANCREAS

The pancreas contains exocrine and endocrine tissues. The exocrine tissue secretes digestive juice through a duct to the small intestine, while the endocrine tissue releases hormones into body fluids. The endocrine portion of the pancreas consists of cells arranged in groups, called islands (islets) of Langerhans. The islands (islets) of Langerhans contain three types of endocrine cells: alpha, beta, and delta. The alpha cells secrete the hormone glucagon. Glucagon causes a temporary rise in blood sugar levels. The beta cells secrete insulin, which is essential for carbohydrate metabolism. Insulin lowers blood sugar levels by increasing tissue utilization of glucose and stimulating the formation and storage of glycogen in the liver. Together, glucagon and insulin act to regulate sugar metabolism in the body. Delta cells produce the hormone somatostatin. Somatostatin helps regulate carbohydrates by inhibiting the secretion of glucagon.

When the islet cells are destroyed or stop functioning, the sugar absorbed from the intestine remains in the blood and excess sugar is excreted by the kidneys into the urine. This condition is called diabetes mellitus, or sugar diabetes. Insulin, a synthetic hormone, is given to patients having this disease as part of their ongoing treatment.
GONADS (TESTES AND OVARIIES)

The term gonad refers to the primary sex organs of the reproductive system (male and female).

Testes

The male gonad is the testis (pl. testes), and the existence of the testes is the primary male sex characteristic (Fig. 6-66). The testes produce and secrete the male hormone testosterone, which influences the development and maintenance of the male accessory sex organs and the secondary sex characteristics.

Male Secondary Sex Characteristics

- Enlargement of the larynx (Adam's apple) and thickening of the vocal cords, which produces a lower-pitched voice
- Thickening of the skin
- Increased muscle growth, broadening of the shoulder and narrowing of the waist
- Thickening and strengthening of the bones

The male accessory sex organs include two groups of organs: the internal sex organs and the external sex organs. See section titled "Male Reproductive System" for more information on the male accessory sex organs.

Ovaries

The female gonads, the ovaries, produce the hormones estrogen and progesterone (Fig. 6-66). Estrogen influences the development and maintenance of the female accessory sex organs and the secondary sex characteristics, and promotes changes in the mucous lining of the uterus (endometrium) during the menstrual cycle. Progesterone prepares the uterus for the reception and development of the fertilized ovum and maintains the lining during pregnancy.

Estrogen and progesterone hormones (naturally derived) are incorporated into oral contraceptives or birth control pills. The combination of hormones released through a monthly series of pills fools the body into not preparing (building-up of uterine lining) for implantation of an embryo. As the uterus has not prepared for implantation, pregnancy cannot occur.

Figure 6-66.—Locations of some major endocrine glands.

Female Secondary Sex Characteristics: Estrogen Influenced

- Development of the breasts and the ductile system of the mammary glands within the breasts
- Increased quantities of fatty (or adipose) tissue in the subcutaneous layer, especially in the breasts, thighs, and buttocks
- Increased vascularization of the skin

Female accessory sex organs are also divided into internal and external accessory sex organs. See section titled "Female Reproductive System" for more information on the female accessory sex organs.

PLACENTA

“The placenta, the tissue that forms on the lining of the uterus as an interface between the circulatory systems of the mother and developing child, serves as a temporary endocrine gland. The placenta produces the human chorionic gonadotropin (HCG).” This hormone is high during the first 3 months of pregnancy to tell the female’s gonads to maintain the uterine lining instead of falling away as in menstruation. HCG is the hormone used for early pregnancy tests.

THYMUS

The thymus is a gland located in the mediastinum just beneath the sternum. It is large in children and atrophies as they become adults, once they reach old age it becomes a vestige of fat and fibrous tissue. It has a critical role in the immune system, thought to stimulate the production of T cells.

GASTRIC MUCOSA

The hormone Ghrelin produced by the endocrine cells in the gastric mucosa stimulates the hypothalamus to boost appetite, slow metabolism and fat burning, and may play an important role in obesity.

THE RESPIRATORY SYSTEM

LEARNING OBJECTIVES:

Identify the parts, location, and function of each part of the respiratory system.

Describe the process of respiration.

Respiration is the exchange of oxygen and carbon dioxide between the atmosphere and the cells of the body. There are two phases of respiration:

- Physical, or mechanical respiration (external respiration) involves the motion of the diaphragm and rib cage. The musculoskeletal action, which resembles that of a bellows, causes air to be inhaled or exhaled

- Physiological respiration (internal respiration) involves an exchange of gases, oxygen and carbon dioxide, at two points in the body. The first is the transfer that occurs in the lungs between the incoming oxygen and the carbon dioxide present in the capillaries of the lungs (external respiration). The second transfer occurs when oxygen brought into the body replaces carbon dioxide buildup in the cellular tissue (internal respiration).

Oxygen and carbon dioxide exchange in equal volumes; however, certain physiological conditions may throw this balance off. For example, heavy smokers will find that the ability of their lungs to exchange gases is impaired, leading to shortness of breath and fatigue during even slight physical exertion. This debilitating situation is the direct result of their inability to draw a sufficient amount of oxygen into the body to replace the carbon dioxide buildup resulting in fatigue. Another example, hyperventilation brings too much oxygen into the body, overloading the system with oxygen, and depleting the carbon dioxide needed for balance.
ANATOMY OF THE RESPIRATORY SYSTEM

Air enters the nasal chambers and the mouth, then passes through the pharynx, larynx, trachea, and bronchi into the bronchioles. Each bronchiole is surrounded by a cluster of alveoli (Fig. 6-67).

Nasal Cavity

Air enters the nasal cavity through the nostrils (nares). Lining the nasal passages are hairs (cilia), which, together with the mucous membrane, entrap and filter out dust and other minute particles that could irritate the lungs. Incoming air is warmed and moistened in the chambers of the nasal cavity to prevent damage to the lungs.

Figure 6-67.— Structural plan of the respiratory system. The inset shows the alveolar sacs where the interchange of oxygen and carbon dioxide takes place through the walls of the grapelike alveoli.


6-89
Figure 6-68.—Upper respiratory tract. In this midsagittal section through the upper respiratory tract, the nasal septum has been removed to reveal the turbinates (nasal conchae) of the lateral wall of the nasal cavity. The three divisions of the pharynx (nasopharynx, oropharynx, and laryngopharynx) are also visible.


**Pharynx**

The pharynx, or throat, serves both the respiratory and digestive systems and aids in speech. It has a mucous membrane lining that traps microscopic particles in the air and aids in adjusting temperature and humidifying inspired (inhaled) air. The pharynx connects with the mouth and nasal chambers posteriorly. According to its location, the pharynx is referred to as the **nasopharynx** (posterior to the nasal chambers), the **oropharynx** (posterior to the mouth), or the **laryngopharynx** (posterior to the pharynx).

**Epiglottis**

The epiglottis is a lid-like, leaf-shaped cartilaginous structure that covers the entrance to the larynx and separates it from the pharynx. It acts as a trap door to deflect food particles and liquids from entering the larynx and trachea.
Larynx

The larynx, or voice box, is a triangular cartilaginous structure located between the tongue and the trachea. It is protected anteriorly by the thyroid cartilage (called the Adam's apple) which is usually larger and more prominent in men than women. During the act of swallowing, it is pulled upward and forward toward the base of the tongue. The larynx is responsible for the production of vocal sound (voice). This sound production is accomplished by the passing of air over the vocal cords. The ensuing vibrations can be controlled to produce the sounds of speech or singing. The nose, mouth, throat, sinuses, and chest serve as resonating chambers to further refine and individualize the voice (Fig. 6-69).

Figure 6-69.—Vocal folds. A, Vocal folds viewed from above. B, Photograph taken with an endoscope showing the vocal folds in the open position. (B: Custom Medical Stock Photo Inc.)

Trachea

The trachea, or windpipe, begins at the lower end of the larynx and terminates by dividing into the right and left bronchi. It is a long tube about 11 cm composed of 16 to 20 C-shaped cartilaginous rings, incomplete on the posterior surface, embedded in a fibrous membrane, that support its walls, preventing their collapse (Fig. 6-70).

The trachea has a ciliated mucous membrane lining that entraps dust and foreign material. It also propels secretions and exudates from the lungs to the pharynx, where they can be expectorated or swallowed.

Bronchi

The trachea splits into two primary bronchi, the right being larger and more vertical than the left; this is where they enter the lungs. This explains why more foreign objects get lodged on the right side. Once entering the lungs they immediately divide into smaller branches to carry air to each lung and further divide into the bronchioles.

Bronchioles

The bronchioles are much smaller than the bronchi and lack supporting rings of cartilage. They terminate at the alveoli.

Alveoli

The alveoli are thin, microscopic air sacs within the lungs (Fig. 6-71). They are in direct contact with the pulmonary capillaries. It is here that oxygen exchanges with carbon dioxide by means of a diffusion process through the alveolar and capillary cell walls. The lungs are cone-shaped organs that lie in the thoracic cavity. Each lung contains thousands of alveoli with their capillaries. The right lung is larger than the left lung and is divided into superior, middle, and inferior lobes. The left lung has two lobes, the superior and the inferior (Fig. 6-72).

Figure 6-70.—Cross section of the trachea. The inset at the top shows from where the section was cut. The scanning electron micrograph shows details of the mucous coat, the tip of a cartilage ring, and the adventitia that form the wall of the trachea (×300). (From Erlandsen SL, Magney J: Color atlas of histology, St Louis, 1992, Mosby.)

Figure 6-71.—Alveoli. A. Respiratory bronchioles subdivide to form tiny tubes called alveolar ducts, which end in clusters of alveoli called alveolar sacs. B. Scanning electron micrograph of a bronchiole, alveolar ducts, and surrounding alveoli. The arrowhead indicates the opening of alveoli into the alveolar duct. (B: From Erlandsen SL, Magney J: Color atlas of histology, St Louis, 1992, Mosby.)

Pleurae

The pleurae are airtight membranes that cover the outer surface of the lungs and line the chest wall. They secrete a serous fluid that prevents friction during movements of respiration.

The mediastinum is the tissue and organs of the thoracic cavity that form a septum between the lungs. It extends from the sternum to the thoracic vertebrae and from the fascia of the neck to the diaphragm. The mediastinum contains the heart, great blood vessels, esophagus, a portion of the trachea, and the primary bronchi (Fig. 6-73).
Diaphragm

The diaphragm is the primary muscle of respiration. It is a dome-shaped muscle and separates the thoracic and abdominal cavities. Contraction of this muscle flattens the dome and expands the vertical diameter of the chest cavity by descending into the abdominal cavity.

Intercostal Muscles

The intercostal muscles are situated between the ribs. Their contraction pulls the ribs upward and outward, resulting in an increase in the transverse diameter of the chest (chest expansion).

Inhalation is the direct result of the expansion caused by the action of the diaphragm and intercostal muscles. The increase in chest volume creates a negative (lower than atmospheric) pressure in the pleural cavity and lungs. Air rushes into the lungs through the mouth and nose to equalize the pressure. Exhalation results when the muscles of respiration relax. Pressure is exerted inwardly as muscles and bones return to their normal position, forcing air from the lungs.

THE PROCESS OF RESPIRATION

The rhythmical movements of breathing are controlled by the respiratory center in the brain. Nerves from the brain pass down through the neck to the chest wall and diaphragm. The nerve controlling the diaphragm is called the phrenic nerve; the nerve controlling the larynx is the vagus nerve; and the nerves controlling the muscles between the ribs are the intercostal nerves. The respiratory center is stimulated by chemical changes in the blood. When too much carbon dioxide accumulates in the blood stream, causing the blood to become acidic, the respiratory center signals the lungs to breathe faster to get rid of the carbon dioxide.
The respiratory center can be stimulated or depressed by a signal from the brain. For example, changes in one's emotional state can alter respiration through laughter, crying, emotional shock, or panic.

The muscles of respiration normally act automatically, with normal respiration being 14 to 18 cycles per minute. The lungs, when filled to capacity, hold about 6,200 ml of air, but only 500 ml of air is exchanged with each normal respiration. This exchanged air is called tidal air. The amount of air left in the lungs after forceful exhalation is about 1,200 ml and is known as residual air.

THE DIGESTIVE SYSTEM

LEARNING OBJECTIVE:

Identify the location and function of each part of the digestive system.

The digestive system includes organs that digest and absorb food substances, and eliminate the unused residuals. The digestive system consists of the alimentary canal and several accessory organs. The accessory organs release secretions into the canal. These secretions assist in preparing food for absorption and use by body tissues. Table 6-8 illustrates principal digestive juices (secretions) produced by alimentary and accessory organs.

Digestion is both mechanical and chemical. Mechanical digestion occurs when food is chewed, swallowed, and propelled by a wave-like motion called peristalsis. When peristalsis occurs, a ring of reflex contraction appears in the walls of the alimentary canal. As the wave moves along, it pushes the canal's contents ahead of it (Fig. 6-74).

<table>
<thead>
<tr>
<th>Digestive Juice</th>
<th>Source</th>
<th>Substance Acted Upon</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amylase</td>
<td>Salivary glands and pancreas</td>
<td>Starch</td>
<td>Complex sugars (maltose)</td>
</tr>
<tr>
<td>Hydrochloric acid</td>
<td>Gastric glands</td>
<td>Pepsinogen (Proteins)</td>
<td>Pepsin (Split proteins)</td>
</tr>
<tr>
<td>Bile</td>
<td>Liver</td>
<td>Fats</td>
<td>Emulsified fats</td>
</tr>
<tr>
<td>Proteinase</td>
<td>Pancreas</td>
<td>Proteins and split proteins</td>
<td>Peptides and polypeptides</td>
</tr>
<tr>
<td>Lipase</td>
<td>Pancreas</td>
<td>Fats</td>
<td>Fatty acids</td>
</tr>
<tr>
<td>Carbohydrase</td>
<td>Intestinal glands</td>
<td>Complex sugars (maltose, sucrose, and lactose)</td>
<td>Simple sugars (glucose, fructose, and galactose)</td>
</tr>
<tr>
<td>Peptidase</td>
<td>Intestinal glands</td>
<td>Peptides and polypeptides</td>
<td>Amino acids</td>
</tr>
</tbody>
</table>

Table 6-8.—Principal Digestive Juices

Chemical digestion consists of changing the various food substances, with the aid of digestive enzymes, into solutions and simple compounds. Complex carbohydrates (starches and sugars) change into simple sugars (glucose); fats change into fatty acids; and proteins change into amino acids. Once the food substances have been broken down into simple compounds, the cells of the body can absorb and use them.
THE ALIMENTARY CANAL

The alimentary canal (tract) is 9 meters in length, tubular, and includes the mouth, pharynx, esophagus, stomach, small intestine, and large intestine.

Mouth

The mouth, which is the first portion of the alimentary canal, is adapted to receive food and prepare it for digestion (Fig. 6-75). The mouth mechanically reduces the size of solid particles and mixes them with saliva; this process is called mastication. Saliva, produced by the salivary gland, moistens food making it easier to chew (Fig. 6-76). Saliva also lubricates the food mass to aid swallowing. The tongue assists with both mastication and swallowing.

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**Figure 6-74.** Peristalsis. Peristalsis is a progressive type of movement in which material is propelled from point to point along the gastrointestinal (GI) tract. A, A ring of contraction occurs where the GI wall is stretched, and the bolus is pushed forward. B, The moving bolus triggers a ring of contraction in the next region that pushes the bolus even farther along. C, The ring of contraction moves like a wave along the GI tract to push the bolus forward.


**Figure 6-75.** The oral cavity.

Mastication and Deglutition

The mastication process includes the biting and tearing of food into manageable pieces. This usually involves using the incisors and cuspid teeth. The grinding of food is usually performed by the molars and premolars. During the mastication process, food is moistened and mixed with saliva.

Deglutition is the swallowing of food and involves a complex and coordinated process. It is divided into three phases; the first phase of swallowing is voluntarily; phases two and three are involuntary.

- **Phase One, Oral Stage:** the collection and swallowing of masticated food
- **Phase Two, Pharyngeal Stage:** Passage of food through the pharynx into the beginning of the esophagus
- **Phase Three, Esophageal Stage:** The passage of food into the stomach

The process of moving food from the pharynx into the esophagus requires that three openings must be blocked: the mouth, nasopharynx, and the larynx (Fig. 6-77).
**Pharynx**

The pharynx is the passageway between the mouth and the esophagus and is shared with the respiratory tract. The epiglottis is a cartilaginous flap that closes the opening to the larynx when food is being swallowed down the pharynx. Food is deflected away from the trachea to prevent particle aspiration (inhalation).

**Esophagus**

The esophagus is a muscular tube about 25 cm (10 inches) long and pierces the diaphragm on its way to the stomach (Fig. 6-78). It is the passageway between the pharynx and the stomach. “Each end of the esophagus is encircled by muscular sphincters that act as valves to regulate passage of material. The upper esophageal sphincter in the cervical part of the esophagus helps prevent air entering the esophagus during respiration;” it is also the valve that is relaxed when a person belches. The lower esophageal sphincter is at the junction with the stomach which helps keep food in; when this is damaged or does not work properly a patient gets heartburn or gastroesophageal reflux disease (GERD). By means of peristalsis, food is pushed along this tube to the stomach. When peristalsis is reversed, vomiting occurs.

**Figure 6-77. Deglutition. A, Oral stage.** During this stage of deglutition (swallowing), a bolus of food is voluntarily formed on the tongue and pushed against the palate and then into the oropharynx. Notice that the soft palate acts as a valve that prevents food from entering the nasopharynx. B, Pharyngeal stage. After the bolus has entered the oropharynx, involuntary reflexes push the bolus down toward the esophagus. Notice that upward movement of the larynx and downward movement of the bolus close the epiglottis and thus prevent food from entering the lower respiratory tract. C, Esophageal stage. Involuntary reflexes of skeletal (striated) and smooth muscle in the wall of the esophagus move the bolus through the esophagus toward the stomach.

Stomach

The stomach acts as an initial storehouse for swallowed material and helps in the chemical breakdown of food substances. The stomach is a saccular enlargement of the gastrointestinal tube and lies in the left upper quadrant of the abdomen (Fig. 6-79). It connects the lower end of the esophagus with the first portion of the small intestine (the duodenum). The stomach is divided into the cardiac, fundus, body, and pyloric regions (Fig. 6-79). At each end of the stomach, muscular rings (or sphincters) form valves to close off the stomach. The sphincters prevent the stomach’s contents from escaping in either direction while food substances are being mixed by peristaltic muscular contractions of the stomach wall. The sphincter at the esophageal end is the cardiac sphincter or lower esophageal sphincter; at the duodenal end it is the pyloric sphincter.

The chemical breakdown of food in the stomach is accomplished through the production of digestive juices (enzymes) by small (gastric) glands in the wall of the stomach. The principal digestive enzyme produced by the gastric glands is pepsinogen along with a secondary enzyme, hydrochloric acid. Hydrochloric acid activates pepsin from pepsinogen, kills bacteria that enter the stomach, inhibits the digestive action of amylase, and helps regulate the opening and closing of the pyloric sphincter. Pepsin is a protein-splitting enzyme capable of beginning the digestion of nearly all types of dietary protein.

Most food absorption takes place in the small intestine. In general, food is not absorbed in the stomach. An exception is alcohol, which is absorbed directly through the stomach wall. It is for this reason that intoxication occurs quickly when alcohol is taken on an empty stomach.
Abdominal Cavity

The stomach and intestines are enclosed in the abdominal cavity, the space between the diaphragm and the pelvis. This cavity is lined with a serous membrane called the peritoneum. The peritoneum covers the intestines and the organs; by secreting a serous fluid, it prevents friction between adjacent organs. The mesentery (double folds of peritoneum) extends from the cavity walls to the organs of the abdominal cavity, suspending them in position and carrying blood vessels to the organs.

Small Intestine

The small intestine is a muscular, convoluted, coiled tube, about 7 meters (23 feet) long and attached to the posterior abdominal wall by its mesentery.

The small intestine is divided into three contiguous parts: the duodenum, jejunum, and ileum. It receives digestive juices from three accessory organs of digestion: the pancreas, liver, and gallbladder.

DUODENUM.—The duodenum is approximately 25 cm (10 inches) long and forms a C-shaped curve around the head of the pancreas, posterior to the liver. It has enzymes that start the breakdown of foods and receives enzymes from the pancreas that assist in digestion.

JEJUNUM.—The jejunum is the middle part of the small intestine; it is approximately 2.5 meters (8.2 feet) long. Its enzymes continue the digestive process.
ILEUM.—The ileum is the last and longest part of the small intestine; it is approximately 3.5 meters (12 feet) long.

Most of the absorption of food occurs in the small intestines, where fingerlike projections (villi) provide a large absorption surface. After ingestion, it takes 20 minutes to 2 hours for the first portion of the food to pass through the small intestine to the beginning of the large intestine.

Large Intestine

The large intestine is so called because it is larger in diameter than the small intestine. It is considerably shorter, being about 1.5 meters (5 feet) long. It is divided into three parts: cecum, colon, and rectum.

CECUM AND COLON.—The unabsorbed food or waste material passes through the cecum into the ascending colon, across the transverse colon, and down the descending colon through the sigmoid colon to the rectum. Twelve hours after the meal, the waste material passes slowly through the colon, building in mass and reaching the rectum 24 hours after the food is ingested.

The appendix, a long narrow tube with a blind end, is a pouch-like structure of the cecum located near the junction of the ileum and the cecum. There is no known function of this structure. The appendix can become infected, causing inflammation to develop. This inflammation of the appendix is known as appendicitis (Fig. 6-80) and requires surgery to correct.

Figure 6-80.—Acute appendicitis. Note the inflamed tissue surrounding the base of a gangrenous appendix.

The rectum is approximately 17-20 cm (7 or 8 inches) long and follows the contour of the sacrum and coccyx until it curves back into the short 2.5 cm (inch) anal canal. The anus is the external opening at the lower end of the digestive system. Except during bowel movement (defecation), it is kept closed by two sphincters. An internal one made of smooth muscle and external one made of striated muscle (Fig. 6-81).

**ACCESSORY ORGANS OF DIGESTION**

The accessory organs of digestion include the salivary glands, pancreas, liver, and gallbladder. As stated earlier, during the digestive process, the accessory organs produce secretions that assist the organs of the alimentary canal.

**Salivary Glands**

The salivary glands are located in the mouth (Fig. 6-76). Within the salivary glands are two types of secretory cells, serous cells and mucous cells. The serous cells produce a watery fluid containing a digestive juice called amylase. Amylase splits starch and glycerol into complex sugars. The mucous cells secrete thick, sticky liquid called mucus. Mucus binds food particles together and acts to lubricate during swallowing. The fluids produced by the serous and mucous cells combine to form saliva. The salivary glands produce 1.7 liters of saliva daily, greatly aiding in the digestion process. Enzymes are present in saliva; they act on food, and start the breakdown process. In dentistry, location of the saliva glands and ducts (openings) is important in keeping the mouth dry during certain dental procedures. Table 6-5 lists the three major salivary glands.

**Pancreas**

The pancreas is a large, elongated gland lying posterior to the stomach (Fig. 6-82). As discussed earlier in "The Endocrine System," the pancreas has two functions: It serves both the endocrine system and the digestive system. The digestive portion of the pancreas produces digestive juices (amylase, proteinase, and lipase) that are secreted through the pancreatic duct to the duodenum. These digestive juices break down carbohydrates (amylase), proteins (proteinase), and fats (lipase) into simpler compounds.
Figure 6-82.—Pancreas. A, Pancreas dissected to show the main and accessory ducts. The main duct may join the common bile duct, as shown here, to enter the duodenum by a single opening at the major duodenal papilla, or the two ducts may have separate openings. The accessory pancreatic duct is usually present and has a separate opening into the duodenum. B, Exocrine glandular cells (around small pancreatic ducts) and endocrine glandular cells of the pancreatic islets (adjacent to blood capillaries). Exocrine pancreatic cells secrete pancreatic juice, alpha endocrine cells secrete glucagon, and beta cells secrete insulin.

Liver

The liver is the largest gland in the body. It is located in the upper abdomen on the right side, just under the diaphragm and superior to the duodenum and pylorus.

Of the liver’s many functions, the following are important:

- It metabolizes carbohydrates, fats, and proteins preparatory to their use or excretion
- It forms and excretes bile salts and pigment from bilirubin, a waste product of red blood cell destruction
- It stores blood; glycogen; vitamins A, D, and B-12; and iron
- It detoxifies the end products of protein digestion and drugs
- It produces antibodies and essential elements of blood-clotting mechanisms

Gallbladder

The gallbladder is a pear-shaped sac, stained dark green by the bile it contains. It is located in the hollow underside of the liver (Fig. 6-83). Its duct, the cystic duct, joins the hepatic duct from the liver to form the common bile duct, which enters the duodenum (Fig. 6-83). The gallbladder receives bile from the liver and then concentrates and stores it. It secretes bile when the small intestine is stimulated by the entrance of fats. Refer to Table 6-9 for a complete review of the digestive organs and processes.

Figure 6-83.—Ducts that carry bile from the liver and gallbladder. Obstruction of either the common hepatic or the common bile duct by a stone or spasm prevents bile from being ejected into the duodenum. The inset shows an x-ray of the gallbladder and the ducts that carry bile taken during a procedure called endoscopic cholangiography. (From Abrahams P, Marks S, Hutchings R: McMinn’s color atlas of human anatomy, ed 5, Philadelphia, 2003, Saunders.)

Digestion and the Whole Body

The process of digestion, as with any other vital function, provides a means of survival for the entire body and also requires the function of other systems. The digestive system's primary contribution to overall homeostasis is its ability to maintain a constancy of nutrient concentration in the internal environment. It accomplishes this by breaking large, complex nutrients into smaller, simpler nutrients so they can be absorbed (see figure). The digestive system also provides the means of absorption—the cellular mechanisms that operate in the absorptive cells of the intestinal mucosa. The digestive system also provides some secondary, less vital functions. For example, the teeth and tongue aid the nervous system and respiratory system in producing spoken language. Also, acid in the stomach assists the immune system by destroying potentially harmful bacteria. Some of the various vital and nonvital roles played by the different organs that make up the digestive system are summarized in the figure.

To accomplish its functions, the digestive system requires functional contributions by other systems of the body. Regulation of digestive motility and secretion requires the active participation of both the nervous system and the endocrine system. The oxygen needed for digestive activity requires the proper functioning of both the respiratory system and the circulatory system. The body's framework (integumentary and skeletal systems) is required to support and protect the digestive organs. The skeletal muscles must function if ingestion, mastication, deglutition, and defecation are to occur normally. As you can see, the digestive system cannot operate alone—nor can any other system or organ, for that matter. The body is truly an integrated system, not a collection of independent components.

Table 6-9.—The Big Picture

THE URINARY SYSTEM

LEARNING OBJECTIVE:

Describe the parts of the urinary system and their function(s).

The urinary system is the primary filtering system of the body (Fig. 6-84). This system is composed of two main organs, the kidneys and urinary bladder. The kidneys produce urine, which is drained from the kidneys by two tubes called ureters. Urine flows down both ureters to the bladder. The urinary bladder is a large reservoir where the urine is temporarily stored before excretion from the body. A tube called the urethra carries the urine from the bladder to the outside of the body. The length of the urethra differs in males and females, the female’s being shorter.

KIDNEYS

The bladder, ureters, and urethra store and pass the products of the kidneys.

The kidneys are two large, bean-shaped organs approximately 11cm by 7cm by 3cm, designed to filter waste materials from the blood (Figs. 6-85 and 6-86). They assist in controlling the rate of red blood cell formation and in the regulation of blood pressure; the absorption of calcium ions; and the volume, composition, and pH of body fluids. The kidneys are located in the upper posterior part of the abdominal cavity, one on each side of the spinal column. The upper end of each kidney reaches above the level of the 12th rib. The suprarenal (adrenal) gland sits like a cap on top of each kidney. The kidneys are protected by a considerable amount of fat and supported by connective tissue and the peritoneum. Attached to the hollow side of each kidney is the dilated upper end of the ureter, forming the renal pelvis.

Figure 6-84.—Location of urinary system organs. A, Anterior view of the urinary organs with the peritoneum and visceral organs removed. B, Surface markings of the kidneys, eleventh and twelfth ribs, spinous processes of L1 to L4, and lower edge of the pleura (posterior view). C, Horizontal (transverse) section of the abdomen showing the retroperitoneal position of the kidneys. (A: Barbara Cousins. B: From Abrahams P, Marks S, Hutchings R: McMinn’s color atlas of human anatomy, ed 5, Philadelphia, 2003, Mosby.)


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Figure 6-86.—Circulation of blood through the kidney. A, Diagram showing the major arteries and veins of the renal circulation. B, Renal arteriogram. Arcuate arteries (1) are seen near the junction of the cortex and medulla, interlobar arteries (2) are present between the medullary pyramids, and lobar arteries (3) and segmental arteries (4) are seen branching from the main renal artery (5). Note the tip of the catheter used to inject contrast material (6) into the proximal part of the main renal artery. (B: From Weir J, Abrahams P: Imaging atlas of the human anatomy, ed 2, Philadelphia, 1997, Mosby.)

The lateral surface of the kidneys is convex in shape, and the medial side is deeply concave. The medial side of each kidney possesses a depression that leads to a hollow chamber called the renal sinus (Fig. 6-85). The entrance of the renal sinus is referred to as the hilum (Fig. 6-85). Blood vessels, nerves, lymphatic vessels, and the ureters pass through the hilum.

The superior end of the ureter forms a funnel-shaped sac called the renal pelvis (Fig. 6-85). The renal pelvis is divided into two or three tubes, called major calyces. The major calyces (sing. calyx) are further subdivided into minor calyces.

There are groups of elevated projections in the walls of the renal pelvis. These projections are called renal papillae. The renal papillae connect to the minor calyces through tiny openings in the minor calyces (Fig. 6-87).

The principal portion of the kidney is divided into two distinct regions: an inner medulla and outer cortex (Fig. 6-85). The renal medulla is composed of pyramid-shaped masses of tubes and tubules called renal pyramids. Renal pyramids drain the urine to the renal pelvis. The renal cortex forms a shell over the renal medulla. Renal cortex tissue dips down, like fingers, between the renal pyramids, and forms renal columns. The cortex possesses very small tubes associated with nephrons. Nephrons are the functional units of the kidneys.

RENAI BLOOD VESSELS.—The renal artery supplies blood to the kidneys. The renal artery enters the kidneys through the hilum and sends off branches to the renal pyramids. These arterial branches are called interlobar arteries. At the border between the medulla and cortex, the interlobar arteries branch to form the arcuate arteries. The arcuate arteries branch and form the interlobular arteries.

The venous system of the kidneys generally follows the same paths as the arteries. Venous blood passes through the interlobular, arcuate, interlobar, and renal veins.

NEPHRONS.—The functional units of the kidneys are called nephrons. There are about 1 million nephrons in each kidney. Each nephron consists of a renal corpuscle and a renal tubule.

The renal corpuscle (Malpighian corpuscle) is composed of a tangled cluster of blood capillaries called a glomerulus. The glomerulus is surrounded by a sac-like structure referred to as the glomerulus capsule or Bowman's capsule (Fig. 6-88).

Leading away from the glomerulus is the renal tubule. The initial portion of the renal tubule is coiled and called the proximal convoluted (meaning coiled or twisted) tubule. The proximal convoluted tubule dips down to become the descending loop of Henle. The tubule then curves upward toward the renal corpuscle and forms the ascending loop of Henle.
Once the ascending limb reaches the region of the renal corpuscle, it is called the distal convoluted tubule. Several distal convoluted tubules merge in the renal cortex to form a collecting duct. The collecting duct begins to merge within the renal medulla. The collecting ducts become increasingly larger as they are joined by other collecting ducts. The resulting tube is called the papillary duct. The papillary duct empties into the minor calyx through an opening in the renal papilla.

Function

The kidneys are effective blood purifiers and fluid balance regulators. In addition to maintaining a normal pH of the blood (acid-base balance), the kidneys keep the blood slightly alkaline by removing excess substances from it. The end product of these functions is the formation of urine, which is excreted from the body.

Urine is formed through a series of processes in the nephron. These processes are filtration, reabsorption, and secretion.

FILTRATION.—Urine formation begins when water and various dissolved substances are filtered out of blood plasma from a glomerular capillary into the glomerular capsule. The filtered substance (glomerular filtrate) leaves the glomerular capsule and enters the renal tubule.

REABSORPTION.—As glomerular filtrate passes through the renal tubule, some of the filtrate is reabsorbed into the blood of the peritubular capillary. The filtrate entering the peritubular capillary will repeat the filtration cycle. This process of reabsorption changes the composition of urine. For instance, the filtrate entering the renal tubule is high in sugar content, but because of the reabsorption process, urine secreted from the body does not contain sugar.

SECRETION.—Secretion is the process by which the peritubular capillary transports certain substances directly into the fluid of the renal tubule. These substances are transported by similar mechanisms as used in the reabsorption process, but done in reverse. For example, certain organic compounds, such as penicillin and histamine, are secreted directly from the proximal convoluted tubule to the renal tubule. Large quantities of hydrogen ions are secreted in this same manner. The secretion of hydrogen ions plays an important role in regulating pH of body fluids.

Figure 6-88.—Nephron. The nephron is the basic functional unit of the kidney. Arrows show the direction of flow within the nephron. (Adapted from Brundage DJ: Renal disorders. Mosby's clinical nursing series, St Louis, 1992, Mosby.)

The glomerulus filters an estimated 1,200 ml of blood through the kidneys each minute (or 2,500 gallons in 24 hours) and about 80 gallons of glomerular filtrate in 24 hours. All the water from this filtrate is reabsorbed in the renal tubules except those containing the concentrated waste products.

The function of the ureters is to carry urine from each kidney to the urinary bladder. The ureters are two membranous tubes 1 mm to 1 cm in diameter and about 25 cm in length. Urine is transported through the ureters by peristaltic waves (produced by the ureter's muscular walls).

**URINARY BLADDER**

The urinary bladder functions as a temporary reservoir for urine. The bladder possesses features that enable urine to enter, be stored, and later be evacuated from the body.

**Structure**

The bladder is a hollow, expandable, muscular organ located in the pelvic girdle. Although the shape of the bladder is spherical, its shape is altered by the pressures of surrounding organs. When it is empty, the inner walls of the bladder form folds. As the bladder fills with urine, the walls become smoother.

The internal floor of the bladder includes a triangular area called the tr
gone (Fig. 6-89). The trigone has three openings at each of its angles. The ureters are attached to the two posterior openings. The anterior opening, at the apex of the trigone, contains a funnel-like continuation called the neck of the bladder. The neck leads to the urethra.

![Figure 6-89.— Structure of the urinary bladder. Frontal view of a dissected urinary bladder (male) in a fully distended state. Inset shows a cross section of the bladder wall, which has layers similar to those in other hollow abdominopelvic organs (compare to Figure 25-2)](image)

The wall of the bladder consists of four bundles of smooth muscle fibers. These interlaced muscle fibers form the **detrusor muscle** (which surrounds the bladder neck) and comprise what is called the **internal urethral sphincter**. The internal urethral sphincter prevents urine from escaping the bladder until the pressure inside the bladder reaches a certain level. Parasympathetic nerve fibers in the detrusor muscle function in the micturition (urination) process. The outer layer (**serous coat**) of the bladder wall consists of two types of tissue, **parietal peritoneum** and **fibrous connective tissue**.

**Micturition (Urination)**

*Micturition* is the process by which urine is expelled from the bladder. It involves the contraction of the detrusor muscle and pressure from surrounding structures to expel the urine. Urination also involves the relaxation of the **external urethral sphincter**. The external urethral sphincter surrounds the urethra about 3 centimeters from the bladder, and is composed of voluntary muscular tissue.

Urination is usually stimulated by the distention of the bladder as it fills with urine. When the walls of the bladder contract, nerve receptors are stimulated and the urination reflex is triggered. The urination reflex causes the internal urethral sphincter to open and the external urethral sphincter to relax. This relaxation allows the bladder to empty. The bladder can hold up to 600 ml of urine. The desire to urinate may not occur until the bladder contains 250-300 ml.

**URETHRA**

The urethra is the tube that carries urine from the bladder to the outside of the body. The **urinary meatus** is the external urethral orifice. In the male, the urethra is common to the urinary and reproductive systems; in the female, it belongs only to the urinary system.

**Female Urethra**

The female urethra is about 4 cm long, extending from the bladder to the external orifice.

**Male Urethra**

The male urethra is about 20 cm long and is divided into three parts: the prostatic, membranous, and penile portions.

**PROSTATIC URETHRA**—The prostatic urethra is surrounded by the prostate gland; it contains the orifices of the prostatic and ejaculatory ducts. This portion of the male urethra is about 2.5 cm long.

**MEMBRANOUS URETHRA.**—The membranous urethra is about 2 cm in length and is surrounded by the external urethral sphincter.

**PENILE URETHRA.**—The penile urethra, the longest portion, is about 15 cm long. It lies in the ventral portion of the penis. The urethra terminates with the external orifice at the tip of the penis.
MALE REPRODUCTIVE SYSTEM

LEARNING OBJECTIVE:

Identify the parts of the male reproductive system and their function(s).

The gonads of the male and female reproductive systems are concerned with the process of reproducing offspring, and each organ is adapted to perform specialized tasks. The primary male sex organs of the reproductive system are the testes. The other structures of the male reproductive system are termed accessory reproductive organs.

The accessory organs include both internal and external reproductive organs. See Figure 6-90 for an illustration of the male reproductive system.

The testes, as stated earlier, are the primary male reproductive organs. They produce sperm cells (spermatozoa) and male hormones, both necessary for reproduction.

Figure 6-90.— The male reproductive system. Illustration shows the testes, epididymis, vas (ductus) deferens, and glands of the male reproductive system in an isolation/dissection format. (Barbara Cousins.)

**Structure**

The testes are oval glands suspended inside a sac (the scrotum) by a **spermatic cord**. The spermatic cords are formed by the vas deferens, arteries, veins, lymphatics, and nerves, all bound together by connective tissue.

Each testis is encapsulated by a tough, white, fibrous tissue called the tunica albuginea. The interior of the testis is divided into 200 or more cone shaped lobules (small lobes). Each lobule contains 1 to 3 highly coiled, convoluted tubules called **seminiferous tubules**. These tubules unite to form a complex network of channels called the **rete testis**. The rete testis give rise to several efferent ductules that join a tube called the **epididymis** (Fig. 6-91).

**Functions**

The testes perform two functions: to produce sperm cells and to secrete male sex hormones. The process by which sperm cells are produced is called **spermatogenesis**. Spermatogenesis occurs in the seminiferous tubules of the testes. Once the sperm cells are formed, they collect in the lumen of each seminiferous tubule. When the sperm cells are ready, they pass through the rete testis to the epididymis, where they remain to mature. The production of sperm cells occurs continually throughout the reproductive life of a male.

The male hormone **testosterone** is produced in the testes. This hormone is initially responsible for the formation of the male reproductive organs. During puberty, testosterone stimulates the enlargement of the testes and various other accessory reproductive organs.

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It causes the development and maintenance of the male secondary sexual characteristics and accessory organs such as the prostate, seminal vesicles; and adult male behavior. Refer to the section titled "The Endocrine System" for more detailed discussion on male secondary sexual characteristics.

Other actions of testosterone include increasing the production of red blood cells. As a result, the average number of red blood cells in blood is usually greater in males than in females. Testosterone promotes the growth of skeletal muscles, which has tempted people to use them in a dangerous way.

INTERNAL ACCESSORY ORGANS

The internal accessory organs of the male reproductive system include the epididymis, vas deferens, ejaculatory ducts, seminal vesicle, urethra, prostate gland, bulbourethral glands, and semen (Figs. 6-90 and 6-91).

Epididymis

Each epididymis is a tightly coiled, thread-like tube that is approximately 6 meters long. This tube is connected to the ducts within the testis. The epididymis covers the top of the testis, runs down the testis' posterior surface, and then ascends to form the vas deferens.

The epididymis secretes the hormone glycogen, which helps sustain the lives of stored sperm cells and promotes their maturation. When immature sperm cells enter the epididymis, they are not mobile. They spend 1 to 3 weeks maturing; immature and unused cells will breakdown to be reabsorbed by the body. As the sperm cells travel through the epididymis, they mature and become mobile. Once the sperm cells are mature, they leave the epididymis and enter the vas deferens.

Vas Deferens

The vas deferens is a small tube that connects the epididymis and ejaculatory duct. It can be palpated through the scrotal sac as a smooth movable cord. It ascends as part of the spermatic cord through the inguinal canal of the lower abdominal wall into the pelvic cavity and transmits the sperm to the ejaculatory ducts. The sperm can stay here up to a month without any loss of fertility depending upon sexual activity.

Ejaculatory Ducts

The vas deferens and the seminal vesicles converge, just before the entrance of the prostate gland, to form the ejaculatory ducts (Fig. 6-90). The ejaculatory ducts open into the prostatic urethra. Its function is to convey sperm cells to the urethra.

Seminal Vesicles

The seminal vesicles are two pouches attached to the vas deferens near the base of the urinary bladder. The lining of the inner walls of the seminal vesicles secrete an alkaline, viscous, creamy-yellow liquid that contributes about 60% of the semen volume. This fluid is thought to help regulate the pH of the tubular contents as sperm cells are conveyed to the outside. The secretion produced by the seminal vesicles also contains a variety of nutrients, such as fructose (simple sugar) that provides the sperm cells an energy source. At the time of ejaculation, the contents of the seminal vesicles are emptied into the ejaculatory ducts. This action greatly increases the volume of fluid that is discharged by the vas deferens.

Urethra

The urethra is an important organ of both the urinary and reproductive systems. The role of the urethra, in the reproductive system, is to transport sperm through the penis to outside the body. See "The Urinary System" section for information on the structure of the urethra.
**Prostate Gland**

The prostate gland, made of smooth muscle and glandular tissue, surrounds the first part of the urethra. It resembles a chestnut in shape and size, and secretes a watery, milky-looking, and slightly acidic fluid to keep the sperm mobile. This substance is discharged into the urethra as part of the ejaculate, or semen, during the sexual act and constitutes about 30% of the fluid. Many older men suffer from an enlarged prostate which can squeeze the urethra to complete closure making it impossible to urinate.

**Bulbourethral Glands**

Bulbourethral glands, also known as Cowper's glands, are two pea-sized bodies located below the prostate gland and lateral to the membranous urethra (Fig. 6-90). These glands are enclosed by fibers of the external urethral sphincter. They secrete an alkaline fluid that is important for counteracting the acid present in the male urethra and the female vagina. Mucus produced here help with lubrication of the urethra to protect it from damage during ejaculation.

Semen is composed of sperm and secretions from the seminal vesicles, prostate, and bulbourethral glands. It is discharged as the ejaculate during sexual intercourse. There are millions of sperm cells in the semen of each ejaculation, but only one is needed to fertilize the ovum. It is generally considered that fertilization of the ovum occurs while it is still in the fallopian tubes. Therefore, it is apparent that sperm cells can move actively in the seminal fluid deposited in the vagina and through the layers of the secretion lining the uterus and fallopian tubes.

**EXTERNAL ACCESSORY ORGANS**

The external accessory organs of the male reproductive system include the scrotum and penis (Fig. 6-90).

**Scrotum**

The scrotum is a cutaneous pouch containing the testes and part of the spermatic cord. Immediately beneath the skin is a thin layer of muscular fibers (the cremaster), which is controlled by temperature and contracts or relaxes to lower or raise the testes in relation to the body. This muscular activity is necessary to regulate the temperature of the testes, which is important in the maturation of sperm cells.

**Penis**

The penis is a cylindrical organ that conveys urine and semen through the urethra to the outside. The penis is composed of three columns of spongy cavernous tissue, bound together by connective tissue and loosely covered by a layer of skin. Two of the columns, the corpora cavernosa, lie superiorly side by side; the third column smaller in size is the corpus spongiosum, lies below the other two columns. The urethra is located in the corpus spongiosum. The dilated distal end of the corpus spongiosum is known as the glans penis (Fig. 6-90). The urethra terminates at the glans penis.

The cavernous tissue becomes greatly distended with blood during sexual excitement, causing an erection of the penis. The loose skin of the penis folds back on itself at the distal end (forming the prepuce, or foreskin) and cover the glans. The prepuce is sometimes removed by a surgical procedure called a circumcision.
FEMALE REPRODUCTIVE SYSTEM

LEARNING OBJECTIVE:

Identify the parts of the female reproductive system and their function(s).

The organs of the female reproductive system are specialized to produce and maintain the female sex cells, or egg cells; to transport these cells to the site of fertilization; to provide an environment for a developing offspring; to move the offspring outside; and to produce female sex hormones. The primary female reproductive organs are the ovaries. The other structures of the female reproductive system are considered accessory reproductive organs. The accessory organs include both internal and external reproductive organs (Fig. 6-92).

OVARIES

The ovaries are the primary female reproductive organs and produce the female sex cells and sex hormones (Figs. 6-92 and 6-93).

Structure

The ovaries, or female gonads, are two almond-shaped glands suspended by ligaments in the upper pelvic cavity. One ovary on each side of the uterus. The ligaments that suspend the ovaries contain ovarian blood vessels and nerves.

The tissues of an ovary are divided into two regions, an inner medulla and an outer cortex. The ovarian medulla is largely composed of loose connective tissue, numerous blood vessels, lymph vessels, and nerves.

Figure 6-92.—Female reproductive organs. A, Diagram (sagittal section) of pelvis showing location of female reproductive organs.

The external surface of the ovary is covered by a layer slightly raised squamous-shaped epithelial cells called the germinal epithelium. Beneath the epithelial cells is a tough gray-white connective tissue layer called the tunica albuginea that covers the ovarian cortex. Scattered throughout the ovarian cortex is composition of compact tissue containing tiny masses of cells called ovarian (primordial) follicles. The follicles contain the female sex cells or ova.

Primordial Follicle

In the outer region of the ovarian cortex, microscopic groups of cells are referred to as primordial follicles. The primordial follicles consist of a single large cell, called an oocyte, which is surrounded by a layer of flattened epithelial cells called follicular cells. The oocyte is an immature egg cell. Follicular cells surround a developing egg cell and secrete female sex hormones. There are approximately 400,000 primordial follicles at puberty. Fewer than 500 will be released from the ovary during the reproductive life of a female.

At puberty, the anterior pituitary gland secretes increased amounts of FSH (follicle-stimulating hormone). In response, ovaries enlarge and many primordial follicles begin to mature. During this maturation process, the oocyte enlarges and the follicle cells multiply until there are 6 to 12 layers. Fluid-filled spaces begin to appear among the follicle cells. These spaces join to form a single cavity called the antrum. Ten to fourteen days after this process begins, the primordial follicle reaches maturity. The mature primordial follicle (preovulatory or graafian follicle) and its fluid-filled cavity bulges outward on the surface of the ovary, like a blister.

Ovulation

Ovulation is the process by which the mature oocyte is released from the primordial follicle. Ovulation is stimulated by hormones from the anterior pituitary gland. These hormones cause the mature follicle to swell rapidly and its walls to weaken. Eventually the wall ruptures, permitting the oocyte and 1 or 2 layers of follicle cells to be released from the ovary's surface.

After ovulation, the oocyte is usually propelled to the opening of a nearby fallopian tube. If the oocyte is not fertilized by a sperm cell within a relatively short time, it degenerates.

The process of ovulation occurs once a month. Each ovary normally releases an ovum every 56 days. The right and left ovary alternately discharges an ovum approximately every 28 days. The menstrual cycle in most women is approximately 28 days (Fig. 6-93).
Female Sex Hormones

Female sex hormones of estrogen and progesterone are produced by the ovaries and various other tissues, such as the adrenal glands, pituitary gland, and placenta (during pregnancy). The primary source for estrogen is the ovaries. At puberty, estrogen stimulates enlargement of various accessory organs, which include the vagina, uterus, fallopian tubes, and external structures. Estrogen is also responsible for the development and maintenance of female secondary sexual characteristics. See section titled “Endocrine System” for listing of secondary female sexual characteristics.

The ovaries are the primary source of progesterone (in a nonpregnant female). This hormone promotes changes that occur in the uterus during the female reproductive cycle. Progesterone stimulates the enlargement of mammary glands and ducts, and increases fat deposits in female breasts during puberty.

INTERNAL ACCESSORY ORGANS

The internal accessory organs of the female reproductive system include a pair of fallopian tubes, the uterus, and the vagina (Fig. 6-94).

Fallopian Tubes (uterine tubes)

The fallopian tubes serve as ducts for the ovaries providing a passageway to the uterus. The fallopian tubes are composed of three tissue layers. These tissue layers include an inner mucosal layer, middle muscular layer, and outer serous layer. They are continuous with the layers of the uterus. The fallopian tubes are in contact with the ovaries but are not continuous with them. Their funnel-shaped openings, called free openings, are fringed with fingerlike processes that pick up an ovum and draw it into the fallopian tubes. As the ovum enters the fallopian tubes, it is transported to the uterus by peristalsis and gravity. Fertilization of an ovum normally takes place in the fallopian tubes.

Figure 6-94.—Female reproductive organs. B, MRI scan (sagittal view) of female pelvic viscera. (B: From Moses K, Nava P, Banks J, Petersen D: Moses atlas of clinical gross anatomy, Philadelphia, 2005, Mosby.)

Uterus (Womb)

The function of the uterus is to receive the embryo that results from the fertilization of an egg cell and to sustain its life during development. The uterus is a hollow, pear-shaped organ with thick, muscular walls. The uterus is divided into two main regions, the body and cervix (Figs. 6-92 and 6-94). The body of the uterus consists of the upper two-thirds of the uterus. The cervix is the lower one-third portion of the uterus that projects into the upper part of the vagina. The cervical opening into the vagina is called the external os.

The uterine wall is composed of three layers: endometrium, myometrium, and perimetrium. The inner lining consists of specialized epithelium, called endometrium, which undergoes partial destruction approximately every 28 days in the non-pregnant female. The middle layer, myometrium, consists of bundles of interlaced muscular fibers. The muscular layer produces powerful rhythmic contractions important in the expulsion of the fetus at birth. The perimetrium consists of an outer serosal layer that covers part of the uterine body and none of the cervix. The uterus also has three openings: superiorly and laterally, two openings connect the fallopian tubes to the uterus, and inferiorly, an opening leading to the vagina.

Vagina

The vagina receives the male sperm during intercourse. It forms the lower portion of the birth canal, stretching widely during delivery. In addition, it serves as an excretory duct for uterine secretions and menstrual flow.

The vagina is a fibromuscular tube capable of great distention. The canal is approximately 7-8 cm long extending from the uterus to the outside. The vaginal orifice is partially closed by a thin membrane of tissue called the hymen. The wall of the vagina consists of three layers. The inner mucosal layer does not have mucous glands; mucous found in the vagina comes from the glands of the cervix. The middle muscular layer consists mainly of smooth muscle fibers. At the lower end of the vagina is a thin band of smooth muscle that helps close the vaginal opening. The outer fibrous layer consists of dense fibrous connective tissue interlaced with elastic fibers. These fibers attach the vagina to the surrounding organs.

EXTERNAL ACCESSORY ORGANS

Many of the external accessory organs of the female reproductive system are referred to collectively as the vulva. The vulva includes the labia majora, the labia minora, the clitoris, and the vestibular glands (Fig. 6-95). The mammary glands are also considered an accessory organ of the female reproductive system.
Labia Majora

The function of the labia majora is to enclose and protect the other external reproductive organs. The labia majora are composed of two round folds of fat tissue and a thin layer of smooth muscle, covered by skin. On the outer portion of the labia majora, the skin has numerous hairs, sweat glands, and sebaceous glands. The inner portion of skin is thin and hairless. The labia majora extend from the mons pubis anteriorly to the perineum (the region between the vaginal orifice and the anus). The mons pubis is the pad of fatty tissue beneath the skin, which overlies the symphysis pubis.

Labia Minora

Within the labia majora folds are two smaller folds, called the labia minora. The labia minora extend from the clitoris to either side of the vaginal orifice.

Clitoris

The clitoris is a small projectile at the anterior end of the vulva between the labia minora. It is richly endowed with sensory nerves that are associated with the feeling of pleasure during sexual stimulation.

Vestibule

The vestibule is the area enclosed by the labia minora that includes those vaginal and urethral openings. The vestibule contains a pair of vestibular glands, more commonly known as the Bartholin's glands. The Bartholin's glands lay on each side of the vaginal opening. The ducts of these glands secrete fluid that moistens and lubricates the vestibule. There are also the Skene glands that are near the opening of the urinary meatus by way of two small ducts.
**Mammary Glands (Breasts)**

The mammary glands are accessory organs of the female reproductive system. They develop during puberty under the influence of the hormones estrogen and progesterone. The breasts are responsible for the secretion of milk (lactation) for the nourishment of newborn infants.

Structurally, the breasts resemble sweat glands. At the center is a nipple containing 15 to 20 depressions into which ducts from the lobes of the gland empty. During pregnancy, placental estrogen and progesterone stimulate further development of the mammary glands in preparation for lactation. After childbirth, hormones secreted by the anterior lobe of the pituitary gland stimulate production for 6 to 9 months.

**FEMALE REPRODUCTIVE CYCLE**

Females around age 11 begin to experience the female reproductive cycle and continue into middle age, after which it ceases. The female reproductive cycle, or menstrual cycle, is characterized by regular, recurring changes in the uterine lining, resulting in menstrual bleeding (menses).

The first phase of the recurring reproductive cycle is menstrual bleeding. Menstrual bleeding begins when the endometrial lining starts to slough off from the walls of the uterus, and it is characterized by bleeding from the vagina. This is day 1 of the cycle, and this phase usually lasts through day 5.

The time between the last day of the menses and ovulation is known as the postmenstrual phase. It lasts from day 6 through day 13 or 14 and is characterized by proliferation of endometrial cells in the uterus, which develop under the influence of the hormone estrogen.

Ovulation is the rupture of a primordial follicle with the release of a mature ovum into the fallopian tubes. It usually occurs on day 14 or 15 of the cycle. The postovulatory (premenstrual) phase is the time between ovulation and the onset of the menstrual bleeding and normally lasts 14 days. During this phase the ovum travels through the fallopian tubes to the uterus. If the ovum becomes fertilized during this passage, it will become implanted in and nurtured by the newly developed endometrial lining. If fertilization does not take place, the lining deteriorates and eventually sloughs off, marking day 1 of the next cycle.

**SUMMARY**

This chapter reviewed the basic structures of the cell to the many complex systems of the human body. It outlined how each body system functions and how each system is interdependent upon each other. Anatomical terminology is used in describing location of injuries or conditions. The HM will use this knowledge of human anatomy and physiology when performing patient assessments.
CHAPTER 7

ORAL ANATOMY AND PHYSIOLOGY

INTRODUCTION

This chapter covers the oral anatomy and physiology of the teeth, the histology of the tissues and supporting structures, and concentrates on the external features of the teeth. The teeth are identified by different sizes, shape, and other characteristics from one person to another. Such knowledge is useful when filling out the dental forms in the health record.

FORMATION PERIOD

LEARNING OBJECTIVE:

Describe the stages of tooth development.

As living things are forming, they go through a developmental process to reach maturity or a final outcome. When teeth are in the odontogenesis phase (tooth formation) they go through three developmental periods called categories: growth, calcification, and eruption. The term emergence describes the tooth as it breaks through the gingival tissue.

GROWTH PERIOD

Dental development usually begins in the fifth or sixth week of prenatal life. By the seventh week, epithelial skin cells of the mouth thicken along the ridge of the developing jaws creating a horse-shoe shaped band called the dental lamina which follows the curve of each developing tooth socket. The growth period of development is divided into the bud, cap, and bell stages (Fig. 7-1).

Bud Stage

As soon as the dental lamina is formed, patches of epithelial cells located there grow into the underlying tissues to become tooth buds. Usually 10 tooth buds are present in each dental arch and they give rise to future primary teeth. Tooth buds for the permanent teeth form between the 17th-week of fetal life through the age of 5 years. When the primary teeth are lost, permanent teeth will replace them.

Cap Stage

This stage is also known as proliferation (reproduction or multiplication) in which the cells of the tooth grow and the tooth bud takes a hollowed cap-like shape. The epithelium of the cap will give rise to the enamel. The zone under the cap is called the dental papilla, a small nipple shaped elevation. It gives rise to the dentin, cementum, and the pulp.

Bell Stage

The last period of growth is also known as histodifferentiation (the acquisition of tissue characteristics by cell groups) or bell stage. It is here the ameloblast cells form the enamel, odontoblast cells form the dentin, and the cementoblast cells form the cementum.

MORPHODIFFERENTIATION

As the tooth begins the bell stage, it begins to take shape and form through a process called morphodifferentiation. Enamel forming cells (ameloblast) and dentin forming cells (odontoblast) line up on a boundary line called dentinonamel junction (DEJ). The odontoblast and cementoblast form the cementodontinal junction. The dentinonamel junction and cementodental junction are the blueprint of the developing tooth.
Apposition refers to depositing of the matrix for the hard dental structures. This matrix is deposited by cells along the boundary line (dentinoenamel junction) at the end of morphodifferentiation.

Calcification (Fig. 7-1) is the process by which organic tissue (the matrix formed during apposition) becomes hardened by a deposit of calcium or any mineral salts. Next, the tooth crown receives layers of enamel that start at the top of the crown and go downward over the sides to the cementonenamel junction (CEJ). The cementonenamel junction is a linear junction between the apical border of the enamel cap and the root cementum.

ERUPTION

After the crown of the tooth has formed, the root begins to develop. Now the tooth begins to erupt (Fig. 7-1), movement of the tooth into its proper position in the mouth. For permanent teeth, it takes about 3 years from crown completion to the time the tooth emerges into the mouth. Figures 7-2 and 7-3 list the average emergence periods of primary and permanent teeth.
Figure 7-2.—Average Periods for Emergence and Exfoliation of Primary Teeth

Figure 7-3.—Average Periods of Emergence of Permanent Teeth
EXFOLIATION (SHEDDING)

When primary teeth prepare to fall out and make way for the eruption of permanent teeth, they go through a process called exfoliation. The root of the primary tooth resorbs (looses structure), and the permanent tooth erupts from beneath the surface of the jaw. The primary teeth act as guides for the developing permanent teeth. The premature loss of primary teeth can have a serious impact on the eruption of permanent teeth and how they will be positioned in the dental arch.

ORAL HISTOLOGY

LEARNING OBJECTIVES:

Identify the tissues of the teeth.

Describe the tissues of the teeth.

Histology is the study of anatomy including the minute structure, composition, and functions of tissues. Oral histology describes in detail the tissues of the teeth, periodontium, and the surrounding oral mucosa.

STRUCTURE OF TEETH

A tooth is divided into two parts: the crown and one or more roots (Fig. 7-4).

The Crown

The crown is divided into the anatomic and clinical crown. The anatomical crown is the portion of the tooth encased in enamel. In young people, areas of the anatomical crown are frequently buried in gingival tissue. As a person gets older, it becomes common for a tooth’s enamel to be completely exposed above the gingiva with the root surface showing (gingival recession). The term clinical crown is applied to the part of the crown exposed (visible) in the mouth.

The Root

The root of a tooth is covered by cementum and embedded in a thin layer of compact bone that forms the tooth socket; this is called alveolar bone. The tooth may have a single root or it may have two or three roots. When teeth have more than one root, the region where the roots separate is called the furcation. When a tooth has two roots it is bifurcated; when it has three roots it is trifurcated (Fig. 7-5). If a tooth has four or more roots, it is said to be multirooted. The tip of each root is called the apex. On the apex of each root, there is a small opening that allows for the passage of blood vessels and nerves into the tooth. This opening is called the apical foramen.

Figure 7-4.—Tooth Crown and Root

Figure 7-5.—Bifurcated and Trifurcated Roots
The Cervix

The cervix or cervical line (see Fig. 7-4) is a slight indentation that encircles the tooth and marks the junction of the anatomical crown with the root. The cementum joins the enamel at the cervix of the tooth. The point at which they join is called the cementoenamel junction (CEJ) or cervical line.

TISSUES OF THE TEETH

LEARNING OBJECTIVE:

Describe the form and function of enamel, dentin, cementum, and dental pulp.

This section describes the histological structures of enamel, dentin, cementum, and the dental pulp. Figure 7-6 illustrates the tissues of the teeth.

ENAMEL

Enamel is translucent and can vary in color from yellowish to grayish white. The different colors of enamel are attributed to the variation in the thickness, translucent proprieties, the quality of the crystal structure, and surface stains of enamel. Enamel (Fig. 7-6) is the calcified substance that covers the entire anatomic crown of the tooth and protects the dentin. It is the hardest tissue in the human body and consists of approximately 96% inorganic minerals, 1% organic materials, and 3% water. Calcium and phosphorus (as hydroxyapatite) are its main inorganic components.

Figure 7-6.—Tissues of the Teeth
Enamel can endure crushing pressure of approximately 100,000 pounds per square inch. A layering of the dentin and periodontium, coupled with the hardness of the enamel, produces a cushioning effect of the tooth’s different structures enabling it to endure the pressures of mastication (chewing). Structurally, enamel is composed of millions of enamel rods or prisms. Each rod begins at the dentinoenamel junction (junction between the enamel and dentin) and extends to the outer surface of the crown. Enamel is formed by epithelial cells (ameloblasts) that lose their functional ability when the crown of the tooth has been completed. After formation enamel has no power of further growth or repair.

**DENTIN**

Dentin (see Fig. 7-6) is the light yellow substance that is less dense (radiolucent) than enamel and is very porous; it constitutes the largest portion of the tooth. The pulp chamber is located on the internal surface of the dentin walls. Dentin is harder than bone but softer than enamel. Dentin consists of approximately 70% inorganic matter and 30% organic matter and water. Calcium and phosphorus are its chief inorganic components. Dentin is a living tissue and must be protected during operative or prosthetic procedures from dehydration (drying) and thermal shock.

The dentin is perforated by tubules (similar to tiny straws) that run between the cementoenamel junction (CEJ) and the pulp. Cell processes from the pulp reach part way into the tubules like fingers. These cell processes create new dentin and mineralize it. Dentin transmits pain stimuli by the way of dentinal fibers. Because dentin is a living tissue, it has the ability for constant growth and repair that reacts to physiologic (functional) and pathologic (disease) stimuli.

**CEMENTUM**

Cementum is the bonelike tissue that covers the roots of the teeth in a thin layer (see Fig. 7-6). It is light yellow in color, slightly lighter than dentin. The cementum is composed of approximately 55% organic material and 45% inorganic material; the inorganic components are mainly calcium salts. The cementum joins the enamel at the cervix of the tooth forming the CEJ.

In most teeth the cementum overlaps the enamel for a short distance. In some, the enamel meets the cementum in a sharp line. In a few, a gap may be present between the enamel and the cementum, exposing a narrow area of root dentin. Such areas may be very sensitive to thermal, chemical, or mechanical stimuli.

The main function of cementum is to anchor the teeth to the bony walls of the tooth sockets in the periodontium. This is accomplished by the fibers of the periodontal ligament or membrane. Cementum is formed continuously throughout the life of the tooth to compensate for the loss of tooth substance because of occlusal wear and to allow for the attachment of new fibers of the periodontal ligament to the surface of the root.

**DENTAL PULP**

The dental pulp, (Fig. 7-7), is the soft tissue inside the tooth developed from the connective tissue of the dental papilla. Within the crown, the chamber containing the dental pulp is called the pulp chamber. The coronal pulp and pulp horns are within the crown and the radicular pulp is within the root. The apical foramen is at the end or apex of the radicular pulp. Blood vessels, nerves, and connective tissue pass through this area to reach the interior of the tooth.

![Figure 7-7.—Dental Pulp](image-url)
The chief function of the pulp is the formation of dentin. It furnishes nourishment to the dentin; provides sensation to the tooth; and responds to irritation, either by forming reparative secondary dentin or by becoming inflamed.

PERIODONTIUM

The tissues that surround and support the teeth are collectively called the periodontium. Their main functions are to support, protect, and provide nourishment to the teeth. Figure 7-8 illustrates the supporting tissues of the periodontium. The periodontium consists of cementum, alveolar process of the maxillae and mandible, periodontal ligament, and gingiva.

CEMENTUM

Cementum (Fig. 7-8) is the only tissue considered as both a basic part of the tooth and a component of the periodontium. It is a thin, calcified layer of tissue that completely covers the dentin of the tooth root. Cementum is formed during the development of the root and throughout the life of the tooth. Cementum functions as an area of attachment for the periodontal ligament fibers.

ALVEOLAR PROCESS

The alveolar process (Fig. 7-8) is that bony portion of the maxilla and mandible where the teeth are embedded and tooth roots are supported. The alveolar socket is the cavity within the alveolar process in which the root of the tooth is held by the periodontal ligament.

The bone that divides one socket from another is called the interdental septum. When multi-rooted teeth are present, the bone is called the interradicular septum. The alveolar process includes the cortical plate, alveolar crest, trabecular bone, and the alveolar bone proper, covered below.

Cortical Plate

The cortical plate is composed of facial (toward the face) and lingual (toward the tongue) plates of compact bone. It is dense in nature, provides strength and protection, and acts as the attachment for skeletal muscles. The mandibular cortical plate is more dense than the maxilla cortical plate because it has fewer perforations for the passage of nerves and blood vessels.

Alveolar Crest

The alveolar crest is the highest point of the alveolar ridge and joins the facial and lingual cortical plates.

Trabecular Bone

Trabecular or spongy bone lies within the central portion of the alveolar process, and is the less dense, cancellous bone. When viewed by radiograph, trabecular bone has a web-like appearance.
Alveolar Bone Proper

The alveolar bone proper is a thin layer of compact bone; a specialized continuation of the cortical plate that forms the tooth socket. The lamina dura is a horseshoe shaped white line on a dental radiograph that directly corresponds to the alveolar bone proper.

PERIODONTAL LIGAMENT

The periodontal ligament (Fig. 7-8) is a thin, fibrous ligament that connects the tooth to the bony socket. Normally, teeth do not contact the bone directly; a tooth is suspended in its socket by the fibers of the ligament. This arrangement allows each tooth limited individual movement. The fibers act as shock absorbers to cushion the force of mastication.

TISSUES OF THE ORAL CAVITY

The oral cavity is made up of specialized epithelial tissues that surround the teeth and serve as a lining. These tissues are called the oral mucosa and consist of three types: masticatory mucosa, lining mucosa, and specialized mucosa.

Masticatory Mucosa

Masticatory mucosa is comprised of the tissue that covers the hard palate and the gingival (Fig. 7-9). It is light pink in color (can vary with skin color) and is keratinized. Keratinized tissue has a tough, protective outer layer of tissue. Characteristics of masticatory mucosa are:

- Submucosa lies under and supports the masticatory mucosa
- Held in place firmly to bone and does not move
- Has a dense, hard covering
- Functions to withstand the active process of chewing and swallowing food

Hard palate (Roof of the Mouth)

The hard palate (Fig. 7-9) is covered with masticatory mucosa and is firmly adhered to the palatine process (bone). Its color is pale pink. Important structures of the hard palate are:

INCISIVE PAPILLA.—Located at the midline, directly posterior of the maxillary central incisors (pear-shaped in appearance).

PALATINE RAPHE.—Extends from the incisive papilla posteriorly at the midline (may be ridge shaped in appearance with a whitish streak at the midline).

PALATINE RUGAE.—Extends laterally (along side) from the incisive papilla and from the palatine raphe (wrinkled, irregular ridges in appearance).
**Gingiva**

The gingiva shown in (Fig. 7-10), is specialized masticatory mucosa covering the alveolar process. Gingiva is firm and resilient encircling the necks of the teeth. It aids in the support of the teeth, and protects the alveolar process and periodontal ligament from bacterial invasion.

The color of healthy gingiva range from pale pink to darker shades (purple to black) depending on each individual’s pigmentation. Under normal flossing and brushing activities it does not bleed. Like the tongue, the gingiva is highly vascular and receives its blood supply from the lingual, mental, buccal, and palatine arteries. The two types of gingiva are unattached and attached gingiva.

**Unattached Gingiva (Free Gingiva)**

The portion of gingiva that extends from the gingival crest to the crest of the bone is called unattached gingiva. It can be displaced and is not bound directly to the tooth or bone. In a healthy mouth, this portion is approximately 1 to 3 mm wide and forms the soft tissue wall of the gingival sulcus next to the tooth.

Other structures of unattached gingiva include:

- **Gingival Margin:** The 1mm narrow band of gingiva that forms the immediate collar around the base of the tooth. This area is first to show symptoms of gingivitis.
- **Gingival Sulcus:** Area between the unattached gingiva and the tooth. Popcorn hulls get trapped in this area.
- **Epithelial Attachment:** Joins the gingiva to the tooth surface.
- **Interdental Papilla:** The portion of the free gingiva that fills the embrasures, a triangular space near the gingiva below the contact areas of adjacent teeth. It helps prevent food from packing between the teeth.

**Attached Gingiva**

It is located apical to the free gingiva on the labial and lingual aspects. It is firmly fixed to the underlying bone of the cortical plates of the alveolar process. The surface of the attached gingiva and interdental papillae may be stippled (resembling the texture of an orange peel).

![Figure 7-10.—Structures of the Gingiva](image-url)
Lining Mucosa

Lining mucosa is found on the inside of the lips, cheeks, vestibule, soft palate, and under the tongue. It consists of a thin, fragile tissue that is very vascular. Lining mucosa is brighter red in color than masticatory mucosa. Included in the lining mucosa is alveolar mucosa which is loosely attached and lies apical to the mucogingival junction (line where the attached gingiva and alveolar mucosa meet).

Specialized Mucosa

Specialized mucosa is the mucous membrane on the tongue in the form of lingual papillae, which are structures associated with sensations of taste. A full description is explained in the “Human Anatomy and Physiology” chapter.

DENTITION PERIODS

LEARNING OBJECTIVES:

Describe the dentition periods and what occurs during them.

Explain the orientation of teeth based upon various descriptive methods.

Humans have two sets of teeth in a lifetime, but there are three dentition periods: primary, permanent, and mixed. The primary dentition consists of 20 primary teeth referred to as baby teeth. The permanent dentition consists of 32 teeth which are called the adult teeth. The mixed dentition is the period at which the primary teeth are shed and the permanent teeth erupt. This happens with each tooth resulting in both primary and permanent teeth being present at the same time.

DENTAL ARCHES

The teeth of the upper arch are called maxillary teeth (Fig. 7-11); their roots are embedded within the alveolar process of the maxilla. Those of the lower arch are called mandibular teeth; their roots are embedded within the alveolar process of the mandible. Each arch contains 16 teeth. The teeth in an arch are composed of 6 anteriors (cuspid to cuspid) and 10 posterior (all teeth distal to the cuspids).

Figure 7-11.—Maxillary and Mandibular Arches Showing Relationship of the Bones and Teeth

DENTAL QUADRANTS

Each dental arch is divided into a right and a left quadrant. The quadrants are formed by an imaginary line called the midline that passes between the central incisors in each arch and divides the arch in half (Fig. 7-12). There are four quadrants in the mouth (two per arch) that divide the mouth into four equal parts. Teeth are described as being located in one of the four quadrants: right maxillary quadrant, left maxillary quadrant, right mandibular quadrant, or the left mandibular quadrant. In a quadrant, there are 3 anterior and 5 posterior teeth.

Figure 7-12.—Maxillary and Mandibular Arches Divided into Quadrants
LOCATION OF THE TEETH

A human receives two sets of teeth during a lifetime. The first set consists of 20 teeth referred to as deciduous or primary (baby teeth). The second (permanent) set usually consists of 32 teeth. In each quadrant, there are eight permanent teeth: two incisors, one cuspid, two bicuspids, and three molars.

The tooth positioned immediately to the side of the midline is the central incisor, named due to its central location in the arch. To the side of the central incisor in order of appearance are the lateral incisor, the cuspid, the two bicuspids (the first bicuspid, followed by the second bicuspid), and the three molars. After the second bicuspid comes the first molar, followed by the second molar, followed by the third molar called the “wisdom tooth.”

Another method of describing the location of teeth is to refer to them as anterior or posterior teeth (Figs. 7-13 and 7-14). Anterior teeth are those located in the front of the mouth, the incisors, and the cuspids. These are the teeth that are visible when a person smiles. The posterior teeth are those located in the back of the mouth—the bicuspids and molars.

Figure 7-13.—Names of the Teeth in the Right Maxillary and Mandibular Quadrants; Anterior and Posterior Teeth
TYPES OF TEETH

Man is omnivorous, his teeth are formed for cutting, tearing, and grinding food. The human permanent dentition is divided into four classes of teeth based on appearance and function or position. Figure 7-15 illustrates the types and working surfaces of the four classes of teeth.

Incisors

They are used to incise food. They are located in the front of the mouth and have sharp, thin edges for cutting. The lingual surface can have a shovel-shaped appearance.
Cuspids (Canines)

Cuspids are at the angles of the mouth. Each has a single cusp instead of an incisal edge and is designed for cutting and tearing.

Bicuspid (Premolars)

Bicuspid are similar to the cuspids. They have two cusps used for cutting and tearing, and an occlusal surface that is wider to crush food.

Molars

Molars are located in the back of the mouth; their size gradually gets smaller from the first to third molar. Each molar has four or five cusps, is shorter and more blunt in shape than the other teeth, and provides a broad surface for grinding and chewing solid masses of food.

IDENTIFICATION OF TEETH

To avoid confusion, the HM must identify a tooth as completely as possible. Give its full name: Central incisor (not incisor), second molar (not molar), etc. But even the full name of a tooth does not provide adequate identification because several teeth have the same name. Complete tooth identification requires that the HM identifies:

- The quadrant in which the tooth appears
- The full name of the tooth

For example, identify a specific second molar in the following manner: right mandibular second molar. Although there are four second molars in the mouth, naming the quadrant (right mandibular) narrows the field down to one specific second molar.

UNIVERSAL NUMBERING SYSTEM

The Universal Numbering System is a simplified method of identifying teeth that is approved by the American Dental Association (ADA) and used by the Armed Services. This method employs numbers with each tooth designated by a separate number from 1 to 32. Figure 7-14 illustrates the numbering system used on a Standard Dental Chart.

When charting, refer to a tooth by number rather than the name. Instead of referring to the right maxillary third molar, refer to tooth No. 1. Each permanent tooth has its own number. The numbering starts with the maxillary right third molar, (tooth No. 1) and goes across to the maxillary left third molar, (tooth No. 16); down to mandibular left third molar (tooth No. 17) and across to the mandibular right third molar (tooth No. 32).
The 20 primary teeth are identified on the dental chart by the use of capital letters A through T. Lettering starts with upper right second primary molar (tooth A, located above the root of the maxillary second premolar); goes across to the upper left second primary molar (tooth J); down to the lower left second primary molar (tooth K), and across to the lower right second primary molar. Note that the letters of the primary, second and first molars appear above the roots of the permanent teeth of the second and first premolars.

When using a dental form, the right and left sides are reversed. The right side of the patient’s mouth appears on the left side of the dental chart; the left side of the patient’s mouth appears on the right side. This arrangement is necessary for the Dental Officer and the HM to see the sides as they appear when looking into a patient’s mouth.

**SURFACES OF THE TEETH**

Not only must the HM be able to name and locate a tooth, but must also be able to identify the different types of tooth surfaces. To get a clearer picture of the various tooth surfaces, refer to Figure 7-16. The Standard Dental Chart shows each of the teeth “unfolded” so that the facial, occlusal, incisal, and lingual surfaces of the teeth can be shown. For posterior teeth, the facial surfaces are shown adjacent to the roots, followed by the occlusal surfaces, and then by the lingual surfaces (which are located next to the numbers on the chart). For anterior teeth, the facial surfaces are shown as a line between the facial and lingual surfaces. The lingual surfaces are located next to the numbers on the chart.

**Facial**

The facial is the surface of a tooth that “faces” toward the lips or cheeks. When required for specificity, terms like labial and buccal are used. The labial is the surface of an anterior tooth that faces toward the lips. The buccal is the surface of a posterior tooth that faces toward the cheek.

**Mesial**

The mesial is the proximal surface closest to the midline or middle of the arch.

**Distal**

The distal is the opposite of mesial. The distal is the proximal surface oriented away from the midline of the arch.

**Lingual**

The lingual is the surface of an anterior or posterior tooth that faces toward the tongue. Incisal edges are narrow cutting edges found only in the anterior teeth (incisors).
Proximal Surfaces

A tooth has two proximal surfaces (Fig. 7-17), one that is oriented toward the midline of the dental arch (mesial) and another that is oriented away from the midline of the arch (distal). Other important surfaces of the proximal area are discussed in the following paragraphs.

CONTACT POINT

The point on the proximal surface where two adjacent teeth actually touch each other is called a contact point. This is exemplified when the HM passes dental floss in between two teeth and resistance is felt as the dental floss passes through the contact point.

INTERPROXIMAL SPACE

The interproximal space is the area between the teeth. Part of the interproximal space is occupied by the interdental papilla, a triangular fold of gingival tissue. The part of the interproximal space not occupied is called the embrasure.

EMBRASURE

The embrasure occupies an area bordered by interdental papilla, the proximal surfaces of the two adjacent teeth, and the contact point (Fig. 7-18). If there is no contact point between the teeth, then the area between them is called a diastema instead of an embrasure.

OCCLUSAL

The occlusal surface is the broad chewing surface found on posterior teeth (bicuspids and molars).
VERTICAL AND HORIZONTAL OVERLAP

Vertical overlap is the extension of the maxillary teeth over the mandibular counterparts in a vertical direction when the dentition is in centric occlusion (Fig. 7-19). Horizontal overlap is the projection of maxillary teeth over antagonists (something that opposes another) in a horizontal direction.

OCCLUSION

Occlusion is the relationship between the occlusal surfaces of maxillary and mandibular teeth when they are in contact. Many patterns of tooth contact are possible. The reason for the variety is the mandibular condyle’s substantial range of movement within the temporal mandibular joint (TMJ). Malocclusion occurs when any abnormality in occlusal relationships exist in the dentition. Centric occlusion (Fig. 7-20), is the centered contact position of the chewing surfaces of mandibular teeth on the chewing surface (occlusal) of the maxillary teeth.

OCCLUSAL PLANE

Maxillary and mandibular teeth come into centric occlusion and meet along anteroposterior and lateral curves. The posterior teeth do not form a flat plane they curve slightly, this curve is called the Curve of Spee, (Fig. 7-21). The mandibular arch forms a concave (a bowl-like upward curve). The lateral curve is called the Curve of Wilson (Fig. 7-22). The combination of these curves form a line called the occlusal plane, and is created by the contact of the upper and lower teeth as shown in Figure 7-23. Dental arches are stable when all teeth are present; the absence of one or more teeth causes malocclusion and the functionality and stability of the dentition is affected.
KEY TO OCCLUSION

The occlusal surfaces of opposing teeth bear a definite relationship to each other (Fig. 7-24). In normal jaw relations when teeth are of normal size and in the correct position, the mesiofacial cusp of the maxillary first molar occludes in the facial groove of the mandibular first molar (Fig. 7-25). This normal relationship of these two teeth is called the key to occlusion.
ANGLES CLASSIFICATION

Edward Angle was a dentist who developed a classification of normal and abnormal ways teeth meet into centric occlusion. Angle came up with three classes, Class I, II and III, as illustrated by Figure 7-26.

- **Class I:** Patient’s profile is characterized as normal
- **Class II:** Patient’s profile is deficient in chin length and characterized as a retruded (retrognathic) profile
- **Class III:** Patient’s profile is excessive in chin length and characterized as protruded (prognathic) profile

TOOTH MORPHOLOGY

LEARNING OBJECTIVE:

Describe the shape of each tooth in the mouth.

Tooth morphology is the study of the form and shape of teeth, which will be helpful in the following clinic procedures:

- Dental charting
- Selecting rubber dam clamps
- Forming matrix bands before use
- Mounting dental radiographs

A thorough understanding of tooth morphology makes it easier to identify and differentiate between maxillary, mandibular, right and left teeth, maxillary and mandibulary.

MAXILLARY CENTRAL INCISORS

The maxillary central incisor (tooth #8 or #9) illustrated in Figures 7-27 and 7-28. Viewed mesially or distally, a maxillary central incisor looks like a wedge, with the point of the wedge at the incisal (cutting) edge of the tooth.

Figure 7-27.—Surfaces of a Maxillary Central Incisor

Figure 7-26.—Angle's Classification
Facial Surface

The facial surface resembles a thumbnail in outline. The mesial margin is nearly straight and meets the incisal edge at almost a 90° angle. The distal margin meets the incisal edge in a curve. The incisal edge is straight. The cervical margin is curved like a half moon. Two developmental grooves are on the facial surface.

Lingual Surface

The lingual surface (Fig. 7-28) is quite similar to the facial surface in outline except that it is slightly smaller in all dimensions. At the mesial and distal margins there are marginal ridges. Occasionally there is a cingulum occurring on the lingual or palatal aspects, that forms a convex protuberance at the cervical third of the anatomic crown at the junction of the lingual surface with the cervical line. Sometimes a deep pit, the lingual pit, is found in conjunction with a cingulum.

Root

As with all anterior teeth, the root of the maxillary central incisor is single. Usually, the apex of the root is inclined slightly distally.

MAXILLARY LATERAL INCISORS

The maxillary lateral incisor (tooth #7 or #10), illustrated in Figure 7-29, is similar to the maxillary central incisor, except in size: it is shorter, narrower, and thinner.

Facial Surface

The developmental grooves on the facial surface are not as easily evident as those of the central incisor. Of more significance is the distoincisal angle, which is well-rounded with this curvature continuing to the cervical line. The mesiofacial angle is nearly straight to the cervical line.

Lingual Surface

The shape of the lingual surface varies with each patient. In some patients, it is markedly concave, almost spoon-like in appearance, and in others it is flat. The lingual surface is almost the same as the facial surface.

Root Surface

The root is conical (cone-shaped) but somewhat flattened mesiodistally.
MANDIBULAR CENTRAL INCISORS

The mandibular central incisor (tooth #24 or #25) is illustrated in Figure 7-30. These are the first permanent teeth to erupt, replacing deciduous teeth, and are the smallest teeth in either arch. These erupt around the same time as the mandibular first molars, usually after them.

Facial Surfaces

The facial surface of the mandibular central incisor is widest at the incisal edge. Both the mesial and the distal surfaces join the incisal surface at almost a 90° angle. Although these two surfaces are nearly parallel at the incisal edge, they converge toward the cervical margin. The developmental grooves may or may not be present. When present, they appear as very faint furrows.

Lingual Surface

The lingual surface is concave from the incisal edge to the cervical margin.

Root Surface

The root is slender and extremely flattened on its mesial and distal surfaces.
MANDIBULAR LATERAL INCISORS

The mandibular incisor (tooth #23 or #26), illustrated in Figure 7-31, is a little wider mesiodistally than the mandibular central incisor, and the crown is slightly longer from the incisal edge to the cervical line.

**Facial Surface**

The facial surface is less symmetrical than the facial surface of the mandibular central incisor. The incisal edge slopes upward toward the mesioincisal angle, which is slightly less than 90°. The distoincisal angle is rounded. The mesial border is more nearly straight than the distal border.

**Lingual Surface**

The lingual surface is similar in outline to the facial surface. The incisal portion of the lingual surface is concave. The cingulum is quite large but blends in smoothly with the rest of the surface.

**Root Surface**

The root is single and extremely flattened on its mesial and distal surfaces.
MAXILLARY CUSPIDS

The maxillary cusp (tooth #6 or #11) is illustrated in Figures 7-32 and 7-33. The maxillary cusp is usually the longest tooth in either jaw. This tooth is called a canine as it resembles a dog’s tooth.

Facial Surface

The facial surface of the crown (Fig. 7-32) differs considerably from that of the maxillary central or lateral incisors. Specifically, the incisal edges of the central and lateral incisor are nearly straight; the cusp has a definite point, or cusp. There are two cutting edges, the mesioincisal and the distoincisal. The distoincisal cutting edge is the longer of the two. The developmental grooves that are so prominent on the facial surface of the central incisor are present here, extending two-thirds of the distance from the tip of the cusp to the cervical line.

Lingual Surface

The lingual surface has the same outline as the facial surface but is somewhat smaller because the mesial and distal surfaces of the crown converge toward the lingual surface. The lingual surface is concave, with very prominent mesial and distal marginal ridges, and a lingual ridge, which extends from the tip of the cusp toward the cervical line. There is often a cingulum in the cervical portion of the lingual surface of the crown.

Root Surface

The root is single and is the longest root in the arch. It is usually twice the length of the crown and helps anchor it in. This is because the cusp is designed for seizing and holding food.
MANDIBULAR CUSPIDS

The mandibular cuspid (tooth #22 or #27) is illustrated in Figure 7-34. These teeth, like the mandibular incisors, are smaller and more slender than the opposing teeth in the maxillary arch.

Facial Surface

The facial surface of a mandibular cuspid is much the same as that of a maxillary cuspid, except that the distoincisal cutting edge is almost twice the length of the mesial edge.

Lingual Surface

The lingual surface as a rule is very smooth, and a cingulum is rarely present.

Root Surface

The single root is not as long as that of the maxillary cuspid and is much flatter mesiodistal.

MAXILLARY FIRST BICUSPID

The maxillary first bicuspid (tooth #5 or #12), illustrated in Figure 7-35, is the fourth tooth from the midline. It is considered to be the typical bicuspid. Sometimes bicuspids are called premolars because they are just in front of the molar teeth.

Facial Surface

The facial surface is somewhat similar to the facial surface of the cuspid. However, the tip of the facial cusp is located in the center of the “biting” edge, which is called the occlusal edge or occlusal margin. From the cusp tip to the cervical margin, there is a slight ridge, called the facial ridge, similar to the facial ridge found in cuspid teeth.

Lingual Surface

The lingual surface is narrower and shorter than the facial surface, and is smoothly convex in all directions.
Root

The root is quite flat on the mesial and distal surfaces. In about 50 percent of maxillary first bicuspids, the root is divided in the apical third, and when it so divided, the tips of the facial and lingual roots are slender and finely tapered.

Occlusal Surface

The occlusal surface (Fig. 7-36) has a facial cusp and a lingual cusp. There are mesial and distal marginal ridges. Two fossae (pit: a concavity in a surface) are on the occlusal surface—the mesial and distal fossae.

MAXILLARY SECOND BICUSPID

The maxillary second bicuspid (tooth #4 or #13), illustrated in Figure 7-37 resembles the first bicuspid very closely, but is smaller in dimensions. The cusps are not as sharp as the maxillary first bicuspid and have only one root.

Figure 7-37.—Surfaces of a Maxillary Second Bicuspid

Figure 7-36.—Features of an Occlusal Surface of Maxillary First Bicuspid
MANDIBULAR FIRST BICUSPID

The mandibular first bicuspid (tooth #21 or #28), illustrated in Figure 7-38, is the fourth tooth from the midline. It is the smallest of the four bicuspids. The term bell-crowned is used to describe its appearance. The mandibular first bicuspid has many characteristics of a cuspid.

Figure 7-39.—Surfaces of a Mandibular Second Bicuspid

Root Surface

The root of the mandibular first bicuspid is usually single, but on occasion can be bifurcated (two roots).

Occlusal Surface

A large facial cusp, which is long and well defined, and a small nonfunctional lingual cusp are present on the mandibular first bicuspid.

MANDIBULAR SECOND BICUSPID

The mandibular second bicuspid (tooth #20 or #29), illustrated in Figure 7-39 is the fifth tooth from the midline.

Figure 7-39.—Surfaces of a Mandibular Second Bicuspid

Root Surface

The root of the tooth is single, and in a great many instances, the apical region is found to be quite curved.
MAXILLARY FIRST MOLAR

The maxillary first molar (tooth #3 or #14), illustrated in Figures 7-40 and 7-41, is the sixth tooth from the midline. The first molars are also known as 6-year molars, because they erupt when a child is about 6 years old.

Facial Surface

The facial surface has a facial groove that continues over from the occlusal surface, and runs down to the middle third of the facial surface.

Lingual Surface

In a great many instances, there is a cusp on the lingual surface of the mesiolingual cusp. This is a fifth cusp called the cusp of Carabelli, which is in addition to the four cusps on the occlusal surface.

Occlusal Surface

In all molars the patterns of the occlusal surface (Fig. 7-41) are quite different from those of the bicuspids. The cusps are large and prominent, and the broad grinding surfaces are broken up into rugged appearing ridges and well-defined grooves. An oblique ridge, which is not present on the bicuspids, appears here; it also appears on maxillary second and third molars.

Root Surface

The maxillary first molar has three roots, which are named according to their locations - mesiofacial, distofacial, and lingual (or palatal root). The lingual root is the largest.
MAXILLARY SECOND MOLAR

The maxillary second molar (tooth #2 or #15), illustrated in Figure 7-42 is the seventh tooth from the midline. The second molars are often called 12-year molars because they erupt when a child is about 12 years old.

Because it has the same function as the maxillary first molar, its physical characteristics are basically the same. The second molar is smaller, the occasional fifth cusp of Carabelli does not appear, and there is a marked reduction in the size of the distolingual cusp.

MAXILLARY THIRD MOLAR

The maxillary third molar (tooth #1 or #16), illustrated in Figure 7-43 is the eighth tooth from the midline. Third molars are called “wisdom teeth” because they erupt when the young adult is passing into adulthood. The tooth is much smaller than the maxillary first or second molars, with an occlusal outline that is nearly circular.

Figure 7-43.—Surfaces of Maxillary Third Molar

Occlusal Surface

Numerous fissures and grooves cover the occlusal surface. There is no distinct oblique ridge.

Root

The root may have one to as many as eight divisions. These divisions are usually fused and very often curved distally.
MANDIBULAR FIRST MOLAR

The mandibular first molar (tooth #19 or #30), illustrated in Figures 7-44 and 7-45, is the sixth tooth from the midline. *It is the first permanent tooth to erupt.*

![Figure 7-44.—Surfaces of Mandibular First Molar](image)

**Facial Surface**

The facial surface has two grooves: the facial groove, an extension of the facial groove from the occlusal surface and the distofacial groove, an extension of the distofacial groove from the occlusal surface.

![Figure 7-45.—Features of an Occlusal Surface of Mandibular First Molar](image)

**Occlusal Surfaces**

The occlusal surface has five cusps (Fig. 7-45). The fifth cusp is called the distal cusp.

**Roots**

The tooth has two roots, a mesial and a distal.
MANDIBULAR SECOND MOLAR

The mandibular second molar (tooth #18 or #31), illustrated in Figure 7-46, is the seventh tooth from the midline.

**Facial Surface**

The facial surface has only one groove, the facial groove, which arises on the occlusal surface, extends over the facial margin onto the facial surface.

**Occlusal Surfaces**

The greatest difference between the occlusal surfaces of the mandibular first and second molars is that the occlusal surface of the second molar has no fifth cusp.

MANDIBULAR THIRD MOLAR

The mandibular third molar (tooth #17 or #32), illustrated in Figure 7-47, is the eighth tooth from the midline. It appears in many forms, sizes, and shapes. Since its function is similar to that of the other two mandibular molars, its general appearance is the same. It has smaller surfaces, more supplemental grooves, and four or five cusps, which are not as sharply differentiated as those of the first two molars.

**Roots**

The roots, generally two in number, are shorter in length and tend to be fused together. In many instances they show a distinct distal curve.
GLOSSARY OF UNIQUE DENTAL ANATOMY

LEARNING OBJECTIVE:

Describe each of the unique dental anatomy structures and their function(s).

The following list will be helpful in understanding some of the anatomical terms used in this chapter.

Cusp: A pointed or rounded elevation of enamel found on cuspids and on the chewing surfaces of bicuspids and molars. (Fig. 7-48)

Cingulum: Found on the lingual aspect of an anterior tooth. It is a convex mount of enamel localized to the cervical one-third of the crown (Fig. 7-49).

Fissure: A linear fault that sometimes occurs in a developmental groove by incomplete or imperfect joining of the lobes. A pit is usually found at the end of a developmental groove or a place where two fissures intersect (Fig. 7-50).

Fossa: A rounded or angular depression of varying size found on the surface of a tooth.

Central fossa: Centrally located depression found on the occlusal surface of molars and mandibular second bicuspids. The other bicuspids have mesial and distal triangular fossa, but do not have a central fossa (Fig. 7-51).
**Lingual Fossa:** Irregular, shallow depression found on the lingual surfaces of an incisor or cuspid (Fig. 7-52).

![Figure 7-52.—Lingual Fossa](image)

**Triangular Fossa:** Located adjacent to the marginal ridges on the occlusal surfaces of posterior teeth. Two types of triangular fossae are mesial and distal (Fig. 7-53).

**Groove:** A small linear depression on the surface of a tooth.

![Figure 7-53.—Triangular Fossa](image)

**Developmental Groove:** Fissure between the cusps on the crown of the tooth. Cusp tips are the initial site where enamel develops. As the enamel develops and spreads laterally, it touches enamel developing from other cusps. This junction forms a developmental groove. Such grooves appear on the labial, buccal, and lingual surfaces, and are least apparent on the labial aspect of anteriors (Fig. 7-54).

![Figure 7-54.—Developmental Groove](image)
**Supplemental Groove:** A minor, auxiliary groove that branches off from a much more prominent developmental groove. They do not represent the junction of primary tooth parts and gives the occlusal surface a wrinkled appearance (Fig. 7-55).

![Figure 7-55.—Supplemental Groove](image)

**Lobe:** Is one of the primary divisions of a crown; all teeth develop from four or five lobes. Lobes are usually separated by readily identifiable developmental grooves (Fig. 7-56).

![Figure 7-56.—Lobe](image)

**Mamelons:** Are small, rounded projections of enamel from the incisal edges of newly erupted anterior teeth. The projections wear away soon after eruption (Fig. 7-57).

![Figure 7-57.—Mamelons](image)

**Cusp Ridge:** Each cusp has four cusp ridges radiating from its tip. They are named according to the direction they take away from the cusp tip (for example, mesial, distal, buccal, or lingual) (Fig. 7-58).

![Figure 7-58.—Cusp Ridge](image)
**Lingual Ridge:** The ridge of enamel that extends from the cingulum to the cusp tip on the lingual surface of most cuspids (Fig. 7-59).

**Marginal Ridge:** A linear, rounded border of enamel that forms the mesial and distal margins of anterior teeth as viewed from the lingual, and the mesial and distal borders of occlusal surfaces on posterior teeth (Fig. 7-60).

**Oblique Ridge:** The only tooth on which an oblique ridge is found is the maxillary first and second molars. Consists of an elevated prominence on the occlusal surface and extends obliquely from the tips of the mesiolingual cusp to the distobuccal cusp (Fig. 7-61).

**Triangular Ridge:** Two inclines meet to form a triangular ridge and are located either on a facial or a lingual cusp ridge (Fig. 7-62).
**Summary**

This chapter reviewed oral anatomy and physiology. It covered the morphology of teeth to include their various surfaces. With this knowledge the HM will be able to assist the dentist, physician, or IDC with assessing, treating, and documenting oral care provided to patients.

**Transverse Ridge:** The union of a buccal and lingual triangular ridge that crosses the surface of a posterior tooth transversely (roughly 90° to both the buccal and lingual tooth surfaces) (Fig. 7-63).

**Sulcus:** An elongated valley or depression in the surface of a tooth formed by the inclines of adjacent cusps or ridges (Fig. 7-64).

**Figure 7-63.—Transverse Ridge**

**Figure 7-64.—Sulcus**
INTRODUCTION

Oral pathology is the science that treats the nature, causes, and development of oral diseases. It includes both clinical and microscopic study of structural and functional changes that cause or are caused by oral and other diseases. The calcified or soft tissues of the oral cavity, or both, may be involved.

Some of the abnormal conditions that exist in the oral cavity and cause patients to request treatment will be described in this chapter and Chapter 24 "Emergency Treatment of Oral Diseases and Injuries." Occasionally, the Hospital Corpsman (HM) will be the first one to observe these pathologic conditions in the patient’s mouth. Always notify a provider if observing a condition in question. The HM will never make a diagnosis or tell a patient what condition might exist. That area of expertise is the sole responsibility of the Dental Officer.

MICROORGANISMS

LEARNING OBJECTIVE:

Explain the microorganisms located in the mouth.

Salivary glands secrete about 1,500 ml of saliva on a daily basis. Microscopic counts in saliva show an average of 750 million microorganisms per milliliter. With the temperature in the oral cavity around 98.6° Fahrenheit, the mouth is the perfect environment for microorganisms to live. Microorganisms need a dark, moist, warm area, and a good food supply to live. Some microorganisms that are a concern with oral pathology are bacteria, viruses and fungi, which are discussed in Chapter 9 "Preventive Medicine and Infection Control."

ORAL LESIONS

LEARNING OBJECTIVE:

Identify the types, descriptions, and stages of oral lesions.

Oral lesions can be defined as any pathological or traumatic disorder of tissue that creates a loss of function of the area affected. They can include wounds, sores, and any other tissue damage resulting from disease or injury. Many types of lesions can occur in the mouth. The location of the lesion can assist in determining the type.

LESIONS BELOW THE SURFACE

The most common lesions that extend below the surface of the mucosa in oral pathology are:

Abscess

It is a localized collection of pus in a specific area of soft tissue or bone. Often it is confined in a particular space, and is commonly caused by a bacterial infection.

Cyst

It is an enclosed pouch or sac containing fluid or semi-solid material.

Ulcers

They are a disruption of the superficial covering of the mucosa or skin caused by biting, denture irritation, toothbrush injury, viruses or other irritants.
ELEVATED LESIONS

Numerous types of lesions are above the surface of the mucosa. Two of the most common are discussed below.

- **Vesicles:** A small elevation that contains fluid. Most of these lesions in the oral cavity rupture, leaving superficial ulcers

- **Hematoma:** A localized collection of blood that escaped from blood vessels due to trauma. It is well-defined and with time, changes to a dark color

NONELEVATED LESIONS

Two common lesions of the oral mucosa in this category are:

- **Petechiae:** Round pinpoint, non-raised, purplish-red spots, caused by mucosal or dermal hemorrhage

- **Ecchymoses:** Large, purplish-red areas caused by blood under the skin or mucosa; turns to a blue or yellow color

DENTAL CARIES

Humans have suffered the effects of dental caries for centuries. Considerable study and research have been devoted to their causes and prevention. The disease is caused by a microbial process that starts on the surface of the teeth and leads to the breaking down of the enamel, dentin, and cementum. In some cases it causes pulp exposure. The pathologic break that is produced on or in the tooth surface is called a carious lesion (Fig. 8-1) or commonly called a cavity. The process that destroys the hard surfaces of the tooth is called decay.

Contributing Factors

The cause of tooth decay has been linked to a group of bacteria called streptococci and other acid producing bacteria that are in the oral cavity. Decalcification of the enamel, the first step in the decay process, is caused by:

- Bacterial plaque adhering to the smooth surfaces of the teeth

- Acid, produced by bacteria in food debris, being trapped in pits and fissures

Decay Process

Dental caries usually appear first as a chalky white spot on the enamel, which indicates the decalcification process. If proper oral hygiene is not maintained, the lesion may become stained and take on a dark appearance. In pit and fissure caries, the area of decalcification at the surface is normally small, and the white spot is less noticeable than in smooth surface caries. In either type, the surface becomes roughened, as can be noted by passing a dental explorer point over it.
If the tooth surface has an area that has not progressed past the decalcification stage, this type of carious lesion is called incipient. As the decay spreads in the enamel, it may stop. If this occurs, the process is called an arrested carious lesion (Fig. 8-2). These areas in which dental caries have been arrested are dark and, in some instances, hollowed out. A dental explorer passed over or in these areas will feel hard to the touch. If the area still has active decay, the explorer may “sink in” the soft decay.

Figure 8-2.—Arrested Carious Lesion

Dental caries can progress further into the dentin of the tooth and spread out laterally widely undermining the enamel and dentin. If this occurs, often there may be no visible changes until extensive destruction has taken place. The condition of the caries if not arrested or restored with operative dentistry (filling) will spread through the dentin into the pulp of the tooth, thus requiring endodontic treatment (root canal). Use bitewing radiographs to find and diagnose interproximal dental carries.

RECURRENT CARIES

Recurrent caries are decay processes that occur underneath existing dental restorations. More simply stated another cavity has occurred in the tooth where there was a filling or restoration.

Some of the causes are:

- Improper cavity preparation: The dentist was unable to remove all of the decay in the tooth before the placement of a restoration
- Inadequate cavity restoration: Open margins (space in-between the restoration and tooth)
- Old restorations: The margins of the restoration break down or are not completely sealed when originally placed, creating a "leaky margin"

TYPES OF CARIOUS LESIONS

Depending on its location, a carious lesion is designated as either a pit and fissure type or a smooth surface type. Pit and fissure caries develop in depressions of teeth surfaces that are hard to keep clean of food debris and plaque. Smooth surface caries usually develop on the proximal surface (Fig. 8-3) or the gingival third of facial and lingual surfaces on the teeth. These areas in-between (interproximal) the teeth are where plaque accumulates and forms, starting the decay process.

Figure 8-3.—Smooth Surface Caries
DISEASES OF THE DENTAL PULP

The dental pulp is a living tissue. All living tissues can die or become diseased. The dental pulp is composed of vascular connective tissue encased in dentin, which provides protection. Even with this protection, the pulp may receive injuries by thermal changes, carious lesions from microorganisms, and mechanical trauma. The extent of pulpal damage and the vitality (life) of the tooth depend on the severity of injury and how the pulp reacts to disease. The term pulposis refers to any disease involving the dental pulp. Some of the more common diseases of the pulp are pulpalgia, pulpitis, periapical abscess, and necrosis.

PULPALGIA

Pulpalgia refers to pain in the dental pulp and commonly occurs after a restoration has been placed in a tooth. It can be caused by root planing and periodontal surgery. The tooth may become sensitive to touch, temperature changes, and sweet or sour foods. Pain associated with pulpalgia has been described as short, sharp shooting pain that may increase when lying down or walking upstairs.

PULPITIS

Pulpitis is an inflammation of the dental pulp, caused by a bacterial infection resulting from dental caries or fractured teeth. When microorganisms enter the pulp, they start to produce severe damage, which leads to the buildup of pressure in the canal. The result of this pressure may cause a dull ache that can lead to a more severe, pulsating pain.

Other causes include chemical irritants or thermal changes introduced during dental restorations. When severe pulpitis occurs, the dentist may remove a portion or all of the pulp in an injured tooth.

PERIAPICAL ABSCESS

A periapical abscess results when the pulp has become inflamed and a small pus-like abscess forms in the pulpal canal. If left untreated, the inflammation spreads out through the apex of the root and into the bone. As the abscess gets bigger, pressure from the inflammation and pus at the apex of the root may cause the tooth to be pushed up higher in its socket. The patient may complain the tooth feels “high” when biting and is very sensitive to touch.

Bone loss around the apex of the tooth can occur if left untreated. The abscess and bone loss at the apex cause a radiolucency appearing like a “grape” when viewed on an x-ray. The course the pus from the abscess follows from the apex, into the jaw bone, and draining into the mouth is referred to as a fistula.

NECROSIS

The death of tissue is called necrosis. Pulpal necrosis occurs as a result of untreated pulpitis from a traumatic injury; a tooth that is necrotic must be treated. The dead pulpal tissue will decompose, producing toxins that will smell foul or rotten when the tooth is being treated. Dental pain may or may not occur from necrosis.
PATHOLOGY OF THE PERIODONTIUM

LEARNING OBJECTIVE:
Identify the types, descriptions, and stages of periodontal diseases.

Periodontal disease is the most prevalent chronic disease of humankind. The term periodontal disease refers to all diseases of the periodontium and can affect the tissues around and supporting the teeth. HMs must know symptoms of periodontal disease the patients might describe:

- Bleeding gingival tissue during tooth brushing
- Tender or red swollen gums
- Receding gingival tissue
- Tooth shifting or elongation (looks longer)
- Mobile (loose) teeth
- Purulent exudate (pus) in-between the teeth and gums
- Abnormal change in the fit of partial dentures
- Halitosis (bad breath)

GINGIVITIS

Gingivitis is an inflammation involving the gingival tissues. Conditions pertaining to the gingiva of principal concern are marginal gingivitis and necrotizing ulcerative gingivitis.

Marginal Gingivitis

Marginal gingivitis (Fig. 8-4) is the most common type of gingival disease. Most frequently it is the result of poor oral hygiene and affects both the gingival margins and papilla. Chief irritants are food debris and plaque on the marginal gingiva around the necks of the teeth, interproximal spaces, or overhanging margins of dental restorations. A localized inflamed condition may exist from a popcorn husk or toothbrush bristle. Early formation of calculus deposits can also form under the gingival sulcus (depression or fissure) on the facial and lingual surfaces of the upper and lower teeth. Calculus deposits can also be responsible for the occurrence of marginal gingivitis, and if left untreated, may proceed to destruction of the supporting structures (as in periodontitis).

Figure 8-4.—Marginal Gingivitis

Marginal gingivitis usually starts at the tips of the papillae and then extends to the gingival margins. Swelling, loss of stippling (orange peel texture of surface) of the attached gingiva, redness, easily retractable sulcus, and foremost, a tendency to bleed easily, are the main characteristics. This condition may be generalized (exist around all teeth), or it may be localized to a few teeth.
Necrotizing Ulcerative Gingivitis

Necrotizing ulcerative gingivitis (NUG) (Fig. 8-5) is a disease referred to as trenchmouth, or Vincent’s infection. It is characterized during the acute stage by redness, swelling, pain, accumulation of calculus around the sulcus of the teeth, and bleeding of the gingival tissues. There is a film of necrotic white or grayish tissue around the teeth; it may be wiped off, leaving a raw, bleeding base. The ulceration of the gingival crest results in a characteristic punched-out appearance and loss of the interdental papillae. There is an unpleasant odor and a foul taste in the mouth. The gingival tissues bleed easily when touched, and a patient will complain of not being able to brush their teeth or chew well because of the pain or discomfort.

PERIODONTITIS

Periodontitis (Fig. 8-6) is a chronic inflammatory condition that involves the gingiva, crest of the alveolar bone, and periodontal membrane. This condition results in loss of bone that supports the teeth, periodontal pocket formation, and causes an increase of tooth mobility. It usually develops as a result of untreated chronic marginal gingivitis. The color of the gingival tissues is intensified and becomes bluish red as the disease progresses. A gradual recession of the periodontal tissue will occur.

Neglected deposits of calculus and formation of additional calculus over time contribute to the spread of the disease. Like marginal gingivitis, it may affect the entire dentition, or only localized areas.

Periodontal Pocket Formation

As the inflammation continues, microorganisms and their products progress toward the apex of the tooth, forming a pocket in which additional calculus forms. Frequently, the gingival margin also recedes toward the apex and the pocket is shallow. With pocket formation, the gingival tissue bleeds easily, and shelf-like projections of calculus form between the teeth. These calculus formations irritate the interdental papillae, which become ulcerated and finally are destroyed.

As the rest of the alveolar bone is resorbed, the attachment fibers of the periodontal membrane are loosened. They may remain attached to the tooth for a time, but finally they are destroyed, and the pocket can extend farther toward the apex of the tooth. Eventually, if untreated, the tooth will be lost through destruction of its supporting tissues.
Periodontal Abscess

A periodontal abscess usually results from long-continued irritation by food debris, plaque, deep deposits of calculus, or foreign objects such as a toothbrush bristle or popcorn husk being tightly packed in the interproximal spaces or within the walls of a pocket. The gingiva surrounding the area becomes inflamed and swollen.

PERICORONITIS

Pericoronitis is an inflammation of the gingiva around a partially erupted tooth. The mandibular third molars are most often affected, although any erupting tooth may be involved. In the mouth of a young adult, part of a tooth can be seen projecting through the gingiva, usually distal to the second molar. The surrounding tissues are usually acutely inflamed. The inflammation may be caused by irritation resulting from the patient’s inability to keep the area properly cleansed.

Another cause of inflammation is infection from oral pathogens that gained access to the tissue surrounding the crown of the erupting tooth through the opening made by a projecting tooth cusp. The “gingival flap” may become infected after inflammation as a result of the constant irritation caused by contact with the occlusal surface of an erupting maxillary third molar.

DISEASES OF THE ORAL SOFT TISSUES

LEARNING OBJECTIVE:

Identify the types, descriptions and stages of oral soft tissue diseases.

Many oral diseases can affect the soft tissues. This section will cover only a small portion of the most common types. These lesions can be caused by viruses, bacteria, fungi, and physical and chemical agents. Direct contact with the diseases covered may present some degree of hazard or a life-threatening disease to the HM. Always follow infection control procedures when in contact with all patients.

RECURRENT APHTHOUS STomatITIS

Recurrent aphthous stomatitis (RAS) (Fig. 8-7), or canker sores, are painful ulcerations. These lesions are found in the vestibular and buccal mucosa, tongue, soft palate, and in the floor of the mouth. The exact cause of these lesions is not known, but studies show that physical and emotional stress make them appear. Also injuries from tooth brushing, eating harsh foods, and allergies can start RAS. The healing time of the ulcers is usually 7 to 10 days.

Figure 8-7.—Recurrent Aphthous Stomatitis (RAS)
VIRAL INFECTIONS

The viral infections of main concern are those caused by the herpes simplex virus (HSV), and the human immunodeficiency virus (HIV) which causes acquired immunodeficiency syndrome (AIDS). Both are extremely contagious to the HM, Dental Officer, and other dental patients through cross contamination of dental instruments and dental equipment. The virus can gain access via the skin, eye, or mucous membranes. If the HM treats a patient with one of these or other viruses, ensure that proper infection control procedures are followed as outlined in Chapter 9, “Preventive Medicine and Infection Control.”

Herpes Simplex Virus

The two herpes simplex viruses are among the most common infectious agents.

- **Herpes simplex virus, Type One (HSV-1):** Oral herpes
- **Herpes simplex virus, Type Two (HSV-2):** Genital herpes

In oral pathology the most commonly diagnosed sites for HSV-1 are the oral cavity, tongue (Fig. 8-8), lips, and the eyes. Direct contact with HSV-1 lesions is the most common mode of transmission; it can be transmitted through saliva even if there are no active lesions. Infection on the hands of healthcare personnel from patients shedding HSV can result in herpetic lesions.

Other lesions of the HSV-1 virus are acute herpetic gingivostomatitis, characterized by red and swollen gingiva. All of the oral mucosa is tender and eating is painful. Vesicles form throughout the mouth and rupture, leaving painful ulcers.

The most common of all the herpetic HSV-1 lesions is herpes labialis. They frequently involve the lips and adjacent skin at the corners of the mouth. Recurrence usually starts at the same location with a burning, tingling sensation and then forming vesicles that fuse together leaving large lesions. After the vesicles rupture, crusting of the surface occurs; these lesions are known as “fever blisters.” The crusted lesions are also referred to as “cold sores,” because a common cold sometimes accompanies these HSV-1 lesions. Known causes for the reoccurrence of the HSV-1 lesions are:

- Sunlight
- Menstruation
- Dental treatment (local trauma)
- Stress or anxiety

The recurrent HSV-1 lesions take about 7 to 10 days to resolve. Any routine dental treatment is recommended to be rescheduled during the active phase of these lesions because the disease is highly transmittable.

HIV/AIDS Virus

The human immunodeficiency virus (HIV) is the main cause of the acquired immunodeficiency syndrome (AIDS). It is a worldwide epidemic. This deadly disease is a direct threat to all dental health professionals and other healthcare workers who are exposed to patients who carry the virus.

Healthcare workers can be exposed to the AIDS virus through contaminated body fluids, exposure to blood or blood products, instruments, and equipment.
Some of the more common oral manifestations of HIV infection are as follows:

- **Candidiasis:** (Fig. 8-9) a fungal infection of the mouth, usually red or white in color

- **Hairy Leukoplakia:** (Fig. 8-10) a viral infection on the tongue with lesions that appear as white and slightly raised

- **Kaposi’s sarcoma:** (Fig. 8-11) cancerous, dark bluish-purple lesions that involve blood vessels

Procedures and precautions for protection will be discussed in Chapter 9.

**ORAL CANCER**

**LEARNING OBJECTIVE:**

*Identify the types, descriptions and stages of oral cancer.*

Oral cancers are found in the oral cavity at any site, but most often in the tongue, floor of the mouth, and the lower lip. The cancer is a neoplasm (tumor) and is a growth of abnormal tissue. There are two types of neoplasms:

- **Benign Tumors:** Not life threatening

- **Malignant Tumors:** Life threatening if left untreated
CLASSIFICATIONS OF MALIGNANT TUMORS

Dentists are trained to give special attention when performing an oral cancer screening on a patient to detect any type of cancer. Often these lesions do not cause any pain while in the early stages of development. A malignant tumor can become fatal if not found in its early stages or if left untreated. The following are classifications of malignant tumors.

Carcinoma

Cancer of the epithelium usually found on the oral mucosa of the mouth, lips (Fig. 8-12), tongue, cheeks, and floor of the mouth. Carcinomas start off looking like elevated or ulcerated lesions, and can quickly spread to other locations in the body and invade the lymph nodes.

Adenocarcinoma

Usually found in the oral region or salivary glands, most often of the palate (Fig. 8-13), and appears as a lump or a bulge under the mucosa.

Sarcomas

Affects the supportive and connective tissues, for example, bones of the jaw. The causes for many neoplasms are unknown. What is known is that the disease is characterized by the abnormal growth and spread of cancer cells. This growth or spread of malignant tumors from one area to another is called metastasis. Modern research concerning the development of neoplasms has been linked to the following factors:

- Hereditary
- Chemicals (carcinogens, such as found in tobacco smoke and alcoholic beverages)
- Overexposure to X-rays
- Excessive sunlight
- Smokeless tobacco
Smokeless tobacco, such as chewing tobacco or snuff, may play a role in the development of oral precancerous lesions on the oral mucosa and can result in increased tooth loss from periodontal disease. The area where the user of smokeless tobacco places it in the mouth may leave a smooth or scaly white patch called leukoplakia or snuff-dipper’s keratosis (Fig. 8-14).

Irritation of the oral mucosa occurs because 90 percent of the nicotine of smokeless tobacco is directly absorbed through the oral mucosa, which then goes directly into the blood stream. The effects and damage of nicotine pose a serious health hazard. Many smoking cessation programs are available through naval hospitals, medical and dental clinics, and ships. Dental patients wishing to get assistance for this addiction can be referred to these programs.

CONGENITAL DISORDERS

LEARNING OBJECTIVES:

Identify congenital disorders.

Describe various congenital disorders.

Congenital disorders are present at birth. The congenital disorders that may be seen are:

- **Anodontia:** The absence of single or multiple teeth
- **Supernumery Teeth:** Development of one or more extra teeth
- **Cleft Lip:** The maxillary and medial nasal processes fail to fuse (Fig. 8-15)
- **Cleft Palate:** Results when the palate shelves, right and left side do not fuse leaving a space (Fig. 8-15)


![Figure 8-15.—Cleft Lip and Palate](Image reprinted with permission from: Torres & Ehrlich: Bird, D. L. & Robinson, D. S. (2008). Torres and Ehrlich Modern Dental Assisting (9th ed.). St. Louis: Elsevier Health Sciences.)
• **Ankyloglossia:** Results from a short lingual frenulum attachment also known as tongue tied (Fig. 8-16)

**Figure 8-16.—Ankyloglossia**


**DISORDERS AFFECTING THE TEETH**

**LEARNING OBJECTIVE:**

*Identify the disorders that affect the teeth.*

Disorders that commonly affect the teeth are:

- Impaction
- Attrition
- Abrasion
- Erosion

**IMPACTION**

It is the condition in which a tooth is blocked by a physical barrier, usually teeth or bone (Fig. 8-17).

**Figure 8-17.—Impaction**


A tooth may not erupt in the normal time period if an impaction occurs. Some of the causes of impacted teeth are:

- Movement of the erupting tooth into a horizontal, vertical, or other abnormal position
- Early loss of deciduous teeth
- Insufficient jaw space, abnormally large tooth crowns, supernumerary or other teeth in a dental arch
ATTENTION AND ABRASION

Attrition (Fig. 8-18) is the loss of substance of a tooth from a wearing away process caused by teeth against teeth. Whereas, abrasion results in the loss of tooth structure secondary to the action of external agents.

In attrition, wear involves aspects on the incisal, occlusal, and interproximal surfaces of the teeth and is considered a normal or gradual loss of tooth substance because of the mastication of food. Causes of occlusal attrition can result from bruxism (grinding of teeth), chewing of tobacco or gum, or other oral habits that involve mastication.

In abrasion (Fig. 8-19) one or more teeth may show wear, generally brought about by improper tooth brushing; biting foreign objects such as a pipe stem, thread, or bobby pins; or other mechanical actions such as a poorly fitted clasp of partial dentures.

Figure 8-18.—Attrition

Image reprinted with permission from:

Figure 8-19.—Abrasion

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EROSION

Erosion (Fig. 8-20) is a loss of tooth substances from a chemical process that does not involve bacteria. It occurs usually on the facial surfaces at the gingival third of the crown and often involves the maxillary incisors. The enamel and dentin on the floor of the lesion are smooth, hard, and glistening. During the early stages of erosion, the eroded areas are very sensitive to heat, cold, acidic foods, and tooth brushing; sensitivity may decrease when secondary dentin is formed.

Some types of lesions are called idiopathic erosion because the factors producing this condition are unknown or may occur from a known acid source such as people who have bulimia, an eating disorder characterized by binge eating and self induced vomiting. The distinct erosion is apparent on the lingual surfaces of the teeth of a suspected patient with bulimia. Another factor could be drinking excessive sodas.

Figure 8-20.—Erosion

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SUMMARY

This chapter reviewed the various types of oral pathology conditions that can be encountered when examining the oral cavity including oral lesions, dental caries, periodontal conditions, and soft tissue diseases. It touched on viral infections, oral cancer, congenital disorders, and teeth disorders. Being aware of each of these pathological conditions will allow the HM to assist the dentist and the patient with early identification and treatment leading to successful resolution.
CHAPTER 9

PREVENTIVE MEDICINE AND INFECTION CONTROL

INTRODUCTION

Prevention and control of disease are considered the most desirable means of maintaining good health. Information included in this overview should provide the Hospital Corpsman (HM) with a general knowledge of the principles and practices of the Navy’s Preventive Medicine afloat and ashore. This information is discussed in detail in the Manual of Naval Preventive Medicine, NAVMED P-5010.

PREVENTIVE MEDICINE

LEARNING OBJECTIVE:

Identify the different aspects of preventive medicine.

SANITATION

Sanitation is defined as the hygienic means of promoting health through prevention of human contact with the hazards of wastes. The goal of the Navy’s sanitation program is to provide personnel with a clean and healthy work and living environment.

Personal Hygiene

Because of the close living quarters in the Navy, particularly aboard ships, personal hygiene is of utmost importance. Uncleanliness or disagreeable odor affects the morale of shipmates. Disease and other health problems can spread rapidly affecting an entire compartment or division. Good personal hygiene promotes health and prevents disease. HMs are responsible for presenting health education training programs to the personnel in their unit, including the basics of personal hygiene, proper exercise, sleep, and nutritional requirements.

Sanitation of Living Spaces

The HM, as the Medical Department Representative (MDR), performs sanitation inspections and provides recommendations to the Commanding Officer (CO). The living spaces, their inspection, cleaning, and maintenance practices are discussed in detail in NAVMED P-5010.

Habitability

Factors that can affect habitability of working and berthing spaces are air ventilation, heating, and air conditioning. Measurements of thermal stress are used to monitor environmental conditions in which personnel work, live, and exercise. Monitoring environmental conditions is crucial to maintaining a safe environment for personnel.

VECTOR AND PEST CONTROL

A vector is any animal capable of transmitting pathogens or producing human or animal discomfort or injury. Some commonly encountered vectors are insects, arthropods (insects with hard, jointed exoskeleton and paired, jointed legs) and rodents. Pests are organisms (insects, rodents, snakes, etc.) that adversely affect military operations and the well-being of man and animal; attack real property, supplies, and equipment; or are otherwise undesirable.

FOOD-SERVICE SANITATION

Food-borne illnesses represent an ever-present threat to the health and morale of military personnel. To prevent food-borne illnesses, HMs need to ensure that all foods are procured from approved sources and processed, prepared, and served with careful adherence to recommended sanitary practices. When assigned as a MDR for a command or station, HMs may be given the responsibility of inspecting food, food-service facilities, and investigating food-borne illness outbreaks.
For guidance on safe time limits for keeping food, proper storage temperatures, and storage life of perishable and semi-perishable items, refer to tables in Naval Supply Publication 486, Food Service Management General Messes.

Training and Hygiene of Food-Service Personnel

Food-service personnel should be thoroughly indoctrinated in personal hygiene, food sanitation procedures, and in the methods and importance of preventing food-borne illness. Requirements for food service training are addressed in SECNAVINST 4061.1 series, Food Service Training Program.

Food-Service Report

Navy and Marine Corps food-service facilities are required to be inspected by a MDR, together with the food-service manager, officer, or designated representative. The findings of the inspection are reported on a NAVMED Form 6240/1, Food Service Sanitation Inspection. The inspector assigns an appropriate number of defect points based upon the guidelines for each area. Complete step-by-step procedures for filing the report are provided in NAVMED P-5010.

IMMUNIZATIONS AND COMMUNICABLE DISEASES

Navy and Marine Corps personnel are exposed to a wide variety of environmental conditions, including climatic extremes, stressful situations, and close living quarters. Many of these personnel travel to foreign lands where conditions may be unsanitary and have a high level of disease. Preventive medicine’s major role is to minimize disability by emphasizing immunization programs.

Immunizations

Vaccines used to protect Navy and Marine Corps personnel against certain diseases before exposure to infection are called prophylactic immunizations. Prophylactic immunizations are limited to very serious diseases for which effective and reliable immunizing agents have been developed. Immunizations procured for the Armed Forces are required to meet the minimum standards set by the Department of Health and Human Services (HHS).

Immunizations for Military Personnel

Navy and Marine Corps personnel are required to be in a deployable readiness status at all times. To make sure personnel are prepared for deployment, HMs should BUMEDINST 6230.15 series, Immunizations and Chemoprophylaxis, and review the immunization records on a routine basis including before deployments. Initial and booster dosages and routes of administration are dictated by the vaccine manufacture, the U.S. Public Health Service Immunization Practices Advisory Committee (ACIP), or both.

Communicable Diseases

As the name implies theses are diseases that may be transmitted from a carrier to a susceptible host. They may be transmitted directly from an infected person or animal or indirectly through an intermediate host, vector, or inanimate object. The illness produced is the result of infectious agents invading and multiplying in the host, or from the release of their toxins (poisons).
An important step in the control of communicable disease is the expeditious preparation and submission of the Medical Event Report. Instructions and requirements for reporting to local, state, national, and international health authorities can be found in the preface of the NAVMED P-5038, Control of Communicable Diseases Manual. Follow instructions for the Medical Event Report (BUMEDINST 6220.12 series), when reporting communicable diseases affecting Navy and Marine Corps personnel.

WATER SUPPLY

A hygienically safe and continuously dependable water supply is a necessity of life. Drinking water should be free of disease-producing organisms, poisonous chemicals, and from objectionable color, odor, and taste.

Water Supply Ashore

Typically, Navy and Marine Corps activities ashore within the continental limits of the United States are situated where a municipal water supply is available. BUMEDINST 6240.1 series, Standards for Potable Water, sets drinking water standards for U.S. Naval establishments worldwide, both ashore and afloat. Both municipal and Navy generated water supplies must meet Navy standards.

Water Supply in the Field

Hospital Corpsmen are frequently called upon to approve field water sources and to recommend disinfection methods before water is considered safe to drink. Consider water acquired in the field as unsafe until it has been disinfected and tested. Approval of water sources should be based on a thorough surveillance of available water sources.

Water Quantity Requirements

The daily water requirements for personnel in the field vary with a number of factors including the season of the year, geographical location, and the tactical situation. Personnel who do not drink enough water can quickly become dehydrated both in extremely hot or extremely cold climates.

Water Treatment

Water treatment is the process of purifying water to make it potable (safe to drink). Various processes can be used to purify water. These processes include aeration, coagulation, flocculation, filtration, reverse osmosis, and disinfection, all of which are discussed in depth in NAVMED P-5010.

Water Supply Afloat

Potable water for shipboard use comes from one of several sources: the ship’s distillation plant, shore-to-ship delivery, or ship-to-ship transfer. The ship’s medical department is responsible for determining the quality of the water. The ship’s engineering section determines the quantity stored or produced and performs the actual chlorination or bromination.

Water Testing

Naval vessels follow water testing requirements and procedures outlined in the latest edition of Standard Methods for the Examination of Water and Wastewater, published by the American Public Health Association (APHA), American Water Works Association (AWWA), and the Water Pollution Control Federation (WPCF).
**Manufacture and Handling of Ice**

Most ships and shore activities use ice machines to make ice. To reduce bacterial growth, ice used around food or in food or drink must be made from potable water. All ice must be prepared in a sanitary manner and afforded the same protection as potable water. The medical departments aboard ships are required to include ice samples in any bacteriological analyses they perform on water.

**WASTEWATER TREATMENT AND DISPOSAL**

Wastewater is the spent water of a ship, base, industrial plant, or other activity. This spent water contains wastes, such as soil, detergent, and sewage. The proper disposal of these waste materials is one of the most important measures for controlling water-borne diseases, such as cholera and typhoid fever.

**Wastewater Treatment and Disposal Systems Ashore**

The use of approved municipal or regional wastewater collection and disposal systems is the preferred method for disposing of wastes from shore activities. Municipal or regional wastewater disposal systems are used by Navy shore activities whenever feasible.

**Wastewater Treatment and Disposal Systems Afloat**

The overboard discharge of untreated sewage from DoD ships within the navigable waters of the United States and the territorial seas (within three nautical miles of shore) is prohibited by federal law. To comply with the law, Naval vessels are being equipped with marine sanitation devices (MSD) that either treat sewage before discharge or collect and hold it until it can be properly disposed of through dockside sewer connections or pumped overboard in unrestricted waters.

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**INFECTION CONTROL**

**LEARNING OBJECTIVE:**

Describe basic infection control procedures.

Infection control involves taking steps to prevent the spread of infectious agents. The HM’s command will develop local standard infection control policies and written protocols following NAVMED P-5010; BUMEDINST 6220.9 Series, Nosocomial Infection Control Program; and BUMEDINST 6600.10 series, Dental Infection Control Program. COs and Officers in Charge (OIC) must appoint, in writing an Infection Control Officer (ICO) to assist in implementing an infection control program. Some of the information may be different from what the Corpsman’s command policies and procedures are for infection control. COs and OIC may adapt the policies and procedures from these instructions to meet their local conditions and criteria.

All HMIs must be aware of sources and methods of transmission of pathogenic micro-organisms and infectious diseases. With the constant threat of thousands of diseases and viruses that exist, it is more important than ever to know how to protect healthcare professionals and the patients. In 2008, infections accounted for an estimated 1.7 million infections and 99,000 associated deaths in American hospitals alone, according to the Centers for Disease Control and Prevention (CDC). In this chapter, the HM will learn the vital basics to defend themselves and their patients from these dangers.
INFECTION CONTROL TERMS AND DEFINITIONS

The following terms and their definitions will help the HM understand the material that is in this chapter and in Chapter 10, “Disinfection and Sterilization.”

- **Asepsis**: The state of being free of pathogenic organisms.
- **Aseptic Technique**: A set of specific practices and procedures performed under carefully controlled conditions with the goal of minimizing contamination by pathogens.
- **Bioburden**: The number of microorganisms contaminating an object; known as bioload or microbial load.
- **Bloodborne Pathogens**: Pathogenic microorganisms that are present in human blood and capable of causing disease in humans.
- **Bowie-Dick Type Test**: A diagnostic test of a prevacuum sterilizer’s ability to remove air from the chamber and detect air leaks. This is not a sterility assurance test.
- **Chemical Disinfection**: The destruction or inhibition of most viruses and bacteria while in their active growth phase; does not necessarily kill all spores nor can it be verified by a monitor.
- **Chemical Indicator**: Chemical dyes used to determine whether the conditions required for sterilization are met; known as internal or external indicators, dosage indicator, or process indicator.
- **Contaminated**: The presence or reasonably expected presence of blood or other potentially infectious material on an item or surface.
- **Contaminated Laundry**: Laundry that has been visibly soiled with blood or other potentially infectious materials.
- **Culture**: The reproduction and growth of micro-organisms in living tissue cells or on a nutrient medium.
- **Dental Item Classification**: Dental items are classified as critical, semi-critical or non-critical based on the pathways through which cross-contamination may occur and the location and technique of instrument use.
- **Critical Items**: Instruments and materials that penetrate the skin, mucous membranes, or bone; these items must be sterile before use. Examples include surgical instruments, periodontal knives, and suture needles.
- **Semi-Critical Items**: Instruments, equipment, or materials that frequently contact mucous membranes, but cannot be sterilized because of their design or inability to withstand heat. At minimum these items require high-level disinfection. Examples include some radiographic positioning devices and plastic impression trays.
- **Non-critical Items**: Instruments, equipment, or materials that do not normally penetrate or contact mucous membranes but which are exposed to splatters, sprays, or splashing of blood, or are touched by contaminated hands. These items require intermediate-level disinfection. Examples include the dental unit and medical exam table.
- **Disinfected**: To cleanse something so as to destroy or prevent the growth of disease-carrying microorganisms.
- **Infectious Agent**: An infectious agent is an organism that is capable of producing an infection or infectious disease.
- **Infectious Micro-Organisms**: Organisms capable of producing disease in a host.
- **Invasive Procedure**: A surgical entry into the tissues, cavities, organs, or repair of major traumatic injuries. This includes the manipulation, cutting, or removal of any oral or perioral tissue during which bleeding occurs, or the potential for bleeding exists.
- **Micro-Organisms**: Bacteria, fungi, viruses, and bacterial spores.
• **Nosocomial Infection:** An infection resulting from treatment in a hospital and is secondary to the patient's original condition; it is unrelated to the primary diagnosis.

• **Personal Protective Equipment (PPE):** Specialized barrier attire worn by an employee to protect against a hazard.

• **Occupational Exposure:** Reasonably anticipated skin, eye, mucous membrane, or parenteral exposure to blood or other potentially infectious materials that may result from performance of duties, despite the appropriate use of PPE.

• **Saturated Steam Sterilization:** A process that uses steam heat under pressure for sufficient length of time to kill all forms of micro-organisms.

• **Sanitary Sewer System:** A sewer system connected to a sewage treatment plant.

• **Spray-Wipe-Spray:** An acceptable method of cleaning and disinfecting. Presently there is no agent on the market with the Environmental Protection Agency (EPA) registration that cleans and disinfects in one step. The importance of cleaning as a separate step from disinfection and sterilization cannot be overemphasized.

• **Sterile field:** A specified area, such as within a tray or on a sterile towel, which is considered free of microorganisms.

• **Sterile, Sterility:** Free from all living micro-organisms.

• **Sterilization:** Process that destroys all types and forms of micro-organisms.

• **Sterilization Area:** The area of a health care facility designed for housing sterilization equipment and conducting sterilization procedures.

• **Sterilizer (Gravity Displacement Type):** A type of sterilizer in which incoming steam displaces via gravity, the residual air through a port or drain usually in or near the bottom of the sterilizer chamber.

• **Sterilizer (Prevacuum Type):** A type of sterilizer that relies on one or more pressure and vacuum evolutions at the beginning or the end of the cycle.

• **Unit Dose:** The quantity of materials or supplies required to treat a single patient.

• **Standard Precautions:** A protocol for infection control that treats all human blood and body fluids as if known to be infectious for human immunodeficiency virus (HIV), hepatitis B virus (HBV), and other blood borne pathogens.

• **Engineered Controls:** Method of managing environment and health by placing a barrier between the contamination and the rest of the site, thus limiting exposure pathways.

• **Work Practice Controls:** Controls that reduce the likelihood of exposure by altering the way one performs a task such as having patients brush their teeth or using antiseptic mouthwash before beginning a procedure; using the rubber dam whenever possible, disinfecting the isolated teeth, and using a disinfectant mouthwash before and after applying the dam; heavy duty, puncture-resistant utility gloves are used when handling instruments, and while cleaning and disinfecting instruments during the sterilization process; using an accepted and safe technique for recapping needles; and disposing of sharps before beginning cleanup procedures at the conclusion of treatment.
CLASSIFICATIONS OF MICRO-ORGANISMS

Microbiology is the study of microscopic life forms called micro-organisms. Disease producing organisms are said to be pathogenic. Other micro-organisms that are not considered pathogenic can produce infections under favorable conditions. Micro-organisms are classified as bacteria, bacterial spores, viruses, protozoa, and fungi. With regards to the process of infection control, HMs need to know the kinds of micro-organisms present and how to deal with them so that they know how to fight them.

Bacteria

Not all bacteria will take on the form of a spore’s shell-like coating to withstand unfavorable conditions. Bacteria in a spore state remain alive but passive. They are resistant to the effects of heat, drying, and most bactericidal chemicals. They remain capable of becoming virulent (strongly pathogenic) again under favorable conditions. Under unfavorable conditions they will either die or remain dormant in a spore state until another opportunity for growth presents itself.

Viruses

Viruses are micro-organisms that are much smaller than bacteria. Viruses vary in size, from being the size of a single protein molecule to the size of a more complicated bacterial cell. They can be so small that they can be seen only through an electron microscope.

Viruses cannot live long or reproduce outside of a living body (host). They must be able to enter and live in specific cells. For descriptive purposes, they are customarily divided into three subgroups, based on host specificity:

- Bacterial viruses
- Animal viruses (including those that attack humans)
- Plant viruses

Some of the most common diseases caused by viruses are colds, smallpox, measles, rubella, herpes simplex, AIDS, and hepatitis. Viruses are usually not affected by therapeutic treatment with antibiotics.

Most viruses are susceptible to immersion in boiling water for at least 20 minutes; an exception to this rule is hepatitis. Due to these exceptions to heat resistance, autoclaving is the preferred method for sterilization which is discussed in Chapter 10.

Protozoa

Protozoa are single-celled animals that do not have a rigid cell wall. Some protozoa cause parasitic diseases but not all are pathogens. Most species are harmless, living on dead organic matter or bacteria. Protozoa that are pathogenic survive freely in nature and must be spread by a carrier. Most protozoa pass through a life-cycle that has definite stages of development such as malaria.

Fungi

Fungi are plants that lack chlorophyll. They are free-living organisms that are smaller than protozoa. Mold and yeast forms of fungi, have firm cell walls, and resemble plants more than animals.

Molds usually form cells in long chains or threads that grow into tangled masses. Some threads of the mass bare clusters of seed-like spores that when dry are easily blown into the air like dust. Each microscopic seed is capable of growing new mold upon settling in a suitable place. Mold spores are easily destroyed by heat. The most common infections in humans because of fungus are athlete’s foot and ringworm. The mold penicillin is very common in nature and contributes to the spoilage of food; the penicillin drug is derived from this mold.
STANDARD PRECAUTIONS

All personnel must assume that all body fluids, contaminated instruments, and contaminated materials are infectious. Standard Precautions must be used to protect HMs and the patients. Identifying potentially infectious patients by medical history, physical examination, or readily available laboratory tests is not always possible. A period of up to several weeks often exists between the time a person becomes infected with a virus and the time when a laboratory test can detect the antigens or antibodies that form. In an HIV-infected individual, this period could be 6 months or more. Even if a patient tests negative, he or she may still be infectious.

Standard Precautions are intended to reduce the transmission of microorganisms from recognized and unrecognized sources of infection. Standard Precautions should be applied to all patients receiving care regardless of their diagnosis or presumed infection status. Universal Precautions is a subset of Standard Precautions focusing on the infection control methods to prevent the spread of disease from blood and body fluids from direct contact by utilizing gloves, gown, goggles, and mask. Standard Precautions include other contaminated sources (i.e. stethoscope, linen, etc.) and prevention measures. Standard precautions include the following:

Hand Hygiene

Hand washing is one of the most important procedures in preventing the transfer of microorganisms from one person to another. The purpose of hand washing is to remove these micro-organisms from the folds and grooves of the skin by lifting and rinsing them from the skin surface. Good hand washing techniques and use of gloves are essential before anticipated exposure to patients’ blood or bodily fluids.

Hand washing **must** (at minimum) be completed:
- At the beginning of each day
- Before and after each patient contact
- Before handling food and medications
- After coughing, sneezing, or nose blowing
- After using the toilet
- In contact with blood, bodily fluids, secretions, excretions and contaminated items, whether or not gloves are worn
- Between patients, before and after going to lunch, after taking a break, after using the bathroom, or any time they become contaminated
- At the end of the day

The skin harbors two types of flora, **resident** or normal flora and **transient** flora.

**Resident** organisms’ characteristics:
- Can survive and will multiply on the skin
- Can be cultured repeatedly from the skin
- Are usually of low virulence and are not easily removed

**Transient** bacteria characteristics:
- Do not survive and will not multiply on the skin
- Are not firmly attached to the skin
- Are effectively removed by rubbing of the hands together and rinsing them under running water

Special attention is needed while washing hands to ensure common mistakes are not made, such as:
- Fingertips, thumbs, and the areas between the fingers are washed poorly or may be skipped entirely
- The dominant hand is generally washed less thoroughly than the non-dominant hand
- Microbe counts under the fingernails have been found to remain high even after surgical scrubs
Hand Washing Agents

There are many commercial hand washing products available for use in clinical settings. The HM needs to be aware of the two main hand washing agents used in the Navy, **water-based** cleaning agents and **waterless** hand washing agents.

**Water-Based Cleaning Agents**

Water-based cleaning agents include chlorhexidine, alcohol, and iodophors among the active antimicrobial ingredients approved for hand washing.

**CHLORHEXIDINE GLUCONATE.**—This antiseptic is usually marketed as 4 percent chlorhexidine gluconate with 4 percent isopropyl alcohol in a sudsy base. Chlorhexidine gluconate is an effective antiseptic for reducing transient and resident microbial hand flora, and has a sustained antimicrobial effect. It does not appear to affect the skin adversely. It is approved as a surgical scrub.

**IODOPHORS.**—These are water soluble complexes of iodine with organic compounds that are effective against all gram-positive and gram-negative bacteria and viruses. Iodophors usually do not have a long-acting germicidal action and, if used frequently, may cause severe drying of the skin.

**Waterless Hand Washing Agents**

Waterless hand washing agents contain 70 percent isopropyl alcohol and virtually disinfect the skin in 20 seconds. They are effective against bacilli, fungi, and viruses. Unfortunately, they are volatile, flammable, evaporate quickly, and dry the skin. Alcohol-based, waterless hand washing agents may be used in areas where hand washing sinks are not readily available and should only be used when hands are not visibly soiled.

Hand Washing Equipment and Soap Dispensers

All patient care areas should have sinks with electronic or mechanical elbow, foot, or knee action faucet control for asepsis and ease of function.

The uses of hands-free actuated soap dispenser controls are preferable. Maintenance for refillable hand washing agent dispensers is to empty, disassemble, and clean them weekly. Do not use bar soaps in bathrooms or clinical and common areas.

Hand Washing Techniques

Personnel involved in patient care must follow a rigid hand washing protocol including the following practices:

- Removing all jewelry and other ornaments from the hands and wrists
- Wetting the hands under warm, running water and applying the necessary amount of antimicrobial soap is required to work up a lather
- Vigorously rub the hands together, fingers entwined. This creates friction and loosens dirt and micro-organisms
- Clean under the fingernails using a nail brush or pick
- Continue scrubbing the wrists and lower forearms
- Visibly soiled hands may require more time
PERSONAL PROTECTIVE EQUIPMENT (PPE)

LEARNING OBJECTIVES:

- Identify types of personal protective equipment (PPE).
- Describe the purpose for each type of personal protective equipment (PPE).

GLOVES

HMs should wear gloves for all patient contact activity. Complete all treatment on each patient, wash, and re-glove before beginning treatment procedures on another patient. Gloves torn or punctured during patient treatment should be replaced immediately.

Washing increases the protective nature of the gloves up to 60 percent, repeated use of a single pair of gloves is not permitted. Do not use petroleum-based hand lotions before donning gloves as they will break down the gloves. If a staff member has an allergy to latex, it should be documented in the member’s medical record so that latex free gloves can be acquired.

Many types of gloves are available for use in dental and medical procedures. The most common are as follows:

- **Sterile Surgical Gloves:** They are the highest quality, most expensive, and best fitting. They are used for surgical or invasive (bloody) procedures where maximum protection against infection must be provided for the patient and the provider.

- **Under Gloves:** These are sterile surgical gloves that are worn underneath the primary surgical gloves; this process is called double gloving. They are a green or blue color allowing more protection from needle sticks and making small punctures in the top gloves more visible. Double gloving is now standard practice in most surgical areas.

- **Procedural Gloves:** They are manufactured like sterile surgical gloves but they are non-sterile and are not individually wrapped in pairs. Procedural gloves offer the highest quality and best fit at a greatly reduced cost when sterile surgical gloves are not required.

- **Latex Examination Gloves:** These are the least expensive type of non-sterile gloves that are commonly used in routine procedures. They are available in a variety of sizes and can with cornstarch to ease putting them on and off. Some individuals may develop hypersensitive reactions either to the latex material or the cornstarch; latex powderless gloves or latex free gloves should be worn if this occurs.

- **Nitrile Gloves:** These can be sterile or unsterile examination gloves made of synthetic latex. They contain no latex proteins, reducing the possibilities of any hypersensitivities and adverse reactions from patients. They offer excellent resistance to punctures and tears. Nitrile gloves are three times more puncture resistant than rubber and can be used to offer superior resistance to many types of chemicals.

Clinical Apparel

Wear reusable or disposable clinical apparel, such as smocks, scrubs, laboratory coats, or other PPE when treating patients or working in areas where contaminated or potentially contaminated materials may be present. When surgical procedures are performed involving reasonable exposure to blood or other potentially infectious materials (OPIM), additional personnel protective equipment or apparel, such as long-sleeved gowns, is required. Forearms must be covered if one reasonably assumes that they will be splattered with saliva or blood.
All personnel must take the following precautions regarding the use of clinical apparel:

- Wear clinic apparel only in the treatment facility
- Change clinic apparel daily or when visibly soiled
- Turn in soiled linen at the end of the work period and place them in a soiled linen receptacle
- Do not leave dirty clinic attire in personal clothing lockers or spaces overnight
- Do not take clinic attire home to avoid the spread of pathogens to home and family

**Face Mask and Shield**

Wear a face mask or a full-length face shield with a face mask during any patient treatment where aerosols, particulates and splashes will be a possibility. All personnel must wear a mask in the surgical suite, dental treatment rooms (DTR), medical treatment rooms (MTR), and central sterilization room (CSR), especially on the dirty side of the CSR. Personnel must change face masks in the following situations:

- After each patient or when the mask is visibly soiled
- When involved in other activities such as prosthetic laboratory and equipment repair procedures where airborne particles or dusts are produced
- After sorting laundry
- During decontamination procedures. When cleaning spills of *infectious wastes*

There are several types of masks available for different purposes:

- **Surgical Mask** is made from paper or other non-woven material and is worn by health professionals during surgery and at other times to catch the bacteria shed in liquid droplets and aerosols from the wearer's mouth and nose
- **Cone Mask** is a stiff, thin, woven mask used for simple procedures for protection from splashing and aerosols
- **N95 Respirator** is a lightweight, nose-and-mouth respirator that can provide some level of protection for the wearer from viruses and small particles. The masks come in different sizes due to the necessity for a proper fit for optimal protection. It can be used during surgery or during airborne precautions

**Protective Eyewear**

Wear protective eyewear when assisting or providing treatment in all surgical procedures or other procedures that may cause a splash, splatter, or airborne particles. Eyewear or goggles must have solid side shields to provide maximum protection. Patients must be provided approved protective eyewear for all dental exams and treatments. Disinfect patient eyewear after treatment.

**Protective Headwear**

Wear disposable protective headwear during surgical procedures. Headwear must fit the head to minimize exposure of the head and hair to potential splashing or spraying of blood or airborne particles. Cloth scrub caps may also be worn, but must be washed daily and in a style in accordance with the treatment facility regulations.
TRANSMISSION-BASED PRECAUTIONS

LEARNING OBJECTIVES:

Identify the three types of transmission-based precautions.

Describe the purpose of the three types of transmission-based precautions.

Transmission-based precautions are the second tier of infection prevention. It has been designed for patients with confirmed or suspected pathogens that can be spread by airborne, droplet, or direct contact with the patient. A specific and constantly updated list can be found on the Healthcare Infection Control Practices Advisory Committee (HICPAC) / CDC Isolation Guideline, on the CDC web site. The precautions listed below are in addition to the standard HM precautions.

AIRBORNE PRECAUTIONS

Airborne transmission occurs by the evaporation of droplets that can remain in the air for long periods or spread by dust particles that contain the infectious agent (measles, tuberculosis, chicken pox, etc.). Airborne precautions include the following:

- Place patient in a private, negative pressure room (6 to 12 exchanges per hour) with air being pumped outside or through a HEPA filter
- All medical personnel must wear Occupational Safety and Health Administration (OSHA)-specified respiratory protection (such as a N95 mask)
- Place a surgical mask over the patient’s nose and mouth while transporting

NOTE:
Patient transport should be limited to essential purposes only.

DROPLET PRECAUTIONS

Droplet precautions are used for patients infected with microorganisms spread by coughing, sneezing, or talking such as influenza virus, adenovirus and rhinovirus. The following actions should be taken:

- If possible the patient should be placed in a private room or one with another patient infected with the same organism. If that is still not possible a 3 foot partition should be maintained between the infected patient and any other patients
- All healthcare providers should wear a mask within three feet of the patient
- Place a surgical mask over the patient’s nose and mouth while transporting

NOTE:
Patient transport should be limited to essential purposes only.
CONTACT PRECAUTIONS

Contact precautions should be used for patients infected or colonized with organisms that can be transmitted by direct contact with a provider or indirect contact (spread by contact with patient care equipment or surfaces in the patient’s room). Examples include methicillin-resistant Staphylococcus aureus (MRSA) and vancomycin-resistant E. coli (VRE).

- Place the patient in a private room or one with another patient infected with the same organism and no other infections
- Gloves must be worn upon entering, changed after handling any infective material, and removed before leaving the patient’s room. Hands must be washed immediately after glove removal
- Masks are not necessarily mandatory in this situation, ensure to avoid touching the face with contaminated items such as gloves
- Disposable gowns are worn on entering the patient’s room to prevent contact of any clothing with the patient or infected materials. The gown is removed before leaving the patient’s room exercising care to avoid surfaces in the room
- Transport patients only if necessary and the transporting team maintains contact precautions
- Patient-care equipment is dedicated to a single patient to prevent cross infections. If this is not possible, the equipment must be thoroughly cleaned and disinfected before being used by another patient

IMMUNIZATION AND TESTING

All personnel providing direct patient care, including civilian employees, volunteers, laboratory, and repair personnel who are potentially exposed to blood and saliva, must receive an HBV vaccine. All active duty healthcare personnel will be tested for HIV every two years and tuberculosis testing and/or screening on an annual basis.

MEDICAL HISTORY REVIEW

A thorough review of each patient’s current medical history is mandatory before initiating any examination or treatment procedure.

EATING, GROOMING, DRINKING, AND SMOKING

Eating, grooming, drinking, and smoking are permitted only in designated areas separate from MTFs and DTFs. Follow all BUMED and command instructions pertaining to this matter.

INFECTION CONTROL IN TREATMENT ROOMS

In accordance with BUMEDINST 6220.9 Series, Nosocomial Infection Control Program; BUMEDINST 6600.10 Series, Dental Infection Control Program; and the NAVMED P-5010 the terms and procedures described in the following sections will be used.

MEDICAL ASEPSIS

Medical asepsis describes those practices used to prevent the transfer of pathogenic organisms from person to person, place to place, or person to place. Medical aseptic practices are routinely used in direct patient care areas and other service areas in the healthcare environment to interrupt the chain of events necessary for the continuation of an infectious process. The components of this chain of events consist of the elements defined below.

Reservoir of Infectious Agents

The carrier on which the infectious agent primarily depends for survival. The agent lives, multiplies, and reproduces so that it can be transferred to a susceptible host. Reservoirs can be man, animal, plants, or soil. Man himself is the most frequent reservoir of infectious agents pathogenic to man.
Portal of Exit

The avenue by which the infectious agent leaves its reservoir. When the reservoir is man, these avenues include various body systems, such as respiratory, intestinal, genitourinary tracts, and open lesions.

Mode of Transmission

The mechanism by which the infectious agent is transmitted from its reservoir to a susceptible being (host). Air, water, food, dust, dirt, insects, inanimate objects, and other persons are examples of modes of transmission.

Portal of Entry

The avenue by which the infectious agent enters the susceptible host. In man, these portals correspond to the exit route avenues, including the respiratory and gastrointestinal tracts, through a break in the skin, or by direct infection of the mucous membrane.

Susceptible Host

Man or another living organism that affords an infectious agent nourishment or protection to survive and multiply.

NOTE:
Removal or control of any one component in the above chain of events will control the infectious process.

Concurrent Disinfection

Consists of the daily measures taken to control the spread of pathogenic organisms while the patient is considered infectious.

Terminal Disinfection

Consists of those measures taken to destroy pathogenic organisms remaining after the patient is discharged from isolation. There are a variety of chemical and physical means used to disinfect supplies, equipment, and environmental areas. Each facility will determine its own protocols based on the recommendation of an Infection Control Committee.

INFECTION CONTROL IN THE TREATMENT ROOM

As a HM, infection control in the treatment room is an all hands responsibility throughout the day. There are many precautions and procedures involved with infection control practices. The implementation of aseptic technique is required when preparing for patient treatment, during treatment, and after the patient is dismissed. There can be no deviation from the command written procedures and guidelines on infection control. The HM must be able to accomplish the following infection control procedures:

- Prepare the treatment room for patient care
- Assist the Medical/Dental Officer during treatment
- Disinfect the treatment room between patients
- Secure the treatment room at the end of the day
- Perform housekeeping duties
- Sort laundry
- Dispose of infectious waste
Preparing the Treatment Room

OSHA and the Navy require that all treatment facilities ensure a clean and sanitary workplace. Work surfaces, equipment, and other reusable items must be decontaminated with an EPA-registered disinfectant upon completion of procedures when contamination occurs through splashes, spills, or other contact with blood and OPIM. Observe and perform the following procedures:

- Wipe all flat surfaces (tables, chairs, hanging lights etc.)
- Ensure all trash is empty from the day before
- Place clean protective barriers on equipment that is difficult to clean (microscopes, dental chairs, exam beds etc.)
- Open instrument trays, packs, or cassettes and leave wrapping material underneath as a barrier for the work surface
- For DTRs, at the beginning of the day flush each of the unit water lines and hoses for at least 1 minute, even if their use is not anticipated and flush for at least 30 seconds between patients
- Potable water supplies may contain up to 100 bacterial colony forming units per millimeter (cfu/ml), and water in dental units, at times, can contain in excess of 1,000,000 cfu/ml
  - This microbial contamination comes from the retraction of contaminated water and saliva through the dental hand piece and the growth of bacteria in the unit water lines
  - Although most incoming water is chlorinated, chlorine loses its potency as the water lies stagnant in the unit tubing
  - Under the right circumstances, these bacteria will multiply and may become pathogenic

Infection Control for the DTR

Aerosols (spray originating from a patient’s mouth during dental procedures) in the work environment present a potential health hazard for both the staff and patient. The long term effect is cumulative and may be harmful. Aerosol levels can also be lowered and minimize the potential risk by employing the following procedures:

- Clean cavity preparations with water, air, or an air and water combination
- Use high-volume evacuator (HVE)
- Use rubber dams
- Cover ultrasonic tanks when in use

The Dental Officer may direct the HM to have patients brush their teeth or rinse with a mouthwash before treatment. This reduces the microbial concentration of oral flora (saliva). Three 10-second rinses will temporarily reduce a patient’s microbial count by up to 97 percent. Many Dentists are now using a 0.12 percent chlorhexidine gluconate preoperative rinse that also significantly decreases the amount of microbial count of an aerosol.
The following procedures should be used with all dental patients for infection control:

- HMs must wash their hands before donning and after removal of gloves.
- Wear sterile gloves for all invasive surgical procedures.
- Use non-sterile gloves for examination and other non-surgical dental procedures.
- Use a rubber dam whenever possible.
- Swab isolated teeth with an antimicrobial mouthwash to reduce aerosolization of oral bacteria.
- Use disposable suction, saliva ejector, and irrigation tips.
- Autoclave all instruments that can withstand heat sterilization.
- Sterilize rotary cutting instruments such as burs and diamonds before using.
- Use the unit dose concept when dispensing supplies for each treatment setup.
  - **This is mandatory**
- Use sterilizable cassettes, tray sets, or packs for instruments.
- Place the proper amount of supplies in each setup before sterilizing.
- Store opened packages of supplies in closed drawers or cabinets in the DTR (in a covered container if practical).
- Use clean forceps to dispense only enough supplies for immediate use. HMs must **never** use their hands to dispense items from bulk storage containers.
- Use of bottled irrigation solution for surgical and non-surgical procedures is considered sterile only for that patient if aseptic techniques are maintained.
- Record expiration dates on all opened containers.

Before leaving the DTR, all personnel will remove and discard gloves and masks worn during patient treatment, **except** when transporting contaminated items to the CSR or to the prosthetic laboratory.

To prevent contamination of a patient’s chart, remove gloves and wash hands (unless cover gloves are worn) before writing in dental records, viewing radiographs, or taking photographs.

**Preparing for the Next Patient**

HMs must clean and disinfect the previously covered surfaces between patients when the integrity of the physical barriers has been compromised or the surface is visibly soiled or if there is any question about the possibility of contamination. For example, if moisture is absorbed through the cover to the underlying surface, then the purpose of the barrier is defeated, and the surface must be disinfected.

HMs will:

- Ensure their room is clean.
- Wipe down any patient contact areas.
- Put away all equipment used for the previous patient.
- Remove their gloves and wash their hands and other exposed skin surfaces with an antimicrobial soap.
- Replace clean disposable barriers and set up clean hand pieces and instruments for the next patient.
Securing the Treatment Room

HMs must thoroughly clean their space and all their equipment. Every command will have different procedures to fit their needs, but the following are the basic requirements.

- Remove all debris and particulate matter before disinfection
- Remove and discard all the disposable coverings or barriers contacted during patient treatment while still gloved. It is important to remove the surface covers carefully to prevent contamination of the covered areas. This is accomplished by turning the soiled outer side toward the inside
- Using the spray-wipe-spray technique, clean and disinfect all unprotected “high touch” areas. To be effective, the disinfectant must remain in contact with the surfaces for the time specified by the manufacturer

**NOTE:**

Do not use 2 percent glutaraldehyde as a surface disinfectant because of its caustic vapors and high cost.

- Clean uncarpeted floor and other horizontal surfaces regularly and when spills occur
- Use mops with a detergent and an EPA-registered disinfectant or a detergent with sodium hypochlorite (1:100 dilution)
  - Mops must be cleaned once every 24 hours or more often as needed
- Clean walls and blinds only if they are visibly soiled
- Inspect, clean, and disinfect on a regular basis, all bins, pails, cans, and similar receptacles intended for reuse and having the potential for contamination with blood or OPIM; clean and disinfect these containers immediately or as soon as possible upon visible contamination
- Noninfectious waste refuse containers are not considered infection control hazards. Line them with plastic bags, leave them uncovered, and do not allow them to overflow
- Remove hinged doors on cabinet refuse containers and hinged lids on freestanding containers since they present an increased potential for cross-contamination
- Do not pick up broken glassware directly with hands. Instead, use mechanical means such as a brush and dust pan, vacuum cleaner, tongs, cotton swabs, or forceps

Securing the DTR

For the DTR there are a few extra responsibilities that must be taken care of at the end of the day.

- Flush the High-Volume Evacuator (HVE) system with at least one quart of water
- Clean the system with an HVE system cleaner at least once each week. Use the system cleaner more often if indicated by problems
- HMs must never lay contaminated instruments directly on countertops or work surfaces
- Rewrap cassettes, packs, or trays in the original wrap and place individually packaged instruments in a leak proof covered container to transport to the CSR
- Flush each unit waterline and hose for 30 seconds
- If the unit has a self-contained water delivery system, follow manufacturer’s instructions for flushing and air purging the lines
Contaminated Dental Hand Pieces

Many dental clinics with CSRs will have the HM remove the contaminated hand pieces they have used and turn them into the CSRs along with their instruments. The CSR technician will handle, disinfect, lubricate, and sterilize the dental hand pieces. This saves the Dental assistant valuable time and avoids any excess aerosols that occur during the disinfection and lubrication procedure.

Some commands require the HM to perform hand piece maintenance; it includes removing the hand pieces after each patient, lubricating it, and operating it for 30 seconds. This will purge the tubing removing any potentially infectious material from retraction of coolant water during previous treatment. Many manufacturers require lubrication of hand pieces before and after sterilization. To prevent cross-contamination, follow these procedures:

- Use two separate containers of lubricant—one marked for lubrication before sterilization and another marked for after sterilization
- Lubricate hand pieces with one end in a headrest cover to capture the aerosol contaminants or use one of the many commercial products for cleaning and lubricating hand pieces

For disinfecting non-autoclavable hand pieces while wearing gloves, use the following procedures:

- Submerge two gauze sponges per hand piece in a high level, EPA registered disinfectant. Squeeze out any excess
- Use one sponge to wipe the hand piece and discard
- Wrap the second sponge around the hand piece and return it to the holder for the period of time specified by the manufacturer
- Before reuse, wipe the hand piece thoroughly with potable water to remove residual disinfectant

- If the hand piece is autoclavable, remove the hand piece from the couplings, clean, and lubricate following the manufacturer’s instructions

Bringing Contaminated Items to the CSR

After completion of the above procedures, the HM can now take all metal and heat stable items to the CSR for sterilization. Ensure all instruments and equipment are handled properly and no sharp objects are protruding through packs or cassettes while transporting items to the CSR.

Housekeeping

Although micro-organisms are normal contaminants of walls and floors, these surfaces are rarely associated with transmitting infection to staff and patients; all facilities must remain clean. The infection control instruction will determine and implement a written schedule for cleaning and a method of disinfection based upon location within the facility. The OSHA and NAVOSH requirements for housekeeping include sections on equipment, laundry, and infectious waste disposal.

EXPOSURE INCIDENT

All personnel must pay close attention when using sharps and fluids. Accidents happen and personnel who sustain a penetrating injury (needle stick or cut) or a splash (into the eye or onto mucous membranes) with contaminated fluids must not be ignored.

Immediately complete the following:

1. Stop activity immediately and step back from the point of contamination.
2. Squeeze the skin around the needle stick or cut to expel blood and contaminants.
3. Cleanse the puncture site or flush the eye with cool water for 15 minutes.
4. Report the incident and seek medical attention promptly.
5. Follow the facility’s protocol for follow-up.
If a needle stick is involved, most facilities will draw a baseline blood sample from the patient and the injured caregiver. Periodic blood samples are drawn over 12 months to determine health status and the need for treatment.

Refer to NEHC-TM89-2, Nosocomial Infection Control Manual for Ambulatory Care Facilities, and report the incident as a mishap to the command safety officer and command risk manager using OPNAVINST 5102.1 series.

MANAGEMENT OF INFECTIOUS WASTE

LEARNING OBJECTIVES:

- Identify medical waste sorting, packaging, handling, and disposal procedures.
- Identify ordinary and contaminated laundry and how they are each handled.

Concern exists about potentially adverse effects of infectious waste on public health and the environment. Scientific evidence shows that infectious waste is no greater threat to the public health or environment than residential solid waste. Treatment facilities must establish an effective plan for dealing with infectious waste. This plan should include the segregation, packing and handling, storage, transportation, treatment, and disposal of such debris. The management plan must establish recordkeeping systems, personnel training programs, and incorporate the minimally acceptable management standards for Navy MTF and DTF (as contained in BUMEDINST 6280.1 series, Management of Infectious Waste).

INFECTIOUS WASTE

Infectious waste is liquid or solid waste containing pathogens in sufficient numbers and of sufficient virulence to cause infectious disease in susceptible hosts exposed to the waste. If there is doubt as to the infectiousness of the material in question, contact the ICO or supervisor.

Several examples are:

- Sharps (needles, scalpel blades)
- Microbiology waste (cultures, stocks containing microbes)
- Pathological waste (human tissue, body parts)
- Liquid waste (blood, cerebrospinal fluid)
- Medical waste from isolation rooms

Segregation

Separate infectious waste from noninfectious waste at its point of origin. (i.e. MTFs, DTFs, and immunization stations) Infectious waste shall be placed in containers labeled with the universal biohazard symbol and the word "BIOHAZARD" or be red in color. Containers shall be lined with plastic bags of sufficient thickness, durability, puncture resistance, and burst strength to prevent rupture or leaks.

Plastic bags must be red with the BIOHAZARD symbol and be of sufficient quality and thickness so that only one bag is needed for most situations, though most commands suggest to double bag. Bags must never be overloaded and they shall be labeled and secured before being removed or replaced.
How to close a biohazard bag:

1. Twist the top of the bag.
2. Wrap tape around the twisted neck of the bag starting from the lower part of the neck ascending to the opening.
3. At the top of the bag, bend the neck in half and tape the neck to itself; this is known as “goose necking.”

Each MTF and DTF will have their own protocol. HMs need to ensure they are familiar with local Hazardous Material laws and instructions.

Place sharps into rigid, puncture resistant red sharps container (Fig. 9-1) with the BIOHAZARD symbol. Never clip, cut, or bend needles or overfill containers. Sharps containers shall be closed before removal or replacement to prevent spillage or protrusion of contents during handling, storage, or transport.

**Liquid Regulated Waste**

Pour liquid regulated wastes into the sanitary sewer system through clinical sinks (not hand washing sinks), unless local or state regulations prohibit this practice.

**Disposable Sharps**

Treat used disposable sharps, such as needles, scalpel blades, capsules, disposable syringes, used burs, and broken instruments as regulated waste. Handle these items with extreme care to prevent any unintentional injury and the possible spread of blood borne diseases.

In the dental and surgical setting, because a patient may require a second injection of local anesthetic, and most syringes are not disposable, recapping is sometimes necessary. Use the following guidelines when recapping:

- Never recap a needle using a two-handed technique
- Use one of the commercially available sheath holders, or use the “scoop” technique
- If using the scoop technique, the cap is scooped up from the tray with the needle tip using only one hand
- Never allow uncovered needles to remain on the instrument tray

![Figure 9-1.—BIOHAZARD Sharps Container](image)

*Photograph provided by HM2 Timothy Hanna of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD*
Linen Handling

Improper handling of linen results in the transfer of pathogenic organisms through direct contact with the healthcare provider’s clothing and subsequent contact with the patient, patient-care items, or other materials in the care environment. Bed linens, towels, smocks, trousers, and other protective attire are considered ordinary laundry unless they are visibly soiled by blood or OPIM. Ordinary laundry should be sorted wearing gloves and processed following the command’s laundry policy. Place all dirty linen in appropriate laundry bags.

Contaminated laundry is any laundry soiled with blood or OPIM and will be packed in a red biohazard container or bag, or in a leak-proof plastic bag with a biohazard label. Linen from patients having infectious or communicable diseases must be handled in a special manner. When sorting laundry, the HM must wear gloves and other appropriate personnel protective attire. Bag contaminated laundry at the location of use.

All linen, whether clean or used, must never be held against one’s clothing or placed on the floor. The floors of a healthcare facility are considered to be grossly contaminated; any article coming in contact with the floor will also be contaminated. Do not sort or reuse soiled laundry in patient care areas. If there is an on-site laundry service, follow instructions contained in BUMEDINST 6600.10 series.

Storage

If the HM is in an area where infectious waste cannot be treated on-site, the following storage requirements apply:

- Do not store without refrigeration for more than 7 days
- Keep storage time to a minimum
- Store waste at or near the transport site in a site
- The storage area should be able to protect from rodents and other pests
- Waste should be marked with the universal biohazard symbol and be clearly visible from outside of the storage area
- Access should be limited to authorized personnel only
Transportation

When the infectious waste is ready to be moved, there are regulations that must be followed while in transport.

- Place it in ridged, leak-proof containers marked by the biohazard symbol
- Refer to the Federal, State and Local laws for regulations on licensing and vehicle labeling

The treatment and disposal methods shown in Table 9-1 are the minimally acceptable standards. The ICO should ensure that all areas within a command handle regulated waste in a uniform manner and as always consult all Federal, State and local laws and regulations.

<table>
<thead>
<tr>
<th>Types of Infectious Waste</th>
<th>Methods of Treatment</th>
<th>Methods of Disposal</th>
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<tbody>
<tr>
<td>Microbiological</td>
<td>Steam sterilization ¹</td>
<td>Sanitary Landfill</td>
</tr>
<tr>
<td></td>
<td>Chemical Disinfection ²</td>
<td></td>
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<tr>
<td></td>
<td>Incineration ³</td>
<td></td>
</tr>
<tr>
<td>Pathological</td>
<td>Incineration ³&amp;⁴</td>
<td>Sanitary Landfill</td>
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<tr>
<td></td>
<td></td>
<td>Burial ⁵</td>
</tr>
<tr>
<td>Bulk blood and other</td>
<td>Gelatinization ⁶</td>
<td>Sanitary sewer ⁷</td>
</tr>
<tr>
<td>potentially infectious</td>
<td></td>
<td>Sanitary landfill ⁸</td>
</tr>
<tr>
<td>liquids</td>
<td>Steam sterilization ⁷</td>
<td></td>
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<tr>
<td></td>
<td>Incineration</td>
<td></td>
</tr>
<tr>
<td>Sharps in sharps containers</td>
<td></td>
<td>Sanitary landfill</td>
</tr>
</tbody>
</table>

Several steps should be used in the treatment and disposal of infectious waste. These steps include the identification of waste; segregation, sorting, packaging,

1. For effective sterilization, the temperature must be maintained at 121 degrees C (250 degrees F) for at least 90 minutes, at 15 pounds per square inch of gauge pressure. Bacillus stearothermophilus spore strips must be used weekly to test the sterilization process.
2. Chemical disinfection is most appropriate for liquids.
3. Ash remaining after incineration may go directly to the sanitary landfill, unless state or local regulations require testing the ash for characteristics of hazardous waste.
4. Disposal of placentas by grinding with subsequent discharge to a sanitary sewer is acceptable unless prohibited by county or local laws/regulations.
5. Burial or cremation is acceptable.
6. Must be further treated by steam sterilization or incineration.
7. Discharge to a sanitary sewer is acceptable unless prohibited by county or local laws/regulations.
8. Must be treated by steam sterilization or incineration before landfill disposal.

Table 9-1.—Treatment and Disposal Methods for Infectious Waste
Recordkeeping

The ICO should implement a practical system to monitor disposal of infectious waste. This system includes date, type of waste, amount (weight, volume, or number of containers), and disposition. Further guidance for infectious waste can be found in BUMEDINST 6600.10 series and BUMEDINST 6280.1 series.

INFECTIONOUS WASTE SPILLS

In case of a spill or break in containment immediately do the following:

- Affected area should be cleaned immediately
- Wear all appropriate PPE to prevent exposure
- Place all leaking or broken containers in a new double-lined container marked with the biohazard symbol
- Remove any blood or fluid spills with an absorbent material and disinfect the area with a solution of household bleach diluted 1:10 with clear water or an EPA approved disinfectant

CLEANING THE OPERATING/MEDICAL TREATMENT ROOM

LEARNING OBJECTIVE:

Identify how to properly field day a surgical suite.

Cleanliness in the operating room is an absolute must. Cleaning routines must be clearly understood and carefully followed. The causes of postoperative wound infections have, on occasion, been traced to the operating room. Since no two patients are alike and all patients have their own resident bacteria, every surgical case must be considered to be contaminated.

At the beginning of each day, all the fixtures, equipment, and furniture in each operating room will be damp-dusted with an antiseptic germicide solution. During the operation, keep the room clean and orderly at all times. Should sponges be dropped on the floor, or if blood or other body fluids spill, clean the area immediately using a disinfectant germicide solution and a clean cloth.

Between operations, clean all used items. The area of the floor occupied by the surgical team must be cleaned using the wet vacuum method. If a wet vacuum is not available, mops may be used but a clean mop head must be used following each operation. Gowns and gloves must be removed before leaving the room. All linens and surgical drapes must be bagged and removed from the room after each case. All trash and disposable items must be bagged and disposed of appropriately after each case. All instruments must be washed by gloved hands or placed in perforated trays and put through washer/sterilizer.
At the completion of the day’s operations, each operating room should be terminally cleaned using an antiseptic germicide solution and the following tasks accomplished.

- Clean all wall or ceiling-mounted equipment
- Clean all spotlights and lights on tracks
- Thoroughly scrub all furniture used in the room, including the wheels
- Clean metal buckets and other waste receptacles and put them through the washer/sterilizer, if possible
- Clean scrub sinks
- Machine scrub the entire floor in each room. If a machine is not available, use a large floor brush
- Suction up the disinfectant germicide solution that is used on the floor, using a wet vacuum. If mops are used, make sure a clean mop head is issued for each room

NOTE:
The use of mops in the operating room is the LEAST DESIRABLE method of cleaning.

SURGICAL ASEPTIC TECHNIQUE

LEARNING OBJECTIVE:

Identify the principles and guidelines for surgical aseptic technique.

Surgical aseptic technique is the term that describes the sterilization, storage, and handling of articles to keep them free of pathogenic organisms. There are important procedures that need to be understood before entering the surgical environment: the preparation and sterilization of surgical equipment and supplies; and the preparation of the operating room for performing a surgical procedure. Specific methods of preparation will vary from place to place, but the basic principles of surgical aseptic technique will remain the same.

Before an operation, it is necessary to sterilize and keep sterile all instruments, materials, and supplies that come in contact with the surgical site. Every item handled by the surgeon and the surgeon’s assistants must be sterile. The patient’s skin and the hands of the members of the surgical team must be thoroughly scrubbed, prepared, and kept as aseptic as possible.

During the operation, the surgeon, surgeon’s assistants, and the scrub HM must wear sterile gowns and gloves and must not touch anything that is not sterile. Maintaining sterile technique is a cooperative responsibility of the entire surgical team. Each member must develop a surgical conscience, a willingness to supervise and be supervised by others regarding the adherence to standards. Without this cooperative and vigilant effort, a break in sterile technique may go unnoticed or not be corrected, and an otherwise successful surgical procedure may result in complete failure.

BASIC GUIDELINES

To assist in maintaining the aseptic technique, all members of the surgical team must adhere to the following principles:

- Practice good personal hygiene; daily bathing and clothing change
- Personnel having colds, sore throats, open sores, and/or other infections will not be permitted in the operating room
- Operating room attire (which includes scrub suits, gowns, head coverings, and face masks) must not be worn outside the operating room suite. If such occurs, change all attire before re-entering the clean area. (The operating room and adjacent supporting areas are classified as clean areas)
- Surgical team members having direct contact with the surgical site must perform the surgical hand scrub before the operation
- All materials and instruments used in contact with the site must be sterile
• Gowns worn by surgeons and scrub HMs are considered sterile from shoulder to waist (in the front only), including the gown sleeves
• If sterile surgical gloves are torn, punctured, or have touched an unsterile surface or item, they are considered contaminated
• Unsterile articles must not come in contact with sterile articles
• Ensure the patient’s skin is as clean as possible before a surgical procedure
• Take every precaution to prevent contamination of sterile areas or supplies by airborne organisms

HANDLING STERILE ARTICLES

When HMs are changing a dressing, removing sutures, or preparing the patient for a surgical procedure, it is necessary to establish a sterile field from which to work. The field should be established on a stable, clean, flat, dry surface. Wrappers from sterile articles may be used as a sterile field as long as the inside of the wrapper remains sterile. If the size of the wrapper does not provide a sufficient working space for the sterile field, use a sterile towel. Once established, only those persons who have donned sterile gloves should touch the sterile field. The following basic rules must be adhered to:

• An article is either sterile or unsterile
• If there is doubt about the sterility of an item, consider it unsterile
• Any time the sterility of a field has been compromised, replace the contaminated field and setup
• Do not open sterile articles until they are ready for use
• Do not leave sterile articles unattended once they are opened and placed on a sterile field
• Do not return sterile articles to a container once they have been removed from the container

• Never reach over a sterile field
• When pouring sterile solutions into sterile containers or basins, do not touch the sterile container with the solution bottle. Once opened and first poured, use bottles of liquid entirely. If any liquid is left in the bottle, discard it
• Never use an outdated article. Unwrap it, inspect it, and, if reusable, rewrap it in a new wrapper for sterilization
• General rule: anything draped in blue or green (colors of drapes and gowns may vary for each MTF) is considered sterile and should not be touched by anyone but the “scrubbed in” surgical staff

OPENING AND SETTING UP A STERILE FIELD

The size of sterile fields can vary in size, from a small portion of a counter to a whole table or bed. The following is an example of opening a sterile gown and sterile gloves. Though this sounds simple, it is a complicated process. In every case there should be a circulator, usually a nurse or a HM that is not scrubbed in that is free to grab gear for procedures and assist the surgical team. The circulator will perform the following:

1. Inspect the equipment package for rips, punctures or any abnormality. If any are noted, the package should be considered unsterile and discarded.
2. Inspect the chemical indicator to ensure the pack has completed the sterilization process.
3. Remove and discard the protective plastic covering from the gown and the cloth covering.
4. Place the wrapped gown on a clean, dry, and flat surface with the folds facing up.
5. To open the wrap, the first corner of the wrap should be pulled away from the person opening the pack, paying special attention so it does not fold back on itself contaminating the gown.
6. Open the two side flaps.

7. Last, open the flap closest to the person opening the pack.

Do not touch the gown while attempting to grasp the corners of the flaps; as seen in Figure 9-2.

4. With the gloves exposed, drop them on the gown, paying attention so that the HM’s clothes do not touch the sterile field.

NOTE:
The one inch border around the edge of the sterile field is considered contaminated. Do not drop the gloves onto the border or they will be considered unsterile. This would contaminate the gown and require the process to be started again.

SURGICAL HAND SCRUB

LEARNING OBJECTIVE:

Identify steps to properly complete a surgical scrub.

The purpose of the surgical hand scrub is to reduce resident and transient skin flora (bacteria) to a minimum. Resident bacteria are often the result of organisms present in the hospital environment. Because these bacteria are firmly attached to the skin, they are difficult to remove. Their growth is inhibited by the antiseptic action of the scrub detergent used. Transient bacteria are usually acquired by direct contact and are loosely attached to the skin. These are easily removed by the friction created by the scrubbing procedure. Proper hand scrubbing and the wearing of sterile gloves and a sterile gown provide the patient with the best possible barrier against pathogenic bacteria in the environment and against bacteria from the surgical team.
The following steps comprise the accepted method for the surgical hand scrub.

1. Trim the fingernails and cuticles. Nails should be no longer than the finger tips to avoid puncturing gloves. Do not use false fingernails since contamination may occur from fungal growth between the false and natural nails. Do not wear nail polish since micro-organisms can hide in small cracks in the finish.

2. Before beginning the hand scrub, don a surgical cap or hood that covers all hair, both head and facial, and a disposable mask covering the nose and mouth.

3. Using approximately 6 ml of antiseptic detergent and running water lather the hands and arms to 2 inches above the elbow. Leave detergent on the arms and do not rinse.

4. Under running water, clean the fingernails and cuticles, using a nail cleaner.

5. Starting with the fingertips, rinse each hand and arm by passing them through the running water. Always keep the hands above the level of the elbows.

6. From a sterile container, take a sterile brush and dispense approximately 6 ml of antiseptic detergent onto the brush and begin scrubbing the hands and arms.

7. Begin with the fingertips. Bring the thumb and fingertips together and scrub across the fingertips using 30 strokes using the brush.

8. Scrub all four surface planes of the thumb and all surfaces of each finger including the webbed space between the fingers; use 20 strokes for each surface area.

9. Scrub the palm and back of the hand in a circular motion, using 20 strokes each.

10. Visually divide the forearm into two parts, lower and upper. Scrub all surfaces of each division 20 strokes each, beginning at the wristband progressing to the elbow.

11. Scrub the elbow in a circular motion using 20 strokes.

12. Scrub in a circular motion all surfaces to approximately 2 inches above the elbow.

13. Do not rinse this arm when finished scrubbing. Rinse only the brush.

14. Pass the rinsed brush to the scrubbed hand and begin scrubbing the other hand and arm, using the same procedure outlined above.

15. Drop the brush into the sink when finished.

16. Rinse both hands and arms, keeping the hands above the level of the elbows, and allow water to drain off the elbows.

17. When rinsing, do not touch anything with scrubbed hands and arms.

18. The total scrub procedure must include all anatomical surfaces from the fingertips to approximately 2 inches above the elbow.

19. Dry the hands with a sterile towel. Do not allow the towel to touch anything other than scrubbed hands and arms.

20. Between operations, follow the same hand scrub procedure.
GOWNING AND GLOVING

LEARNING OBJECTIVE:

*Identify how to properly gown and glove the HM and the surgeon.*

The following will provide step by step instructions for gowning and gloving.

Before beginning the hand scrub process the sterile gown and glove packages must be opened. Upon completion of the surgical hand scrub, back through the door holding the hands up to avoid touching anything with the hands and arms. Gowning technique is shown in the steps of Figure 9-4. Pick up the sterile towel that has been wrapped with the gown (touching only the towel) and proceed as follows:

1. Dry one hand and arm, starting with the hand and ending at the elbow, with one end of the towel. Dry the other hand and arm with the opposite end of the towel. Drop the towel.
2. Pick up the gown in such a manner that hands touch only the inside surface at the neck and shoulder seams.
3. Allow the gown to unfold downward in front.
4. Locate the arm holes.
5. Place both hands in the sleeves.
6. Hold the arms out and slightly up while slipping arms into the sleeves.
7. Another person (circulator) who is not scrubbed will pull the gown onto the scrub HM as the hands are extended through the gown cuffs.

Continue the process by opening the inner glove packet on the same sterile surface on which the gown was opened. The entire gloving process is shown in the steps of Figure 9-5.

1. Pick up one glove by the cuff using the thumb and index finger.
2. Touching only the cuff, pull the glove onto one hand and anchor the cuff over the thumb.
3. Slip the gloved fingers under the cuff of the other glove. Pull the glove over the fingers and hand, using a stretching side-to-side motion.
4. Anchor the cuff on the thumb. With the fingers still under the cuff, pull the cuff up and away from the hand and over the knitted cuff of the gown.
5. Repeat the preceding step to glove the other hand.
6. The gloving process is complete.
Figure 9-4.—Proper Gowning Technique

1. DRY HANDS.
2. PICK UP GOWN.
3. LET GOWN UNFOLD.
4. OPEN TO LOCATE SLEEVE / ARMHOLES.
5. SLIP ARMS INTO SLEEVES.
6. HOLD ARMS OUT AND SLIGHTLY UP.
7. CIRCULATOR PULLS GOWN ON.
1. Pick up one glove with thumb and forefinger.

2. Pull glove on hand.

3. Slip partially gloved hand under cuff of second glove.

4. Pull second glove over other hand and pull glove up to gowned wrist.

5. Slip fingers of completely gloved hand under cuff of first hand; pull glove to gowned wrist.


Figure 9-5.—Proper Gloving Technique
To gown and glove the surgeon, follow these steps:

1. Pick up a gown from the sterile linen pack. Step back from the sterile field and let the gown unfold in front. Hold the gown at the shoulder seams with the gown sleeves facing inward.

2. Offer the gown to the surgeon. Once the surgeon's arms are in the sleeves, let go of the gown. Be careful not to touch anything but the sterile gown. The circulator will tie the gown.

3. Pick up the right glove. With the thumb of the glove facing the surgeon, place the fingers and thumbs of both hands in the cuff of the glove and stretch it outward, making a circle of the cuff.

4. Offer the glove to the surgeon. Be careful that the surgeon's bare hand does not touch the HM’s gloved hands.

5. Repeat the preceding step for the left glove.

**SUMMARY**

This chapter has introduced the HM to many basics in preventive medicine and infection control procedures and philosophies such as standard precautions, infection control in the treatment rooms, biohazardous waste management, and surgical aseptic technique. Having a good grasp of these areas of patient care will give the HM a good base from which they can grow.
CHAPTER 10

DISINFECTION AND STERILIZATION

INTRODUCTION

Concerns about transmitting infectious agents, such as hepatitis virus (HBV) and human immunodeficiency virus (HIV), have caused the health care community to become more aware of the need to disinfect and sterilize instruments, materials, and other equipment to protect providers and patients. This chapter will explain the disinfection and sterilization process with which Hospital Corpsmen (HMs) will be involved. It will also give an overview of the procedures so HMs can effectively carry out duties assigned.

Many types of liquid chemical disinfecting agents are available and a variety of sterilization methods. The highest level of contamination control is sterilization because it results in the total destruction of all forms of microbial life. Sterilization and the availability of sterile products for use in healthcare delivery depend on many factors. The most critical factors are as follows:

- Proper and efficient sterilization facility design
- Sound infection control practices before, during, and after disinfection and sterilization
- The effectiveness of the actual disinfection and sterilization processes

DISINFECTION

LEARNING OBJECTIVE:

Explain the difference between disinfection and sterilization.

Disinfection is achieved by either chemical or heat means. Selecting an appropriate chemical germicide or heat disinfection method depends on what requirements need to be met for that particular product. The following are some of the criteria for effective chemical disinfection:

- The degree of microbial kill or deactivation required
- The composition and texture of the item being treated
- The technical requirement and ease of use of the available agents

LEVELS OF DISINFECTION

LEARNING OBJECTIVES:

Identify the government agency responsible for registering disinfectants.

Identify chemical products used for high, intermediate, and low-level surface disinfection and explain the advantages and disadvantages of each.

The Environmental Protection Agency (EPA) classifies disinfectants as high, intermediate, or low level, based on the effectiveness and contact time of the solution and the biocidal activity of an agent against bacterial spores, mycobacterium tuberculosis, lipid and nonlipid viruses, and vegetative bacteria.
Table 10-1 describes the level of disinfection required to kill the micro-organism named.

<table>
<thead>
<tr>
<th>Level of Bacterial Activity</th>
<th>Bacterial Spores</th>
<th>Tubercle Bacillus</th>
<th>Nonlipid Viruses</th>
<th>Lipid Viruses</th>
<th>Vegetative Bacteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Maybe</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Intermediate</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Low</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

In the absence of gross organic contamination.

**Table 10-1.—Micro-Organisms and Levels of Disinfection**

**FACTORS INFLUENCING GERMICIDAL PROCEDURES**

The factors associated with the micro-organisms, as well as those associated with the surrounding physical and chemical environment, influence the antimicrobial efficiency of the germicides. They are described next.

**Nature of the Material**

The easiest surface to disinfect is a smooth, nonporous, and cleanable one. If the materials are incompatible with disinfectant, damage and corrosion can occur.

**Bioburden**

Under a given set of circumstances, the higher the level of microbial contamination, the longer the required exposure to the disinfectant is needed. Additionally, resistant micro-organisms require longer exposure times.

**Organic Debris Present**

Blood, saliva, and other organic material may contribute to the failure of a germicidal process by either direct inactivation of the disinfectant or the actual layering of the micro-organisms on the instruments or equipment, thereby preventing penetration of the germicide.

**Type and Concentration of the Germicide**

Generally, when all other variables are constant, the higher concentrations of a chemical agent are more effective and require a shorter time to disinfect. Use of dilutions other than those specified by the manufacturer adversely affects some intermediate-level disinfectants, specifically iodophors. In all instances, follow the manufacturer's recommendations.

**GENERAL CATEGORIES OF LIQUID CHEMICAL AGENTS**

A large variety of liquid disinfectants are available today, and it is probable that many new ones will become available in the future. When selecting a product, make sure that the label has an EPA registration number on it. Table 10-2 is a guide to chemical agents for disinfection. They may be subject to change, be sure to read the manufacturer’s instructions before using. This section will discuss the four most commonly used chemical agents, glutaraldehyde and chlorine dioxide based solutions, iodophors, and phenolics.
<table>
<thead>
<tr>
<th>Category/Active Ingredient</th>
<th>Contact*</th>
<th>Pros</th>
<th>Cons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorines (sodium hypochlorite diluted in-office, chlorine dioxide, commercial preparations of sodium hypochlorite with added surfactants)</td>
<td>2–10 min 20°C or 25°C†</td>
<td>Economical; rapid, broad-spectrum activity; tuberculocidal; effective in dilute solution</td>
<td>Diluted solutions must be prepared daily; cannot be reused; are corrosive to some metals; may destroy fabrics; may irritate skin and other tissues; chlorine dioxide is a poor cleaner</td>
</tr>
<tr>
<td>Complex phenols (“synthetic phenols” containing multiple phenolic agents)</td>
<td>10 min 20°C or 25°C†</td>
<td>Broad-spectrum activity; residual activity; effective cleaner and disinfectant; tuberculocidal; compatible with metal, glass, rubber, and plastic</td>
<td>Extended exposure may degrade some plastics or leave etchings on glass; many preparations are limited to one day of use; may leave a residual film on treated surfaces</td>
</tr>
<tr>
<td>Dual/synergized quaternary ammonium compounds (alcohol and multiple quaternary ammonium compounds)</td>
<td>10 min 20°C†</td>
<td>Broad-spectrum activity; tuberculocidal; hydrophilic virus claims; low toxicity; contains detergent for cleaning</td>
<td>Readily inactivated by anionic detergents and organic matter; can damage some materials</td>
</tr>
<tr>
<td>Iodophors (iodine, combined with a surfactant)</td>
<td>10 min 20°C</td>
<td>Broad-spectrum activity; tuberculocidal; relatively nontoxic; effective cleaner and disinfectant; residual biocidal action</td>
<td>Unstable at higher temperatures; may discolor some surfaces; inactivated by alcohol and hard water; must be prepared daily; dilution and contact times are critical</td>
</tr>
<tr>
<td>Phenol-alcohol combinations (phenolic agent in an alcohol base)</td>
<td>10 min 20°C or 25°C†</td>
<td>Tuberculocidal; fast acting; residual activity; some inhibit the growth of mold, mildew, and other fungi</td>
<td>May cause porous surfaces to dry and crack; poor cleaning capabilities</td>
</tr>
<tr>
<td>Other halogens (sodium bromide and chlorine)</td>
<td>5 min 20°C</td>
<td>Fast acting; tuberculocidal; supplied in tablet form for simple dilution; requires minimal storage space</td>
<td>For use on hard surfaces only; chlorine smell</td>
</tr>
</tbody>
</table>

*Contact time/temperatures for tuberculocidal activity. †Varies by active ingredient or disinfectant brand.

Note: Glutaraldehydes and simple quaternary ammonium compounds should not be used for surface disinfection in dentistry.

EPA, Environmental Protection Agency.
**Glutaraldehyde Solutions**

These agents are available in several formulations differing in pH, concentration, and exposure time. They are classified as high-level disinfectants; any chemical agent used chiefly on inanimate objects to destroy or inhibit the growth of harmful organisms or sterilants.

Always wear impermeable gloves and protective eyewear when handling these solutions. Irritation of the hands is common and personnel are always at risk of splashes occurring whenever liquids are being handled, so direct physical contact between glutaraldehyde solutions and human tissues should be avoided. When using these agents, they require proper ventilation because their vapors are extremely toxic.

Immersed items must be rinsed with sterile water before using. Glutaraldehydes of 2 to 3.2 percent are FDA-registered. These solutions are not recognized as acceptable surface disinfectants because of the excessive amounts of exposure time required, corrosiveness, skin sensitization, and odor.

**Chlorine Dioxide Solutions**

Chlorine dioxide is an effective surface disinfectant or sterilant. These solutions may be used for high-level disinfection of semi-critical items that are not subject to corrosion. It has a rapid action of 3 minutes for disinfection or 6 hours for sterilization. As with sodium hypochlorite (bleach), there are several disadvantages: chlorine dioxide must be discarded daily; has a 24-hour use life as a sterilant; and does not readily penetrate organic debris.

It must be used with protective eyewear and gloves because it is extremely irritating to the eyes and skin. It should always be placed in closed containers, and the HM must ensure adequate ventilation when using for surface disinfection. In addition, it corrodes aluminum containers.

**Iodophors**

Iodophors are classified as intermediate-level disinfectants or can be used as antiseptics if the product label claims tuberculocidal (lethal to mycobacterium tuberculosis) activity. They are compounds consisting of iodine and usually detergents to which the iodine quickly binds. Iodophor preparations are less irritating to tissues, cause less allergies, and do not normally stain skin or clothing. They should not be used on white or pastel vinyls that are subject to staining from repeated exposure to iodine. Their biocidal activity is accomplished within 10 to 25 minutes of exposure. To ensure tuberculocidal activity, fresh solutions must be prepared daily. As iodophors lose effectiveness, the color changes from amber to clear. Iodophors become somewhat unstable at high temperatures and can have a rapid loss of antimicrobial activity when inactivated by hard water and alcohol. Distilled or at least softened water is recommended to dilute the iodophors before using. Iodophors are EPA-registered and American Dental Association-accepted as surface disinfectants. They may not be used as sterilants.

Iodophor antiseptics are useful in the preparation of oral mucosa for local anesthesia, surgical procedures, and hand washing. Not only does the Iodophor remove the microbial populations from the skin, but also a residual antimicrobial effect remains on the scrubbed areas. Although Iodophors are used as both antiseptics and disinfectants, the same product is never used for both. Antiseptics are applied to living tissue/skin to reduce the possibility of infection, sepsis, or putrefaction. Disinfectants destroy microorganisms found on non-living objects.
Phenolics

Phenolics are also classified as an intermediate-level disinfectant, provided the product label indicates a claim to tuberculocidal activity. When diluted properly, phenols are used for surface disinfection. Phenolics are useful on metal, glass, rubber, and plastic, and are less toxic and corrosive than glutaraldehyde solutions. However, they create a film accumulation, can degrade certain plastics, and etch glass with prolonged exposure (Fig. 10-1). They are very irritating and contact with skin and mucous membranes should be avoided. To prevent skin and eye irritation, protective gloves and eyewear must be worn during their use.

Figure 10-1.—Phenolics Etched Glass

Photograph provided by HM2 Pablo A. Mercado of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD

SEMI-CRITICAL CATEGORY ITEMS REQUIRING CHEMICAL DISINFECTION

LEARNING OBJECTIVE:

Identify semi-critical and non-critical items requiring chemical disinfection.

Examples of semi-critical items requiring chemical disinfection are three-way syringe tips, High-Volume Evacuator (HVE) saliva ejector tips, and radiographic positioning devices. For the chemical disinfection of semi-critical items, use the following procedures:

1. Thoroughly wipe the item with absorbent material saturated with an EPA-registered disinfectant.
2. Allow the disinfecting solution to remain in contact with the item for the length of time specified by the manufacturer.
3. Whenever possible, all semi-critical items that can withstand sterilization should be sterilized.
4. Nitrous oxide masks and breathing tubes fall into the semi-critical category, if they are autoclavable, clean and sterilize them using steam heat. If not autoclavable, wipe after each use with two separate gauze pads saturated with a high-level disinfectant. If breathing tubes are not autoclavable, after each use, rinse inside and outside with running water, wipe and flush with a high-level disinfectant, and re-rinse with water.

NOTE:

All semi-critical category items should receive high-level disinfection.
NON-CRITICAL CATEGORY ITEMS REQUIRING CHEMICAL DISINFECTION

LEARNING OBJECTIVE:

Identify semi-critical and non-critical items requiring chemical disinfection.

Examples of non-critical category items requiring chemical disinfection are the following: dental delivery systems (DDS), consisting of a chair, unit, and light; portable dental units; surgical table and chair; and X-ray apparatus. For the chemical disinfection of non-critical category items, use the following procedures:

1. Disinfect all equipment and table surfaces at least daily.
2. Use disposable barriers since they reduce the number of surfaces requiring disinfection.
3. Change paper or plastic headrest and bracket tray covers after each patient. If headrest covers are not available, disinfect the headrest after each patient.
4. Disinfect hand-operated controls, switches, and handles after each patient.
5. Follow the manufacturer’s instructions when disinfecting the lamp head and protective shield.
6. Flush HVE and saliva ejector tubing and cuspidor weekly with a central evacuation system cleaner. Use more often as needed. Follow the manufacturer’s instructions.
7. Anesthetic cartridges for nonsurgical use should be dispensed under unit dose guidelines to prevent contamination of bulk supplies. Use only individual dose dental carpules, discard them after use, and always follow the manufacturer’s instructions.

NOTE:
All non-critical category items require at least intermediate-level disinfection.

STERILIZATION

LEARNING OBJECTIVE:

Identify the steps involved in processing instruments.

The highest level of contamination control is sterilization because it results in the total destruction of all forms of microbial life. Sterilization and the availability of sterile products for use in healthcare delivery depend on many factors. The most critical factors are as follows.

PHYSICAL DESIGN

Healthcare Treatment Facilities must have a Central Sterilization Room (CSR) or a central sterilization area. Centralization of sterilization activity is safer, provides more efficient use of materials and personnel, and standardizes execution and monitoring procedures. The following are the critical design elements that make up a CSR.

Dedicated Work Areas

The design and outfitting of a sterilization area must include work areas for receiving, cleaning, processing, sterilizing, storing, and issuing of instruments and equipment.

FUNCTIONAL FLOW OF THE STERILIZATION PROCESS

Most large healthcare facilities will have a permanent CSR technician assigned to the sterilization area. As part of the HM’s indoctrination, temporary assignment in the CSR will enable learning of the command’s sterilization processes. All CSRs should have a functional flow system (Fig. 10-2) where equipment, instruments, and materials are first introduced into the receiving area, and work their way through to the issue area in a specific order.
Once physically in an area of the CSR, the HM must not go backwards or skip an area. This will compromise the entire sterilization process. Do not process contaminated instruments, materials, or equipment in an area that may contaminate the sterilized items.

**TRAFFIC CONTROL**

Controlled access to the sterilization areas minimizes the potential for transfer of microorganisms between contaminated items, patients, and staff. These areas must be off limits to anyone not involved in the sterilization process.

**RECEIVING AND CLEANING**

Ideally, these areas will be physically separate from the remainder of the sterilization area. If physical separation is not obtainable, proper outfitting and equipment selection are critical. Commands should purchase equipment that minimizes the handling of contaminated materials and instruments.

There may also be an area equipped with the utilities necessary for operating dental hand pieces. Some commands require that the disinfection, cleaning, lubrication, and sterilization of dental hand pieces take place in the CSR instead of the medical treatment room (MTR) or dental treatment room (DTR). Check to see what the command’s policies are on where hand piece maintenance should take place.

**PROCESSING**

A processing space should have amble work surface for the volume of materials processed. All inspecting, sorting, wrapping, and packaging of contaminated materials occur here.

**STERILIZATION**

The space requirements for the sterilization process should be determined by the available size, the degree of sufficient access for the loading and unloading, and the ability to service the sterilizer.

**STERILE STORAGE AND ISSUE**

To protect and maintain all sterile items, the storage and issue areas should not be in the immediate vicinity of the contaminated processing areas.

**STERILIZATION PROCESS**

The sterilization process takes place in a CSR. There are many benefits to the centralized approach. Centralized instrument decontamination and sterilization are usually safer and more cost effective than instrument processing in the MTR/DTR. The elimination of large numbers of small capacity ultrasonic baths and tabletop sterilizers in each MTR/DTR can be replaced by the central sterilization approach that has larger capacity centralized equipment.
Whether a centralized or individual sterilization area is used, contaminated instruments and equipment must be processed as described next.

MANAGEMENT OF CONTAMINATED INSTRUMENTS

Following the completion of a patient’s treatment, the HM will take the contaminated instruments and equipment directly to the CSR technician in the receiving area of the CSR. Figure 10-3 illustrates a contaminated instrument pack that has been placed in the designated drop-off location in the receiving area. The CSR technician should take the contaminated instruments and equipment and set them in the receiving area that has been designated as a temporary holding area until they can be processed.

Do not rinse, scrub, or unnecessarily handle contaminated instruments or materials in MTRs/DTRs or other patient treatment areas. In the most extenuating circumstances, only the Commanding Officer (designee) or the Infection Control Officer (ICO) under written direction may make exceptions to this requirement. This does not include hand piece maintenance that will be performed in the CSR, main operating room (MOR), or DTR depending on the local policy.

INSTRUMENT CLEANING

You should take contaminated instruments from the receiving area wearing heavy duty puncture-resistant gloves while handling all potentially contaminated items. Break down all packs and place disposable items and contaminated linens in appropriate containers. All contaminated, reusable items must be decontaminated by immersion in an EPA-registered disinfectant before further handling. This step can be eliminated if these items are cleaned in an ultrasonic cleaner (bath) with an EPA-registered disinfectant that also is approved as an ultrasonic cleaning solution. Process contaminated instruments using one of the following methods. They are discussed in order of preference.

Automated Washer Processor

The automated washer processor is the safest method and provides an effective cleaning process. Figure 10-4 illustrates an automated washer processor being loaded. It is commonly used in hospitals or very large dental clinics. Contaminated instruments are placed in cassettes or baskets. Then they are run through the unit’s cycle of cleaning, rinsing, and disinfecting at temperatures high enough to provide at least a high level of disinfection. This results in a “not touch” system in which the potential for injury during instrument processing is greatly reduced.

Figure 10-3.—Contaminated Instrument Pack Placed at the Entrance of the Receiving Area in the CSR

Figure 10-4.—Loading an Automated Washer

Ultrasonic Cleaning

This process is safer and more effective than manual scrubbing. The ultrasonic cleaner eliminates the possibility of accidental puncture wounds on the hands that frequently occur with manual scrubbing. It also eliminates the splatter of organism-laden debris generated by scrubbing with a brush. The ultrasonic cleaner uses electrical energy to generate sound waves. When the sound waves travel through the liquid, millions of tiny bubbles form and burst continuously. This process is called a "cavitation" effect. The bursting bubbles scrub everywhere the liquid can penetrate. Intricate surfaces and difficult access areas, such as burs, endodontic files, serrated instrument handles, and hinged instruments are cleaned more thoroughly and rapidly. The usage life of cutting instruments, such as burs and endodontic files, is extended by thoroughly removing debris that interferes with the cutting surfaces.

There are several sizes of ultrasonic cleaning units. Figure 10-5 illustrates small and large size ultrasonic cleaners.

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The following general guidelines are common to the proper use of all ultrasonic cleaners:

- Always keep the ultrasonic cleaner reservoir 1/2 to 3/4 full with ultrasonic solution at all times
- The solution must completely cover the items for the ultrasonic action to occur
- Avoid the use of disinfectants, plain water, and non-ultrasonic soaps or detergents
- Cleaning solutions must be changed at least daily or sooner, if visibly contaminated

When using the ultrasonic cleaner follow these guidelines:

- Place instruments into a perforated or wire mesh basket and rinse under water first
- Place basket holding the instruments into the ultrasonic cleaner unit filled with solution
- Never place items directly on the bottom of tanks. This would reduce the amount of ultrasonic waves produced and could damage the unit
- Always close the lid or cover on the unit when in use to decrease aerosols and avoid splattering of the solution onto adjacent surfaces
- Limit ultrasonic cleaning time to 5 minutes to avoid damage to instruments. Follow manufacturer’s instructions for exact cleaning times for different models

NOTE:

**Longer** cleaning times may be required for some nonmetallic instrument cassettes.

**Never** use a hand to remove instruments from the unit. Instead, use the basket to lift the instruments from the solution, drain, and rinse them under running water.

**Be sure** to rinse the instruments thoroughly to remove all the remaining solution.

**Inspect** the instruments for remaining blood or debris, and then dry thoroughly.
Manual Scrubbing

Although manual scrubbing is time consuming and presents an increased potential for contamination injury, this method is effective for cleaning instruments when automated washer processors or ultrasonic cleaning units are not available. Triple-sink modules allow personnel to perform in an orderly sequence multiple functions such as pre-rinsing, soaking, washing, and final rinsing. While wearing heavy-duty utility gloves, face mask, plastic apron, and eye protection, place instruments in a disinfecting solution, allow them to soak, and then scrub them under water to avoid generating splatter.

PRE-STERILIZATION PROCESSING

LEARNING OBJECTIVES:

- Identify the steps in pre-sterilization processing.
- Identify methods of sterilization.
- Identify types of sterilizers.

The HM is still in the processing area of the CSR and has just finished cleaning the instruments using one of the three methods of cleaning discussed previously and letting them dry as shown in Figure 10-6.

Perform the following procedures in the sterilization process next.

Inspection and Sorting of Instruments

After drying, the HM must inspect items closely for wear, breakage, and cleanliness. Sort instruments according to sets or packs. This is the pre-staging area where the instruments are sorted before wrapping and packaging.

Wrapping and Packaging

Wrapping and packaging is the last step just before the sterilization process. Many different types of sterilizers, packaging, and wrapping materials are used in the CSR.

Ensure to place consumable supplies that are required by the command in each particular pack before wrapping such items as needles, cotton rolls and pellets, gauze, aluminum foil for dental light handles, internal indicators, and towels.

Instruments are usually placed in packs, on metal trays or perforated cassettes, before placing them into the sterilizer. The most common wrapping materials and containers are paper, paper/plastic, nylon tubing, and cloth.

Wash rubber tubing in an antiseptic detergent solution. Pay attention to the inside of the tubing. Rinse all tubing well and place it flat or loosely coiled in a wrapper or container.

When packing latex surgical drains for sterilization, place a piece of gauze in the lumen of the tray.

- Never resterilize surgical drains
- Never resterilize rubber catheters bearing a disposable label
- Never resterilize surgical disposable (rubber) gloves

NOTE:
These gloves are for one-time use only.
Do not place surgical knife blades or suture materials inside linen packs or on instrument trays before sterilization.

Modern manufacturing processes make all suture materials available in individual packages, pre-sterilized, with or without a surgical needle attached. Once opened, do not resterilize either the individual package or an individual strand of suture material.

**NOTE:**
The only exception to this rule involves the use of surgical stainless steel. This material is often provided in unsterile packages or tubes. Individual strands or entire packages of surgical stainless steel must be sterilized before use.

Paper materials are available in the form of bags or flat disposable wraps. Both types are sealed with adhesive indicator tape. The combination paper/plastic peel packs (Fig. 10-7) are available in varied sizes of preformed bags or rolls of varied widths that can be cut to the desired length. Either type can be sealed with the adhesive indicator tape or self-sealed.

![Paper/Plastic Peel Packs](image)

**Figure 10-7.—Paper/Plastic Peel Packs**

The packaging or wrapping materials that the HM selects depends on the compatibility of what type of sterilization packaging materials and their suitability to withstand steam or dry heat sterilization. Always refer to the sterilizer manufacturer’s instructions for suitability.

Heat sealed plastic or nylon tubing should only be used as an overwrap after the pack has been sterilized. Heat sealed overwrapping will extend a 30 day shelf life to 180 days.

The practical use of some semi-critical items may preclude wrapping or packing. Basic guidance in proper wrapping techniques includes the following:

- Using trays or cassettes to reduce the possibility of puncturing the wrapping material and risk of injury during post-treatment handling
- Wrapping loosely to allow steam to circulate freely throughout the pack
- Arrange items so that all surfaces receive direct exposure to the sterilization agent
- Opening all hinged instruments during packaging to allow steam to penetrate these areas

**NOTE:**
The uses of muslin wraps are discouraged.

- Cloth and nonwoven wraps are sealed with external indicator tape. The indicator tape will change color if exposed to the sterilization elements
- When wrapping instrument packs with indicator tape, always turn the tabs down on the tape. This provides a folded edge to aid in opening the package and removing the tape
- Launder muslin towels after each use and inspect for tears or pinholes
- Follow the manufacturer’s time and temperature settings on sterilizers for the types of wrapping material used
- Using internal and external chemical indicators or multi-parameter integrators (measures temperature, steam, and time) ensure sterilization is achieved
Expiration Dates

After the packs, instruments, and supplies are wrapped or placed into containers and sealed, they must be labeled with the identification number of the sterilizer, the preparer’s initials, the dates of sterilization and expiration before they are placed in the sterilizer. To label, use an ink marker, preprinted indicator tape, or a marking device that won’t run or fade when exposed to sterilization.

The shelf life or expiration date of sterilized items is the period during which an item is considered safe for use. Shelf life can be time-related or event-related. The command’s ICO will determine what method the sterilization program will use.

Time-Related

Time-related shelf life is identified with an exact expiration date. After this date, the item is considered to be outdated and should not be used. Table 10-3 lists the different wrapping methods and their time-related shelf life in accordance with BUMEDINST 6600.10 series.

<table>
<thead>
<tr>
<th>WRAPPING METHOD</th>
<th>TIME-RELATED SHELF LIFE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper envelope (sealed with sterilization tape)</td>
<td>365 days</td>
</tr>
<tr>
<td>Nonwoven blue wrap</td>
<td>30 days</td>
</tr>
<tr>
<td>Nonwoven blue wrap, plastic covered, heat-sealed</td>
<td>365 days</td>
</tr>
<tr>
<td>Peel plastic packs, heat-sealed or self-sealed</td>
<td>365 days</td>
</tr>
<tr>
<td>Parchment paper or Dennison wrap</td>
<td>30 days</td>
</tr>
<tr>
<td>Glass test tubes with screw caps</td>
<td>Indefinite</td>
</tr>
</tbody>
</table>

Table 10-3.—Time-Related Shelf Life of Sterilized Items

Event-Related Shelf Life

The use of the event-related method presumes continued sterility until the package is damaged, wet, or torn. It is a well-recognized standard for items in good quality, self-sealed or hermetically (airtight) sealed, packaged in paper or plastic, or sequentially-wrapped and sealed in dust covers within a few hours after sterilization. If this method is used, the command policy must be clearly defined and consistently used throughout the healthcare facility. When using the event-related method, all sterilizers must be biologically monitored at least weekly.

Sterile Storage

Sterility of materials, instruments, and supplies is much harder to maintain than it is to achieve. There is little value in precise sterilization procedures if instruments are contaminated upon completion of the process. Items must be dry before they are handled or stored. The time required for drying depends on the type of packs in the load and the sterilizing agent used. Freshly sterilized items are never placed on metal or cold surfaces. Packages become damp from the condensation that occurs and become contaminated.

All sterile supplies, including sterile reusable dental items, must be stored in a manner that will preserve their sterility until used. The following factors affect this process:

- Environmental conditions including cleanliness, proper ventilation, and control of excess heat and humidity are important
- The location where sterile supplies are stored should not be in a manner that may contribute to the increased possibility of contamination
- Sterile items should not be stored with items not intended for clinical use (e.g., office and cleaning supplies)
- Items must not be stored on the deck, under sinks, in window sills, adjacent to heating and air conditioning vents, or in any area where undetected contamination may occur
Figure 10-8 shows an acceptable sterile storage cabinet containing sterilized packs and instruments. Sterile items should not be stored in patient treatment or decontamination areas unless they are protected by enclosures, such as drawers or cabinets.

When storing sterilized items, arrange them according to expiration date; place items with later dates toward the rear. Check supplies periodically to determine any need for resterilizing. Items must be resterilized if the wrapper becomes wet, if the pack touches the deck, if there is any question of contamination, or if the safe storage period has expired.

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**STERILIZATION METHODS**

**LEARNING OBJECTIVES:**

*Identify methods of sterilization.*

*Identify types of sterilizers.*

*Identify the three forms of sterilization monitoring.*

*Identify when and how biological monitoring is done.*

The composition of many of the items used in healthcare is unique and no single sterilization method is suitable for all healthcare items. A HM will need to know several approved methods of sterilization.

**Methods of Sterilization**

Sterilization refers to the complete destruction of all living organisms, including bacterial spores and viruses. The word "sterile" means free from or the absence of all living organisms; any item to be sterilized must be thoroughly cleaned mechanically or by hand, using soap or detergent and water. When cleaning by hand, apply friction to the item using a brush. After cleaning, thoroughly rinse the item with clean, running water before sterilization. The appropriate sterilization method is determined according to how the item will be used, the material from which the item is made, and the sterilization methods available. The physical methods of sterilization are moist heat under pressure and dry heat. Chemical methods include gas and liquid solutions.
Physical Methods

Steam under pressure (autoclave) is the most dependable and economical method of sterilization. It is the method of choice for metalware, glassware, most rubber goods, and dry goods. All articles must be correctly wrapped or packaged so that steam will come in contact with all surfaces of the article. To effectively sterilize items using saturated steam, the temperature of the steam throughout the load must be high enough to destroy the most resistant micro-organisms in the time allotted for sterilization. Similar items should be sterilized together, especially those requiring the same time and temperature exposure. Articles that will collect water must be placed so that the water will drain out of the article during the sterilization cycle.

A sterilizer should be loaded in a manner that will allow the free flow of steam in and around all articles. Each item sterilized must be dated with the expiration of sterility. Sterilization indicators must be used in each load that is put through the sterilization process. This verifies proper steam and temperature penetration.

The operating procedures for a steam sterilizer will vary according to the type and manufacturer. There are a number of manufacturers, but there are only two types of steam-under-pressure sterilizers. Steam sterilizers are available in many sizes, ranging from portable countertop to the fixed room-size sterilizer. Two of the most common types of steam sterilizers used in the Navy are the downward displacement (gravity) and pre-vacuum, high-temperature sterilizers.

Downward Displacement Autoclave

In the downward (gravity) displacement autoclave, air in the chamber is forced downward from the top of the chamber. The temperature in the sterilizer gradually increases as the steam heats the chamber and its contents (Fig. 10-9). The actual timing does not begin until the temperature is above 245°F (118°C).

You should observe the following precautions when loading the sterilizer chamber:

- **Do not overload.** The passage of steam from the top of the chamber to the bottom should not be blocked
- Place all packages on edges, with large packs at the bottom of the chamber, and small packages in an upper layer crosswise to the lower layer. This allows free passage of steam
- If mixed loads of metal items and linen are sterilized together, the linen is placed on the upper shelf and the metal items on the lower
- Articles that require the same amount of time and the same final steps should be sterilized together
- Enclosed fluids are sterilized separately because the pressure must be slowly released
- Load all packages at the same time when they are ready to be sterilized

A standard operation chart for the correct exposure period of all supplies should be prepared and posted for easy reference. It is important to note that sterilizing conditions are based on temperature rather than on pressure.
Effective steam sterilization and exposure time are measured from the moment the thermometer in the discharge line indicates the desired preset temperature. The pressure inside the sterilizer is not an indication of positive sterilization because other factors determine the pressure inside the sterilizer. Pressure merely maintains temperature.

**Prevacuum, High-temperature Autoclave**

The prevacuum, high-temperature autoclave is the most modern and economical to operate and requires the least time to sterilize a single load. By use of a vacuum pump, air is extracted from the chamber before admitting steam. The prevacuum steam sterilizer (Fig. 10-10) was designed to help overcome the trapping of air in the chamber.

**Figure 10-10.—Prevacuum Steam Sterilizer**

Trapping of air is one of the greatest dangers encountered when using saturated steam under gravity cycles. When errors are made by improperly packaging items or overloading the sterilizer chamber, cool air pockets may form resulting in items not being sterilized. This prevacuum process permits instant steam penetration to all articles and through all cotton or linen dry goods. Full heating of the loads is faster in the prevacuum sterilizer than in the gravity displacement sterilizer.

Some spores can withstand temperatures above the normal boiling point of water (212°F or 100°C); the relationship of temperature to spore killing power is critical. Steam temperature and exposure time, not pressure, are crucial components of this process. Pressure is used only to raise the temperature of the steam and, in itself, has nothing to do with microbial killing action. At 15 pounds per square inch (psi), the boiling point increases to 121°C (250°F), a temperature at which all known organisms are killed.

**Sterilizing Times**

If the temperature is increased, the sterilization time may be decreased. The following are some practical sterilization time periods.

- 250°F (121°C): 30 Min
- 273°F (134°C): 10 Min

All operating rooms are equipped with high-speed (flash) sterilizers. Wrapped, covered, opened instruments placed in perforated trays are "flash" sterilized for 3 minutes at 270°F (132°C). Sterilization timing begins when the above temperature is reached, not before.

**Bowie-Dick Test**

The Bowie-Dick type test was developed for prevacuum sterilizers to determine if the air has been removed from the chamber during the prevacuum stage. Air must be removed so that steam can penetrate the load instantaneously. It must be understood that this is not a test for adequate exposure to heat in terms of time-at-temperature. A commercially prepared Bowie-Dick type test can be used by carefully reading and following the manufacturer’s instructions. All Navy prevacuum sterilizers will be tested daily using the Bowie-Dick type test.
Level One Maintenance

The interior of the steam sterilizer should be cleaned each day before being heated. This simple procedure can easily be accomplished by using a mild detergent to wash the surfaces. Follow the wash with a thorough rinse of plain water. Unless this is done, the chamber walls will collect mineral deposits and may become greasy.

Do not use wire brushes, steel wool, or any type of abrasive cleaning compounds on the sterilizer. The manufacturer’s directions must be followed to maintain a properly functioning sterilizer. If the sterilizer does not appear to function properly, Bio-Medical repair technicians should check it at once. Sterilizers should be spot checked frequently for leaks in lines and improperly functioning gauges, dials, thermometers, doors, drain strainers, and valves.

Dry-Heat Sterilization

The dry-heat sterilizer (Fig. 10-11) operates by heating up air and transferring that heated air into the chamber with the instruments. The dry heat sterilizer is the least expensive forms of heat sterilization. The use of dry heat as a sterilizing agent has limitations. It should be restricted to items that are unsuitable for exposure to moist heat like metal instruments that rust or dull in the presence of water vapor.

![Figure 10-11.—Dry Heat Sterilizer](image)

A disadvantage is that the high temperatures destroy many rubber and plastic based materials, melt the solder of most metal impression trays, and weaken some fabrics, as well as discolor other fabrics and paper materials.

High temperatures and extended time periods are required when using dry heat. In most instances, this method often proves impractical. The temperature must be 320°F to 375°F (160°C-190°C), and the time period depends on the manufacturer’s instructions. A typical dry heat cycle is 90 minutes at 320-345°F, plus the time required to preheat the chamber before beginning the sterilization cycle. A common misuse of the dry heat method occurs when the oven door is opened, and an instrument is quickly removed during the timed cycle. This interrupts the cycle and timing must begin all over again. Biological monitoring will be performed weekly. Consult the manufacturer’s instructions of each type of dry heat sterilizer for specific details on its operation and user maintenance.

Chemical Vapor Sterilization

This process uses a mixture of chemicals, including alcohol, formaldehyde, ketone, acetone, and water, that are heated under pressure to form a sterilizing gas. Sterilization requires 20-40 minutes at 270°F with 20 psi when instruments are either unwrapped or bagged following the manufacturer’s instructions.

Advantages to chemical vapor sterilization are as follows:

- No corrosion, rusting, and dulling of instruments since water content is only 15 percent (if instruments are dry when placed in chamber)
- Prevents destruction of dental items such as endodontic files, orthodontic pliers, wires and bands, burs, and carbon steel instruments
- Instruments are dry at the end of the cycle
The major disadvantage of this sterilization method is the requirement for adequate ventilation. Chemical vapors, particularly formaldehyde, can be released when the chamber door is opened, leaving a temporary but unpleasant odor in the area. Chemical vapor sterilization is not routinely used in Navy dentistry. Consult the manufacturer’s instructions for specific details on operation and required user maintenance.

**STERRAD STERILIZATION PROCEDURE**

Sterilization using plasma state hydrogen peroxide (Fig. 10-12) will be accomplished for those products unable to withstand steam sterilization parameters and have been approved, in writing, for sterilization by this method by the medical device manufacturer.

**Preliminary Requirements**

Power will remain on continuously in the ready mode.

- Processing will be restricted to items approved for Sterrad that cannot be sterilized by steam
- Items must be properly cleaned, dried and packaged according to the manufacturer’s guidelines
- No absorbable materials such as cellulose, foam, or linen may be placed inside the Sterrad
- Follow restrictions on items with lumens
- Trays will be placed flat on the sterilizer rack. They should not come in contact with the sides of the chamber
- Wrapping Materials
  - Approved peel packs with plastic and tyvek backing
  - Polypropylene materials must be used to wrap trays
  - Approved containerized systems
- Peel packs will be placed on their sides in a tray or resting against a tray
Operating Cycle

- **Vacuum Stage:** Removes air molecules and lowers chamber pressure
- **Injection Stage:** Introduces hydrogen peroxide into the chamber
- **Diffusion Stage:** Hydrogen peroxide vapor to penetrate packages
- **Plasma Stage:** A radio frequency creates the electromagnetic field that converts the hydrogen peroxide into low temperature gas plasma
- **Vent Stage:** Permits air into the chamber to return to atmospheric pressure

At the end of a cycle, an alarm will indicate the completion of the process
- Verify proper parameters have been met
- Sign printout

Cassette

- Each cassette holds ten (10) cells. At the end of each cycle the printout will indicate how many cells remain
- After ten (10) cycles the printout message will read “insert new cassette”. It will also be displayed on the LED message screen
- Empty cassette falls into retrieval box
- Inspect new cassette before starting a new cycle

Biological Indicator Test

- A biological test pack will be placed on top of an instrument set and placed on the bottom shelf to the rear of the chamber with each load
- At the completion of the cycle, the test pack will be removed and processed according to manufacturer’s recommendation to include the use of Bacillus Subtilis var. niger biological control
- After 48 hours, the results will be documented in the sterilization records and included in the monthly report to the Infection Control Officer
- Sterrad sterilization records are stored for 36 months

Safety Issues for Aborted Cycles

Follow the safety precautions when unloading incomplete cycles. Refer to the guidelines provided by the sterilizer manufacturer. PPE such as gloves may be required.

Ethylene Oxide Sterilization

Ethylene oxide (ETO) gas uses relatively low temperatures for sterilization. Using a heated unit, sterilization can be achieved in 4-12 hours at 120°F. However, a lengthy aeration time of at least 16 hours must follow each cycle.

Materials such as suction tubing, hand pieces, radiographic film holders, and prosthetic appliances may be sterilized without adverse effects. Follow the manufacturer’s instructions for safety precautions, operation, and maintenance. Because of the serious Occupation Safety Health Agency (OSHA) problems with ETO gas, Healthcare facilities should not purchase new ETO equipment.
Chemical Sterilization

Only one liquid chemical, if properly used, is capable of rendering an item sterile. That chemical is glutaraldehyde. The item to be sterilized must be totally submerged in the glutaraldehyde solution for 10 hours. *Anything shorter than 10 hours is disinfection.* Before immersion, the item must be thoroughly cleansed and rinsed with sterile water or sterile normal saline. It should be noted that this chemical is extremely caustic to skin, mucous membranes, and other tissues.

CRITICAL CATEGORY ITEMS REQUIRING STERILIZATION

All critical category items require sterilization. It also lists methods that are effective and acceptable, effective but risk damage, and ineffective with risk of damage to materials. Sterilize critical category items before turning them in for service or repair.

Following BUMEDINST 6600.10 series, sterilize critical category items as follows:

**Surgical instruments**

Effective and preferred methods of sterilization are the steam autoclave, dry heat oven, chemical vapor, or ethylene oxide.

**Hand pieces**

Hand pieces include: low-speed motor attachments, sonic scaler, and tips. Follow manufacturer’s instructions for the cleaning of the fiber optic bundle.

**Burs and diamonds**

Clean burs and diamonds and dry them before sterilizing. Many burs and diamonds are used only for single patient use. One accepted method of sterilization for burs and diamonds are to place them in a screw cap glass test tube or aluminum foil wrapped bur block and dry heat sterilize for 90 minutes at 320-345°F. Place a chemical indicator in each tube or wrapped bur block. At least weekly, place a biological monitor in one tube or foil wrapped block during the first load of the day; retrieve and send for culture testing following the manufacturer’s recommendations.

**Endodontic files and Gates-Glidden burs**

Arrange sets in file blocks and seal in peel packs before autoclaving. When additional files or burs are necessary, take them from a new package or from a file storage box and sterilize them in a bead or salt sterilizer before use.

**STERILIZATION MONITORING**

**LEARNING OBJECTIVES:**

*Identify the three forms of sterilization monitoring.*

*Identify when and how biological monitoring is done.*

Any number of factors can reduce the effectiveness of sterilizers. Overloading and improper wrapping can prevent adequate penetration into the instrument surface. Improper timing, temperature variations, worn gaskets and seals, and sterilizer malfunctions can prevent sterilization. Heat sterilization methods are generally reliable and effective. Nevertheless, regular monitoring of sterilization cycles is necessary to detect inadequate process conditions caused by human error or equipment malfunction.

**Types of Sterilization Monitors**

Commands should base selection of sterilization monitors on reliability, appropriateness to the process, safety, and cost effectiveness. Many types of monitors are available. The three most commonly used sterilization monitors in the Navy are physical, chemical, and biological monitors.
Physical Monitoring

Physical monitoring involves looking at the gauges and readings on the sterilizer and recording the temperatures, pressure, and exposure time.

Chemical Monitoring

Chemical monitoring (internal and external) involves the use of a heat-sensitive chemical that changes color when exposed to certain conditions.

Internal Indicators

Internal indicators are chemical dyes that change color when exposed to steam, dry heat, or chemical vapor for a specified period of time. When placed inside an instrument pack, they determine whether the conditions necessary for sterilization have been met (Fig. 10-13).

External Indicators

External indicators are chemical dyes that change color upon short exposure to sterilizing conditions. They are generally printed on packaging materials or supplied in tape form and are necessary to distinguish processed packages from those that have not been cycled (Fig. 10-14). External indicators are not sensitive enough to be processed as an internal indicator and should not be used.

Figure 10-13.—Internal Indicator

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Figure 10-14.—A: Unprocessed Instruments; B: Wrapped Instruments After Processing

Image reprinted with permission from:
Guidelines for Internal and External Indicators

Use internal indicators inside and external indicators on the outside of each instrument pack. When using glass test tubes during dry heat sterilization, ensure an internal indicator is in each test tube before the screw top is secured. When any indicator of a load test pack fails, sterilize it with a new test pack containing both chemical and biological monitors. Be sure to closely monitor the temperature, pressure, and sterilizing time of the load. Watch the timer to be sure it does not start before the correct temperature is reached. Watch for steam leaks from the sterilizer during the sterilization cycle. If the indicator again fails, notify the ICO and biomedical repair personnel. Log in the results from the failure and secure the sterilizer from use until the results of the biological monitor can be evaluated.

Follow the manufacturer’s instructions when reading the indicators. Please be aware that internal and external indicators are not replacements for biological monitoring. Only biological monitoring can tell the HM whether or not sterilization has actually occurred.

Biological Monitoring

*Biological monitors* are designed to assess whether sterilization actually occurred and to confirm that all bacteria and endospores have been killed. The Centers for Disease Control and Prevention (CDC), the ADA, and the Organization for Safety and Asepsis Procedures (OSAP) recommend at least weekly but preferably daily monitoring.

After endospore tests are processed through a sterilization cycle, they must be incubated (Fig. 10-15) according to the manufacturer’s instructions. A pH indicator in the medium changes color when the ampules of endospores germinate and produce acids. This visually identifies a failure in the sterilization process.

Test Procedure

The biological monitoring systems are designed for specific sterilization methods, the HM must be sure to use a system compatible with the sterilization method used. The following test procedures should be used to ensure effectiveness of the sterilization process:

- The use of a “test pack” is most practical while processing an instrument pack
- Biological spore strips or ampules should be placed between several layers of folded wrapping material, and then the test pack is double-wrapped in the normal manner. Always follow the biological monitor manufacturer’s directions for the placement of the test pack within the sterilizer
- As a general rule, the biological spore strips or ampules should be placed within an area of the sterilizer that is least accessible to the sterilizing agent that is being used
- If using steam under pressure sterilizers, place the test pack in the lower front of the sterilization chamber
- If using tabletop units, place the test pack in the center of the load

**NOTE:**
For each test, use an unprocessed monitor for a control.
Evaluation Criteria

After the completion of the sterilization cycle, open the test pack, and evaluate the dosage indicator to see if it passes or fails the cycle. If it passes, the HM can distribute the sterile goods and continue the biological test procedure. If it fails, follow the procedures under guidelines for internal and external indicators.

Positive Results

When positive biological monitoring occurs, the HM must follow these guidelines:

- Notify the ICO and record the test results in the sterilization log
- If another sterilizer is available, perform the following actions:
  - Retrieve and sterilize all items sterilized since the last negative test of that sterilizer tested positive
  - Process a test pack with both a chemical and biological monitor and secure the sterilizer from further use until the results of the biological and chemical tests are read
- If the results of the biological and chemical tests indicate negative growth or pass the sterilization test, the sterilizer can be placed into service.
- If the results from the test still indicate positive growth or failure of sterilization, the sterilizer must be secured and biomedical repair personnel notified.

If another sterilizer is not available, perform the following actions:

- Notify biomedical repair technicians
- Retrieve and sterilize all items processed since the last negative test. Use a test pack with a biological and chemical monitor in each load when resterilizing all items that came up positive from the last test

If a chemical monitor in the test pack indicates a pass of the sterilization test, these loads can be distributed if necessary. The ideal situation is to have adequate instruments and equipment to be able to hold these items for 48 hours after a negative biological test and then distribute.

If the biological test again fails, complete the following items:

- Secure the sterilizer
- Notify biomedical repair technicians and the ICO
- Make a narrative entry in the log of each action taken and the results as they occur
- Retest the sterilizer using biological monitors
- Confirm exposure of the biological monitor to sterilization process
- Review the sterilization log for recent repairs or maintenance

SUMMARY

As healthcare team members in treatment facilities HMs must understand the importance of proper disinfection and sterilization methods. Most importantly they need to maintain the highest level of safety for both patients and the healthcare team. As a healthcare team member the HM is legally and ethically responsible for performing the procedures described in this chapter in a thorough and careful manner. Proper instrument processing is necessary to prevent the transfer of microorganisms from a previous patient to the next patient or to the HM.
CHAPTER 11

FUNDAMENTALS OF PATIENT CARE

INTRODUCTION

Twenty-first century advances in the medical and technical sciences are having a significant impact on the delivery of quality healthcare services. Today’s patients have a greater expectation of their healthcare options and a strong desire to be informed about both their healthcare needs and the spectrum of healthcare systems available.

The goal of this chapter is to give Hospital Corpsmen (HMs) the basic theories concerning the multidisciplinary aspects of patient care. This chapter is an introduction to some of the critical concepts of providing care to individuals seeking healthcare services.

HEALTH AND WELLNESS

LEARNING OBJECTIVE:

Describe the concepts of health and wellness.

To intelligently and skillfully discharge the HM’s duties as a member of the Navy Medical Department healthcare team, the HM must first gain an understanding of the concepts of health and wellness.

The concept of “health” refers to the mental, physical, and emotional state of being which enables the proper performance of one’s vital functions. Where health is considered to be the absence of disease or disability, “wellness” is considered a state of soundness of mind, body, and spirit free of pain or discomfort.

When individuals need assistance with maintaining their health and wellness, or coping with problems related to their health and wellness, they turn to healthcare professionals.

Comprised of many professionals including Hospital Corpsmen, the Navy’s healthcare team has one common objective: to respond to those healthcare needs by assisting the patient in maintaining, restoring, rehabilitating, and then sustaining the physical or psychological well being of the patient.

THE PATIENT

LEARNING OBJECTIVE:

Explain the components of the Patient’s Bill of Rights and Responsibilities.

The patient is the most important part of Navy Medicine’s healthcare team; without them the healthcare team has little reason for existence. Navy Medicine has increasingly emphasized the importance of excellence in customer relations with the ultimate goal of putting the patient at the center of all healthcare decisions. This is done by respecting the patient’s active participation and capitalizing on the patient’s support system in order to meet the patient’s treatment goals.

HMs are tasked with providing every patient committed to their charge with the best care possible. This care must reflect the HM’s belief in the value and dignity of every person as an individual. The HM must understand the patient’s rights and responsibilities as they apply to providing and receiving healthcare services.

The Joint Commission (TJC) has developed standards addressing the rights and responsibilities of patients. The goal of TJC is to promote excellence in providing healthcare services.
This goal is compatible with those of the Navy Medical Department. HMs seeking additional detailed information about patient rights and responsibilities should refer to the Patient’s Bill of Rights and Responsibilities found in BUMEDINST 6300.10 series, Chapter 3 “Healthcare Administration,” and the Comprehensive Accreditation Manual for Hospitals: The Official Handbook (CAMH) published by TJC annually. The next two sections discuss the professional practice and ethical behavior of HMs in relation to the patient and the healthcare team which directly affect meeting the patient’s rights.

PROFESSIONAL PRACTICE

LEARNING OBJECTIVE:

Identify key elements of professional practice.

Each member of the healthcare team has specific responsibilities and limitations defined by the scope of practice. To fulfill the role as a member of the Hospital Corps within the context of the total mission of the Navy Medical Department, it is imperative the HM’s performance of healthcare services be based on a sound body of knowledge and the development of well-defined technical skills. This rate training manual (TRAMAN) contributes to the development of the HM’s body of knowledge. The HM occupational standards (NAVPERS 18068 series, Chapters 40 and 41) define minimal technical skills required of a Hospital Corpsman. As a member of the healthcare team the mechanisms of on-the-job training, in-service classes, and continuing education programs significantly contribute to the HM’s continued growth in both healthcare knowledge and skills.

HMs must always be conscious of being seen as representatives of Navy Medicine. As such, they will be accorded the respect that goes with having a specialized body of knowledge and an inventory of unique skills.

The Caduceus insignia of the HM marks the person as a member of a prestigious Corps worthy of respect.

PROFESSIONAL LIMITATIONS

In conjunction with their professional responsibilities, all healthcare providers must realize they are subject to certain limitations in providing healthcare services. These limitations are referred to as standards of practice which are based on local regulations and guidelines, as well as, the education, training, and experience possessed by the healthcare provider. The mature, responsible individual recognizes, accepts, and demands these limitations be respected.

In clinical settings, HMs are tasked with administering medication, performing treatments, and providing individual patient care in compliance with the orders of the senior healthcare provider. In the hospital and some clinical environments, a Nurse Corps officer divides and delegates portions of the patient’s care to other members of the team based on the skills and experiences of each member. In other situations such delegation of duties may be made by that unit’s Senior Medical Department Representative (SMDR), usually an experienced Chief or Senior Chief Petty Officer of the Hospital Corps.

ACCOUNTABILITY

Regardless of rank, or rate, all members of the healthcare team are held accountable for their performance. Being accountable means the HM is held responsible for actions taken. As a healthcare provider, the HM should continue to acquire new knowledge, skills and clinical competencies striving to provide the best healthcare services possible. Malpractice occurs when an individual delivers improper care because of negligence or practicing outside of the standard of practice.
Accountability becomes a critical issue when determining issues of malpractice. Areas of expertise and medical duties often overlap within the healthcare team; legal limits of practice are defined in each state by certifications or qualifications.

The medical assignments and duties of HMs frequently include areas of practice usually performed by physicians and nurses. HMs are governed legally by Navy Regulations and BUMED policies and can only perform those assignments and duties while under the authority and direction of the United States Government. Due to this legal requirement, it is vital HMs thoroughly understand the legal rights and limitations when providing patient care services in military and civilian environments.

PATIENT ADVICE

Another area with medical and legal implications regarding the HM’s role as a healthcare provider is giving advice or opinions. As a result of the frequent and close contact with patients, HMs will often be asked an opinion of the care or the proposed care the patient maybe undergoing. These questions are extremely difficult to respond to, regardless of who the healthcare provider is. No one is ever totally prepared or has so much wisdom to intelligently respond in a spontaneous fashion in these situations. It is best to refer the question to the nurse or physician responsible for the patient’s care.

PATIENT BEHAVIOR

When something is threatening the soundness of the body, mind, or spirit or that of a loved one, an individual may behave inappropriately. Occasionally, there are temper outbursts, sarcastic remarks, unreasonable demands, or other inappropriate responses, often to the point of disruptive behavior. The healthcare providers are challenged to look beyond the behavior being displayed to identify the underlying stress and to attempt to relieve the immediate and obvious source of anxiety.

HMs have been charged to provide healthcare services to any human being with the same needs for compassion, safety, security and respect, as everyone else.

PROFESSIONAL ETHICS

LEARNING OBJECTIVE:

Identify elements of professional ethics.

Ethics refers to a system of moral principles or standards of conduct which govern the appropriate conduct for a person, group, or profession. The HM’s indoctrination into the military included an introduction to the Code of the U.S. Fighting Forces. This code of conduct is an ethical guide charging the HM with high standards of general behavior as a member of the Armed Forces.

All professional interactions must be directly related to codes of behavior which support the principles of justice, equality of human beings as persons, and respect for the dignity of human beings. Upholding medical ethics is the responsibility of all HMs. Upon completion of Hospital Corpsman Basic School, HMs take the following pledge:

I solemnly pledge myself before God and these witnesses to practice faithfully all of my duties as a member of the Hospital Corps. I hold the care of the sick and injured to be a privilege and a sacred trust and will assist the Medical Department Officer with loyalty and honesty. I will not knowingly permit harm to come to any patient. I will not partake of nor administer any unauthorized medication. I will hold all personal matters pertaining to the private lives of patients in strict confidence. I dedicate my heart, mind, and strength to the work before me. I shall do all within my power to show in myself an example of all that is honorable and good throughout my naval career.
This pledge morally binds HMs to certain responsibilities and rules included in the science of medical ethics. Ethics enable the HM to judge accurately the moral rightness and wrongness of actions. The one element making healthcare ethics different from general ethics is the inclusion of the moral rule, "Do your duty." This statement is a moral rule because it involves certain expectations (e.g., of confidentiality). Failure to fulfill these expectations may cause harm to the patients and/or colleagues. Through the Hospital Corpsman Pledge, the HM commits to fulfilling certain duties, not only to those entrusted to his/her care, but also to all members of the healthcare team. It is this commitment to service and to mankind that has traditionally distinguished the United States Navy Hospital Corps wherever its members have served.

PERSONAL TRAITS

LEARNING OBJECTIVE:
Describe important personality traits of a healthcare professional.

HMs must develop many personal traits as part of upholding the standards of the Hospital Corps; an understanding of them can be obtained by referring to Military Requirements for Petty Officer Third and Second Class (NAVEDTRA 14504). The following traits, however, apply to Hospital Corps duties and are essential for good performance.

INTEGRITY

Nowhere in the Navy is the need for personal integrity as great as in the Hospital Corps, where HMs deal continually with people, their illnesses, and their personal concerns. The information HMs process in the performance of their duties falls under the category of "privileged communication."

Healthcare team members have no right whatsoever to divulge any personally identifiable information, however trivial, to any unauthorized individuals. Upholding patient confidentiality is essential to the maintenance of personal and professional integrity.

Another important commitment all HMs have is the obligation to never abuse any medications that they have access to or to tolerate abuse by others. These substances are in the department or clinic for use under a medical officer’s supervision for the care of patients. Any other use is not authorized and will not be tolerated.

PERSONAL APPEARANCE

A HM’s appearance can positively or negatively influence the trust and opinions of those individuals who seek out healthcare services. HMs must be very vigilant about upholding the reputation of the Hospital Corps as well as the Navy Medical Department. Excellent personal hygiene, neat hair styles, and spotless, proper uniforms are essential for instilling confidence as competent healthcare providers throughout the world.

INTERPERSONAL RELATIONS

LEARNING OBJECTIVE:
Describe how culture, race, religion, sex, and age can affect interpersonal relations between the patient and their healthcare providers.

As a healthcare provider, it is important for all HMs to develop good "interpersonal relation" skills. In providing total patient care, it is important to see the individual not only as a biological being, but also as a thinking, feeling person. The HM’s commitment to understanding this concept is the key to developing good interpersonal relationships.
Many elements influence the development of how HMs regard and respond to people. In the following section some of these elements will be discussed as to how they apply to the HM’s involvement in the military service and to the relationships with other healthcare providers and the patients.

**CULTURE**

Because of the military mission and the diverse workforce of the Navy Medical Department, HMs will frequently encounter members of various cultures. Culture is defined as a group of socially learned, shared standards and behavior patterns. Concepts such as perceptions, values, beliefs, and goals are examples of shared standards. In addition, apparel, eating habits, and personal hygiene reflect common behavior patterns of specific groups of people. An understanding of common social norms and behavior patterns enhances the quality and often the quantity of service a provider is able to make available. An individual’s cultural background has an effect on every area of healthcare service, ranging from a simple technical procedure to the content and effectiveness of health education activities. Becoming familiar with the beliefs and practices of different cultural (American) and sub-cultural groups (the military community) is not only enriching to the healthcare provider, but also promotes an understanding and acceptance of the various peoples in the world community.

**RACE**

The term race is a classification assigned to a group of people who share inherited physical characteristics. Information identifying racial affiliation can be a valuable asset to the healthcare provider in assessing the patient’s needs, planning and carrying out direct-care activities, and implementing patient education programs. Unfortunately, racial identification also has the potential to create a negative environment in the healthcare setting when factors such as differences in skin color motivate prejudicial and segregation type behaviors. When this is allowed to occur, the environment will feed a multitude of social illnesses and destructive behaviors will develop.

It is a moral and legal responsibility of the healthcare provider to render services with respect for the life and human dignity of the individual without regard to race, creed, gender, political views, or social status. The Navy Medical Department will not tolerate any expressions or actions based on prejudicial attitudes.

**RELIGION**

As a healthcare professional, the HM must be prepared to accept in a nonjudgmental way, the religious or nonreligious beliefs of others regardless of personal beliefs. Patients typically use these beliefs to guide many of their life decisions and turn to them in times of distress. An individual’s religious beliefs frequently help give meaning to suffering and illness; those beliefs may also be helpful in the acceptance of future incapacities or death.

Although the HM may offer religious support when asked and should always provide chaplain referrals when requested or indicated, it is not ethical for the HM to abuse the patients by forcing personal beliefs (or non-beliefs) upon them. The HM must respect the patient’s freedom of choice, offering support for whatever the needs or desires of the patient may be.

**GENDER**

In today’s Navy, HMs will encounter many situations where they are responsible for the care and treatment of service members of the opposite sex. When treating service members of the opposite sex, HMs must always conduct themselves in a professional manner.
To ensure the professional conduct of a healthcare provider is not called into question, the Navy Medical Department provides specific guidelines in BUMEDINST 6320.83 series, Provisions of Standbys During Medical Examinations. Some of the guidelines are as follows:

- A standby must be present when examining or treating a member of the opposite sex. Whether this standby is a member of the same sex as the patient may be dictated by patient request and the availability of personnel. In cases of sexual or domestic assault, the significant other cannot be the standby.

- When caring for a patient, sensitivity to both verbal and nonverbal communication is paramount. A grin, a frown, or an expression of surprise may be misinterpreted by the patient.

- Explanations and reassurances will go far in preventing misunderstandings of actions or intentions.

Knowledge, empathy, and mature judgment guides the care provided to any patient. This is crucial when the care involves touching a patient. As a member of the healthcare team, HMs are responsible for providing complete, quality care to those who need and seek their service. This care must also be provided in a manner compatible with their technical capabilities.

**AGE**

The age of the patient must be considered in performance of patient care. The HM will be responsible for the care of infants, children, adults, and the elderly. Communication techniques and patient interaction may need to be modified because of the age of the patient as age affects various physiological, cognitive, emotional, and psychological elements which may help or hinder care.

**Infants and Children**

Caring for infants and children involves many emotional and physical challenges. Infants can communicate their feelings in a variety of positive and negative ways; they may exhibit their needs by crying, kicking, or grabbing at the affected area of pain. An infant will usually respond quickly and positively to cuddling, rocking, touching, and soothing sounds.

Children may display the same feelings as an adult would when they feel ill; fear, anger, worry, and/or denial and will also need emotional support. Ill children may also display behavior typical for an earlier age. For example, a hospitalized child who has been toilet trained may soil themselves. This is not unusual, and parents should be informed this behavior change is temporary.

While the child is under care in the hospital, the HM is a parent substitute and must gain the child’s confidence and trust. Offer explanations of what is going to be done in ways the child will understand. Using dolls or other play methods may assist in communication, i.e. assessing the doll with a stethoscope and BP cuff prior to assessing the child to ease anxiety and answer questions.

**Elderly**

In providing care for the elderly patient, a healthcare professional must be alert to the patient’s mental and physical capabilities (i.e. physical coordination, mental orientation, and reduced eyesight). Medical management should be modified to accommodate the individual patient’s needs. Give mature patients the opportunity to control as many aspects of their self-care as possible. Allowing patients to self-pace their own care may take more time, but it will result in reducing their feelings of frustration, anger, and resentment. Show genuine respect and warmth with the elderly. The use of overly familiar terms such as “gramps” or "granny" is unprofessional and will be avoided.
Listen to patients and allow them to reminisce if they wish to. There may be a lot to learn from their history and it may even relate to their course of care. Conversation can also be used as a way to bring today’s events into focus for the patient. Remember to involve family members, as needed, into the patient education process. Some elderly patients will require assistance from family members for their continuing medical needs once they return home.

COMMUNICATION SKILLS

LEARNING OBJECTIVE:

**Identify communication techniques used in a healthcare setting.**

Communication is a highly complicated inter-personal process of people relating to each other through conversation, gestures, appearance, behavior, writing, and, at times, even silence. Such communications not only occur among healthcare providers and patients, but also among healthcare providers and support personnel. Support personnel may include housekeeping, maintenance, security, supply, and food service staff. Another critical communication interaction occurs among healthcare providers and visitors. Because of the critical nature of communication in healthcare delivery, it is important the HM understand the communication process and the techniques used to promote open, honest, and effective interactions. Only through effective communication will the HM be able to identify the goals of the individual and the Navy healthcare system.

THE COMMUNICATION PROCESS

The communication process consists of four basic parts: the sender of the message, the message, the receiver of the message, and feedback. The **sender** of the message starts the process. The **message** is the body of information the sender wishes to transmit to the **receiver**. The receiver is the individual intended to receive the message. Feedback is the response given by the receiver to the message. Feedback, at times, is used to validate whether effective communication has taken place.

**Verbal and Nonverbal Communication**

The two basic modes of communication are verbal and nonverbal. Verbal communication is either spoken or written. Verbal communication involves the use of words. Nonverbal communication does not involve the use of words. Dress, gestures, touching, body language, face and eye behavior, and even silence are forms of nonverbal communication. Even though there are two forms of communication, both the verbal and the nonverbal are inseparable in the total communication process. Awareness of this fact is extremely important because the HM’s professional effectiveness is highly dependent upon successful communication.

**Barriers to Effective Communication**

Ineffective communication occurs when obstacles or barriers interfere with the message, transmission, receipt and understanding of the message. These barriers are classified as physiological, physical, or psychosocial. Physiological barriers result from some kind of sensory dysfunction on the part of either the sender or the receiver. Such things as hearing impairments, speech defects, and even vision problems influence the effectiveness of communication. Physical barriers consist of elements in the environment, such as noise, that contribute to the development of physiological barriers (such as the inability to hear).
Psychosocial barriers are usually the result of one’s inaccurate perception of self or others; the presence of some defense mechanism employed to cope with some form of threatening anxiety; or the existence of factors such as age, education, culture, language, nationality, or a multitude of other socioeconomic factors. Psychological barriers are the most difficult to identify and the most common cause of communication failure or breakdown.

An individual’s true feelings are often communicated more accurately through nonverbal communication than through verbal communication.

Listening

Listening is a crucial element of the communication process and one of the primary activities for the healthcare provider, who must use communication as a tool for collecting or giving information. When one is engaged in listening, it is important to direct attention to both the verbal and nonverbal cues provided by the other person. Like many other skills necessary for providing a healthcare service, listening requires conscious effort and constant practice. Listening skills can be improved and enhanced by developing the following attitudes and skills:

- Hear the speaker out
- Focus on ideas
- Remove or manage distractions
- Maintain objectivity
- Concentrate on the immediate interaction

A healthcare provider uses the communication process to service a patient’s needs, both short and long-term. To simplify this discussion, short-term needs will be discussed under the heading of "Patient Contact Point Program." Long-term needs will be discussed under the heading of "Therapeutic Communications."

**PATIENT CONTACT POINT PROGRAM**

To provide a frame of reference for the following section, the following definitions clarify and standardize some critical terms:

- **Initial Contact Point:** The physical location where patients experience their first communication encounter with a person representing, in some role, the healthcare facility
- **Contact Point:** The place or event where the contact point person and the patient meet
- **Contact Point Person:** The healthcare provider in any healthcare experience who is tasked by role and responsibility to provide a service to the patient
- **Patient Contact Point Program:**
  - This program is most commonly known as the Patient Contact Program
  - It is the overarching program facilitating two-way communication with patients so both complaints and complements are documented, tracked, and corrections made to improve the MTF/DTF experience

The contact point person has certain criteria to meet in establishing a good relationship with the patient. Helping the patient through trying experiences is the responsibility of all contact point personnel. Such healthcare providers must not only have skills related to their professional assignment, but they must also have the ability to interact in a positive, meaningful way to communicate concern and the desire to provide a service.

Consumers of healthcare services expect to be treated promptly, courteously, and correctly. They expect their care to be personalized and communicated to them in terms they understand. The Navy healthcare system is a service system, and it is the responsibility of every healthcare provider to give professional, quality customer service. The significance of the contact point and the responsibility of the personnel staffing this area are important to emphasize.
The following message from a former Surgeon General of the Navy reflects the philosophy of the Navy Medical Department regarding contact point interactions.

“Some of the most frequent complaints received by the Commander, Bureau of Medicine and Surgery, are those pertaining to the lack of courtesy, tact, and sympathetic regard for patients and their families exhibited by Medical Department personnel and initial points of contact within Navy Medical facilities. These points of initial patient contact, which include central appointment desks, telephones, patient affairs offices, emergency rooms, pharmacies, laboratories, record offices, information desks, walk-in and specialty clinics, and gate guards, are critical in conveying to the entering patient the sense Navy Medicine is there to help them. The personnel, both military and civilian, who staff these critical areas, are responsible for ensuring the assistance provided is truly reflective of the spirit of "caring" for which the Navy Medical Department must stand.”

No matter how expert the care in the facility may be, an early impression of apathy, disregard, rudeness, or neglect of the patient’s needs reflects poorly on its efforts and achievements. Personnel must be constantly on their guard to refrain from off-hand remarks or jokes in the presence of patients or their families. HMs must insist their actions and attitudes, as well as those of their colleagues and subordinates, are professional at all times and particularly when in patient areas. What may be commonplace to the facility staff may be frightening to a patient or subject to misinterpretation. By example and precept, HMs must respond to each and every complaint in the same manner; providing the best response of which they are capable in dealing with their beneficiaries. No complaint is too trivial not to deserve professional respect and treatment.

THERAPEUTIC COMMUNICATION

A distinguishing aspect of therapeutic communication is its application to long-term communication interactions. Therapeutic communication is defined as the face-to-face process of interacting that focuses on advancing the physical and emotional well-being of a patient. This kind of communication has three general purposes: collecting information to determine illness, assessing and modifying behavior, and providing health education. By using therapeutic communication, the HM attempts to learn as much as possible about the patient in relation to the illness. To accomplish this, both the sender and the receiver must be aware of the confidentiality of the information disclosed and received during the communication process. The HM must have a therapeutic reason for invading a patient’s privacy.

When collecting information, therapeutic communication requires a great deal of sensitivity and expertise in using interviewing skills. The interviewer must carefully observe the patient’s behavior to ensure the identification and a clearer understanding of the thoughts and feelings. Listen to the patient and watch and the response to the interviewer. Observe how the patient gives and receives both verbal and nonverbal communication. Finally, interpret and record the data observed.

Listening is one of the most difficult skills to master. It requires the HM to maintain an open mind, eliminate both internal and external noise and distractions, and channel attention to all verbal and nonverbal messages. Listening involves the ability to recognize pitch and tone of voice, evaluate vocabulary and choice of words, and recognize hesitancy or intensity of speech as part of the total communication attempt. The patient crying aloud for help after a fall is communicating a need for assistance.
The ability to recognize and interpret nonverbal responses depends upon consistent development of observation skills. As the HM continues to mature in the role and responsibilities as a member of the healthcare team, both clinical knowledge and understanding of human behavior will also grow. This growth will contribute to the HM’s ability to recognize and interpret many kinds of nonverbal communication.

The effectiveness of an interview is influenced by the amount of information and the degree of motivation possessed by the patient. Factors enhancing the quality of an interview consist of the participant’s knowledge of the subject under consideration; patience, temperament, and listening skills; and the HM’s attention to both verbal and nonverbal cues. Courtesy, understanding, and nonjudgmental attitudes must be mutual goals of both the interviewer and patient.

To function effectively in the therapeutic communication process, the HM must be an informed and skilled practitioner. Development of the required knowledge and skills is dependent upon the HM’s commitment to seeking out and participating in continuing education learning experiences across the entire spectrum of healthcare services.

**PATIENT EDUCATION**

**LEARNING OBJECTIVE:**

*Describe how patient education affects patient care.*

Patient education is an essential part of the healthcare delivery system. In the Navy Medical Department, patient education is defined as "the process that informs, motivates, and helps people adapt and maintain healthful practices and life styles."

Specifically, the goals of this process are to:

- Assist individuals so they may acquire knowledge and skills that will promote the ability to care for themselves more adequately
- Influence individual attitudinal changes from an orientation emphasizing disease to an orientation emphasizing health
- Support behavioral changes to the extent individuals are willing and able to maintain their health

Healthcare providers tend to be teachers more often than ever expected. Teaching is a unique skill developed through the application of learning principles. Patient teaching begins with an assessment of the patient’s knowledge. Through this assessment learning needs are identified. For example, a diabetic patient may have a need to learn how to self-administer an injection. After the learner’s needs have been established, goals and objectives are developed. Objectives inform the learner of what kind of (learned) behavior is expected. Objectives also assist the healthcare provider in determining how effective the teaching has been. These basic principles of teaching and learning are applicable to all patient-education activities, from the simple procedure of teaching a patient how to measure and record fluid intake/output to the more complex programs of behavior modification in situations of substance abuse (i.e., drug or alcohol) or weight control.

As a member of the healthcare team, the HM shares a responsibility with all other team members to be alert to patient education needs, to undertake patient teaching within the limitation of knowledge and skills, and to communicate to other team members the need for patient education in areas the HM is not personally qualified to undertake.
REPORTING AND ASSESSMENT PROCEDURES

LEARNING OBJECTIVE:

Describe proper patient care reporting and assessment procedures.

Although physicians determine the overall medical management of a person requiring healthcare services, they depend heavily upon the assistance of other members of the healthcare team when evaluating and implementing the patient’s ongoing treatment. HMs spend more time with hospitalized patients than all other providers. This situation places them in key positions as data collection and reporting persons.

The systematic gathering of information is an essential aspect in assessing an individual’s health status, identifying existing problems, and developing a combined plan of action to assist the patient with health needs. The initial assessment is usually accomplished by establishing a health history. Included in this history are elements such as previous and current health problems, patterns of daily living activities, medications, dietary requirements, and relevant occupational, social, and psychological data. Additionally, both subjective and objective observations are included in the initial assessment and throughout the course of hospitalization.

Accurate and intelligent assessments are the basis of good patient care and are essential elements for providing a total healthcare service. The HM must know what to watch for and what to expect. It is important to be able to recognize even the slightest change in a patient’s condition, since such changes may indicate an improvement or deterioration. The HM must be able to recognize the desired effects of medication and treatments, as well as, any undesirable reactions to them. Both of these factors may influence the physician’s decision to continue, modify, or discontinue all or just specific parts of the treatment plan.

ORAL AND WRITTEN REPORTING

Equally as important as assessments is the reporting of data and observations to the appropriate team members. Reporting consists of both oral and written communications and, to be effective, must be done in a manner that is accurate, timely, and complete. Maintaining an accurate, descriptive clinical record serves a dual purpose: It provides documentation of the information gathered about the patient and it serves as a means of communication to everyone involved in the patient’s care. The clinical record provides a valuable source of information for developing a variety of care-planning activities. Additionally, these records serve as an important source of material for educating and training healthcare personnel, for conducting research, and for compiling statistical data. Finally, the clinical record is a legal document and is admissible as evidence in a court of law in claims of negligence and malpractice.

Basic Guidelines for Written Entries

It is imperative to follow some basic guidelines when making written entries in the clinical record. All entries must be recorded accurately and truthfully. Omitting an entry is as harmful as making an incorrect recording. Each entry should be concise and brief; avoid extra words and vague notations. Vocabulary and terminology must be clear, concise and free of alternate meanings. Recordings must be legible. If an error is made, it must be deleted following the standard Navy policy for correcting erroneous written notations. Finally, entries in the clinical record must include the time and date, along with the signature and rank of the HM who provided the care.
SOAP Note Format

Medical documentation of the patient’s chief complaint(s) and treatment must be consistent, concise, and comprehensive. The Navy Medical Department uses the SOAP note format to standardize medical evaluation entries made in clinical records. The acronym SOAP stands for SUBJECTIVE, OBJECTIVE, ASSESSMENT, and PLAN. The four parts of a SOAP note are discussed below. For more detailed instructions, refer to Chapter 16 of the MANMED.

SUBJECTIVE.—The initial portion of the SOAP note consists of subjective observations. These are symptoms verbally given to the HM by the patient or by a significant other (family or friend). These subjective observations include the patient’s descriptions of pain or discomfort, the presence of nausea or dizziness, and a multitude of other descriptions of dysfunction, discomfort, or illness.

OBJECTIVE.—The next part is the objective observation. These objective observations include signs the HM can actually see, hear, touch, feel, or smell. Included in objective observations are measurements such as temperature, pulse, respiration, skin color, swelling, and the results of tests whether normal or abnormal.

ASSESSMENT.—The assessment follows the objective observations. Assessment is the preliminary diagnosis of the patient’s condition.

PLAN.—The last part of the SOAP note is the Plan. The plan may include laboratory and/or radiological tests ordered, medications ordered, treatments performed (e.g., minor surgery procedure), patient referrals (sending patient to a specialist), patient disposition (e.g., binnacle list, Sick-in-Quarters (SIQ), admission to hospital), patient education, and follow-up guidelines for the patient.

ASSESSMENT PROCESS AND REPORTING

Assessment of a patient always begins with a series of questions the HM is asking internally. This “self questioning technique” prompts the HM to evaluate the patient from the general appearance to detailed signs and symptoms of injury or illness. Table 11-1 outlines the self questioning techniques for patient assessment and reporting and is a good guide to assist in developing proficiency in assessing and reporting patient conditions.

SUMMARY

This chapter has introduced many basic patient care procedures and philosophies, such as patient rights and responsibilities, professional conduct, reporting and assessment procedures, and patient education. These principles guide the HM in providing quality patient care in all settings, i.e. pharmacy, inpatient, outpatient, BAS, etc.
### Area of Concern Assessment Criteria

#### General Appearance
- Is the patient of average build, short, tall, thin, or obese?
- well-groomed?
- apparently in pain?
- walking with a limp, wearing a cast, walking on crutches, or wearing a prosthetic extremity?

#### Behavior
- Does the patient appear worried, nervous, excited, depressed, angry, disoriented, confused, or unconscious?
- refuse to talk?
- communicate thoughts in a logical order or erratically?
- lisp, stutter, or have slurred speech?
- appear sullen, bored, aggressive, friendly, or cooperative?
- sleep well or arouse early?
- sleep poorly, moan, talk, or cry out when sleeping?
- join ward activities?
- react well toward other patients, staff, and visitors?

#### Position
- Does the patient remain in one position in bed?
- have difficulty breathing while in any position?
- use just one pillow or require more pillows to sleep well?
- move about in bed without difficulty?

#### Skin
- Is the patient’s skin flushed, pale, cyanotic (bluish hue), hot, moist, clammy, cool, or dry?
- bruised, scarred, lacerated, scratched, or showing a rash, lumps, or ulcerations?
- showing signs of pressure, redness, mottling, edema, or pitting edema?
- appearing shiny or stretched?
- perspiring profusely?
- infested with lice?

#### Eyes
- Are the patient’s eyelids swollen, bruised, discolored, or dropping?
- sclera (whites of eyes) clear, dull, yellow, or bloodshot?
- pupils constricted or dilated, equal in size, and react equally to light?
- eyes tearing or showing signs of inflammation or discharge?
- complaints about pain; burning; itching; sensitivity to light; or blurred, double, or lack of vision?

#### Ears
- Does the patient hear well bilaterally?
- hold or pull on his ears?
- complain of a buzzing or ringing sound?
- have a discharge or wax accumulation?
- complain of pain?

#### Nose
- Is the patient’s nose bruised, bleeding, or difficult to breathe through?
- nose excessively dry or dripping?
- Are the patient’s nares (nasal openings) equal in size?
- Is the patient sniffling excessively?

#### Mouth
- Does the patient’s mouth appear excessively dry?
- breath smell sweet, sour, or of alcohol?
- tongue appear dry, moist, clean, coated, cracked, red, or swollen?
- gums appear inflamed, ulcerated, swollen, or discolored?
- teeth appear white, discolored, broken, or absent?
- Does the patient wear dentures, braces, or partial plates?
- complain of mouth pain or ulcerations?
- complain of an unpleasant taste?

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Table 11-1.—Assessment Criteria

11-13
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<thead>
<tr>
<th>Area of Concern</th>
<th>Assessment Criteria</th>
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<tbody>
<tr>
<td><strong>Chest</strong></td>
<td>Does the patient</td>
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<tr>
<td></td>
<td>• have shortness of breath, wheezing, gasping, or noisy respirations? Cough?</td>
</tr>
<tr>
<td></td>
<td>• have a dry, moist, hacking, productive, deep, or persistent cough?</td>
</tr>
<tr>
<td></td>
<td>• have white, yellow, rusty, or bloody sputum?</td>
</tr>
<tr>
<td></td>
<td>• Is it thin and watery or thick and purulent (containing pus)?</td>
</tr>
<tr>
<td></td>
<td>• How much is produced?</td>
</tr>
<tr>
<td></td>
<td>• Does it have an odor?</td>
</tr>
<tr>
<td></td>
<td>• complain of chest pain?</td>
</tr>
<tr>
<td></td>
<td>• Where is the pain?</td>
</tr>
<tr>
<td></td>
<td>• Is the pain a dull ache, sharp, crushing, or radiating?</td>
</tr>
<tr>
<td></td>
<td>• Is the pain relieved by resting?</td>
</tr>
<tr>
<td></td>
<td>• Is the patient using medication to control the pain (i.e., nitroglycerin)?</td>
</tr>
<tr>
<td><strong>Abdomen</strong></td>
<td>Does the patient</td>
</tr>
<tr>
<td></td>
<td>• have an abdomen that looks or feels distended, board-like, or soft?</td>
</tr>
<tr>
<td></td>
<td>• have a distended abdomen, and, if so, is the abdomen distended above or below the umbilicus or over the entire abdomen?</td>
</tr>
<tr>
<td></td>
<td>• belch excessively?</td>
</tr>
<tr>
<td></td>
<td>• feel nauseated, or has he vomited?</td>
</tr>
<tr>
<td></td>
<td>• If so, how often, and when?</td>
</tr>
<tr>
<td></td>
<td>• What is the volume, consistency, and odor of the vomitus?</td>
</tr>
<tr>
<td></td>
<td>• Is it coffee ground, bilious (containing bile), or bloody in appearance?</td>
</tr>
<tr>
<td></td>
<td>• Is patient vomiting with projectile force?</td>
</tr>
<tr>
<td><strong>Bladder &amp; Bowel</strong></td>
<td>Does the patient have</td>
</tr>
<tr>
<td></td>
<td>• bladder and bowel control?</td>
</tr>
<tr>
<td></td>
<td>• normal urination volume and frequency?</td>
</tr>
<tr>
<td></td>
<td>• Does the urine have an odor?</td>
</tr>
<tr>
<td></td>
<td>• Is the urine dark amber or bloody?</td>
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<tr>
<td></td>
<td>• Is the urine cloudy; does it have sediment in it?</td>
</tr>
<tr>
<td></td>
<td>• Is there pain, burning, or difficulty when voiding?</td>
</tr>
<tr>
<td></td>
<td>• diarrhea, soft stools, or constipation?</td>
</tr>
<tr>
<td></td>
<td>• What is the color of the stool?</td>
</tr>
<tr>
<td></td>
<td>• Does the stool contain blood, pus, fat, or worms?</td>
</tr>
<tr>
<td></td>
<td>• Does the patient have hemorrhoids, fistulas, or rectal pain?</td>
</tr>
<tr>
<td><strong>Vagina or Penis</strong></td>
<td>Does the patient have</td>
</tr>
<tr>
<td></td>
<td>• ulcerations or irritations?</td>
</tr>
<tr>
<td></td>
<td>• a discharge or foul odor?</td>
</tr>
<tr>
<td></td>
<td>• If there is a discharge present, is it bloody, purulent, mucoid (containing mucous), or watery?</td>
</tr>
<tr>
<td></td>
<td>• What is the amount?</td>
</tr>
<tr>
<td></td>
<td>• associated pain?</td>
</tr>
<tr>
<td></td>
<td>• If pain is present, where is it located?</td>
</tr>
<tr>
<td></td>
<td>• Is it constant or intermittent?</td>
</tr>
<tr>
<td></td>
<td>• Is it tingling, dull, aching, burning, gnawing, cramping, or crushing?</td>
</tr>
<tr>
<td><strong>Food &amp; Fluid Intake</strong></td>
<td>Does the patient</td>
</tr>
<tr>
<td></td>
<td>• have a good, fair, or poor appetite?</td>
</tr>
<tr>
<td></td>
<td>• get thirsty often?</td>
</tr>
<tr>
<td></td>
<td>• have any kind of food intolerance?</td>
</tr>
<tr>
<td><strong>Medications</strong></td>
<td>Does the patient</td>
</tr>
<tr>
<td></td>
<td>• take any medications?</td>
</tr>
<tr>
<td></td>
<td>• If so; what, why, and when last taken?</td>
</tr>
<tr>
<td></td>
<td>• have medications with him?</td>
</tr>
<tr>
<td></td>
<td>• have any history of medication reactions or allergies?</td>
</tr>
</tbody>
</table>

Table 11-1.—Assessment Criteria (continued)
CHAPTER 12

INPATIENT CARE

INTRODUCTION

There are times when patients are unable to be treated in an outpatient setting. The disease or injury is severe enough to require twenty-four hour care and monitoring to assist the patient back to a self-sustaining level of health and wellness. There are many types of specialized inpatient care areas. This chapter will review the unique qualities and requirements of the medical, surgical, orthopedic, and terminally ill inpatient care areas.

INPATIENT MEDICAL CARE

LEARNING OBJECTIVE:

Evaluate the needs of a medical inpatient.

THE INPATIENT

For purposes of this section, the term **medical patient** applies to any person who is receiving diagnostic, therapeutic, and/or supportive care for a condition that is not managed by surgical, orthopedic, psychiatric, or maternity-related therapy. This does not mean that patients in other categories are not treated for medical problems. Many surgical, orthopedic, psychiatric, and maternity patients do have secondary medical problems that are treated while they are undergoing management for their primary condition. The basic principles of management are essentially the same for both the inpatient and outpatient.

The medical management of the patient generally consists of laboratory and diagnostic tests and procedures, medication, food and fluid therapy, and patient teaching. For many medical patients during the initial treatment phase, rest is a part of the prescribed treatment.

LABORATORY TESTS AND DIAGNOSTIC PROCEDURES

A variety of laboratory and diagnostic tests and procedures are commonly ordered for the medical patient. The HM will be assigned to prepare the patient for the procedure, collect the specimens, or assist with both. The patient needs a clear and simple explanation about what is to be done and how to assist with the activity. Often the success of the test or procedure is dependent upon the patient’s informed cooperation. When collecting specimens, the HM must complete the following procedures:

- Wash hands
- Identify the correct patient
- Collect the correct type and amount of specimen at the correct time
- Place the specimen in the correct container
- Label the container completely and accurately. This may differ somewhat for each facility; local policies should be consulted
- Complete the appropriate laboratory request form
- Document on the patient’s record or other forms the date, time, and type of specimen collected; the disposition of the specimen; and anything unusual about the appearance of the specimen or the patient during the collection

When assisting with a diagnostic procedure, the HM must understand the sequence of steps of the procedure and exactly how the assistance can best be provided. Since many procedures terminate in the collection of a specimen, the above principles of specimen collection must be followed.
Following the completion of a procedure or specimen collection, it is the responsibility of the assisting HM to ensure that the patient’s safety and comfort are attended to, the physician’s orders accurately followed, and any supplies or equipment used appropriately discarded.

MEDICATIONS

The treatment of illnesses and injuries often include the use of medication. The responsibility of preparing and administering medications often falls to the HM. The preparation and administration of medications demand special knowledge and skills, integrity, and constant vigilance. A medication error, which also includes omissions, can seriously affect a patient, even to the point of death.

No one individual is expected to know everything there is to know about medications. In every healthcare environment, the HM can access other healthcare providers who can assist in clarifying orders and explaining the purposes, actions, and effects of drugs. Reference materials are also available to all personnel handling medications, including the *Physician’s Desk Reference*, the *Nursing Drug Handbook* and a hospital formulary.

It is the HM’s responsibility to consult the members of the healthcare team and these references in any area in which the HM is not knowledgeable or whenever there are questions or doubts. HMs are responsible for continued in-service training and knowing and following local policies and procedures regarding the administration of medications. As the HM gains competence and confidence with medication administration, they will be prepared to answer questions that may arise concerning a particular patient’s medications.

FOOD AND FLUID THERAPY

Loss of appetite, food intolerance, digestive disturbances, lack of exercise, and even excessive weight gain influence a medical patient’s intake requirements. Regardless of their medical needs, all patients have basic nutritional requirements that differ from those of the healthy person. As a part of the patient’s treatment plan, food is usually prescribed in the form of a special diet. Regardless of the kind of diet prescribed, the patient must be educated as to why certain foods are ordered or eliminated, and how compliance with the dietary regimen will assist in the total care. It is the responsibility of HMs to assist the patient in understanding the importance of the prescribed diet and to ensure that accurate recording of the patient’s dietary intake is made on the clinical record.

In some disease conditions, the patient is unable to tolerate food or fluids or may lose these through vomiting, diarrhea, or both. In these cases, replacement fluids as well as nutrients are an important part of the patient’s medical management. There are several disease conditions in which fluid restrictions are important aspects of the patient’s therapy such as preeclampsia and severe chronic obstructive pulmonary disease (COPD). In both of these instances, accurate measurement and recording of fluid intake and output must be carefully performed. Quite often this becomes a major task of the HM. Additional information relating to food and fluid therapy is presented in Chapter 13, Nutrition and Diet Therapy.

PATIENT EDUCATION

In the previous chapter, under "Patient Education," the goals and principles of patient teaching were addressed. When taken in the context of the medical patient, there are some general areas of patient teaching needs that must be considered, particularly as the patient approaches discharge from an inpatient status.
Those areas include the following:

- Follow-up appointments
- Modification in activities of daily living (ADLs) and habits
- Modification in diet, including fluid intake
- Medications and treatment to be continued after discharge
- Measures to be taken to promote health and prevent illness

REST

The primary reason for prescribing rest as a therapeutic measure for the medical patient is to prevent further damage to the body or body part when the normal demand of use exceeds the ability to respond. Prolonged or indiscriminate use of rest, particularly bed rest, is potentially hazardous. Some of the common complications occurring as a result of prolonged bed rest are:

- Circulatory problems (development of blockages) and subsequent skin problems (ulcers)
- Respiratory problems (pneumonia)
- Gastrointestinal problems (anorexia, constipation, and fecal impactions)
- Urinary tract problems (retention, infection, or the formation of calculi)
- Musculoskeletal problems (weakness, atrophy, and the development of contractures)
- Psychological problems (apathy, depression, and temporary personality changes)

The prevention of complications is vital in therapeutic management for the patient on prolonged bed rest. Awareness of potential hazards is the first step in prevention. Alert observations are essential: skin condition, respirations, food and fluid intake, urinary and bowel habits, evidence of discomfort, range of motion, and mood are all critical elements that provide indications of impending problems.

When these findings are properly reported, the healthcare team has time to employ measures that will prevent or arrest the development of preventable complications. Key elements of prevention include turning the patient frequently, providing skin care at least daily if not twice daily, massaging the skin to stimulate circulation, and frequent skin assessments; all must be done IAW local policies and procedures.

THE SURGICAL PATIENT

LEARNING OBJECTIVE:

Identify the needs of a surgical patient during the preoperative, operative, recovery, and postoperative phases of treatment.

Surgical procedures are classified into two major categories: emergency and elective. Emergency surgery occurs when surgery is required immediately to save a life or maintain a necessary function. Elective surgery is surgery that needs to be done but can be scheduled at a time beneficial to both the patient and the provider. Regardless of the type of surgery, every surgical patient requires specialized care at each of four phases. These phases are classified as preoperative, operative, recovery, and postoperative.

PREOPERATIVE PHASE

Before undergoing a surgical procedure, the patient should be in the best possible psychological, spiritual, and physical condition. Psychological preparation begins the moment the patient learns of the necessity of the operation. The physician is responsible for explaining the surgical procedure to the patient, including events that can be expected after the procedure. Since other staff personnel reinforce the physician’s explanation, all members of the team must know what the physician has told the patient. In this manner, they are better able to answer the patient’s questions.
All patients approaching surgery are fearful and anxious. The staff can assist in reducing this fear by instilling confidence in the patient regarding the competence of those providing care. The patient is given the opportunity and freedom to express any feelings or fears regarding the proposed procedure. Even in an emergency, it is possible to give a patient and the family psychological support. Often this is accomplished by the confident and skillful manner in which the administrative and physical preoperative preparation is performed.

The fears of pre-surgical patients may arise from their insecurities in the areas of anesthesia, body disfigurement, pain, and/or death. Religious faith is often a source of strength and courage for some patients. If a patient expresses a desire to see a member of the clergy, every attempt should be made to arrange a visit.

Administrative Preparation

Except in emergencies, the administrative preparation usually begins before surgery. A step-by-step procedure is outlined in the book *Fundamental Skills and Concepts in Patient Care* in the “Caring for the Patient Undergoing Surgery” chapter. Only the Request for Administration of Anesthesia and for Performance of Operations and Other Procedures (SF 522) will be addressed here. The SF 522 identifies the operation or procedure to be performed; has a statement written for the patient indicating in lay terms a description of the procedure; and includes the signatures of the physician, patient, and a staff member who serves as a witness. A SF 522 must be completed before any preoperative medications are administered. If the patient is not capable of signing the document, a parent, legal guardian, or spouse may sign it. It is customary to require the signature of a parent or legal guardian if the patient is under 18 years of age, unless the patient is married or a member of the Armed Forces. In these latter two cases, the patient may sign the permit, regardless of age.

Typically, the physical preparation of the patient begins in the late afternoon or early evening the day before surgery and at home for those scheduled for same day surgery. As with the administrative preparation, each step is clearly outlined in *Alexander’s Care of the Patient in Surgery*.

**PREOPERATIVE INSTRUCTIONS.—**

Preoperative instructions are an important part of the total preparation. The exact time that preoperative teaching should be initiated greatly depends upon the individual patient and the type of surgical procedure. Most experts recommend that preoperative instructions be given as close as possible to the time of surgery. Appropriate preoperative instructions given in sufficient detail and at the proper time greatly reduce operative and postoperative complications.

**OPERATIVE PHASE**

The operative (or intra-operative) phase begins the moment the patient is taken into the operating room. Two of the major factors to consider at this phase are positioning and anesthesia.

**Positioning**

The specific surgical procedure will dictate the general position of the patient. For example, the **lithotomy** position is used for a vaginal hysterectomy, while the **dorsal recumbent** position is used for a herniorrhaphy (hernia repair). Regardless of the specific position the patient is placed in, there are some general patient safety guidelines that must be observed.
When positioning a patient on the operating table, remember the following:

- Whether the patient is awake or asleep, place the patient in as comfortable a position as possible.
- Strap the patient to the table in a manner that allows for adequate exposure of the operative site and is secure enough to prevent the patient from falling, but that does not cut off circulation or contribute to nerve damage.
- Secure all the patient’s extremities in a manner that will prevent them from dangling over the side of the table.
- Pad all bony prominences to prevent the development of pressure areas or nerve damage.
- Make sure the patient is adequately grounded to avoid burns or electrical shock to either the patient or the surgical team.

Topical Anesthesia is administered topically (surface of the body part) to desensitize a small area of the body for a very short time period.

Local blocks consist of the subcutaneous infiltration of a small area of the body with a desensitizing agent. Local anesthesia generally lasts a little longer than topical.

Nerve blocks consist of injecting the agent into the region of a nerve trunk or other large nerve branches. This form of anesthesia blocks all impulses to and from the injected nerves. One type of nerve block is a digital block (ring block) which is specific to the digits of the upper and lower extremities.

This is the most common type of anesthesia the HM will administer. Specific information is located in Chapter 21, “Emergency Medical Care Procedures.”

Spinal Anesthesia consists of injecting the agent into the subarachnoid space of the spinal canal between the third and fourth lumbar space or between the fifth lumbar and first sacral space of the spinal column. This form of anesthesia blocks all impulses to and from the entire area below the point of insertion, provided the patient’s position is not changed following injection of the agent.

If the patient’s position is changed, for example, from dorsal recumbent to Trendelenburg, the anesthetic agent will move up the spinal column and the level of the anesthesia will also move up. Because of this reaction, care must be exercised in positioning the patient’s head and chest above the level of insertion to prevent paralysis (by anesthesia) of the respiratory muscles. In general, spinal anesthesia is considered the safest for most routine major surgery.
**Epidural blocks** consist of injecting the agent into the epidural space of the spinal canal at any level of the spinal column. The area of anesthesia obtained is similar to that of the subarachnoid spinal method.

The epidural method is frequently used when continuous anesthesia is desired for a prolonged period. In these cases, a catheter is inserted into the epidural space through a spinal needle. The needle is removed, but the catheter is left in place. This provides for continuous access to the epidural space. It is used most frequently in pregnant women during delivery for pain control.

**Saddle blocks** consist of injecting the agent into the dural sac at the third and fourth lumbar space. This form of anesthesia blocks all impulses to and from the perineal area of the body.

**Caudal blocks** consist of injecting the agent into the sacral canal. With this method, anesthetic effect or loss of sensation range from the umbilicus to the toes.

**GENERAL ANESTHESIA.**—General anesthetics cause total loss of sensation and complete loss of consciousness in the patient. They are administered by inhalation of certain gases or vaporized liquids, intravenous infusion, or rectal induction. The induction of inhalation anesthesia is divided into four stages (Fig. 12-1).

- **Stage 1** is the stage of analgesia or induction. During this period the patient experiences dizziness, a sense of unreality, and a lessening sensitivity to touch and pain. At this stage, the patient’s sense of hearing is increased, and responses to noises are intensified.

- **Stage 2** is the stage of excitement. During this period there is a variety of reactions involving muscular activity and delirium. At this stage, the vital signs show evidence of physiological stimulation. It is important to remember that during this stage the patient may respond violently to very little stimulation.

- **Stage 3** is called the surgical or operative stage. There are four levels of consciousness (also called planes) to this stage. It is the responsibility of the anesthetist or anesthesiologist to determine which plane is optimal for the procedure. The determination is made according to specific tissue sensitivity of the individual and the surgical site. Each successive plane is achieved by increasing the concentration of the anesthetic agent in the tissue.

- **Stage 4** is called the toxic or danger stage. This is never a desired stage of anesthesia as cardiopulmonary failure and death can occur. Once surgical anesthesia has been obtained, the healthcare provider must exercise care to control the level of anesthesia. The fourth level of consciousness of stage 3 is demonstrated by cardiovascular impairment that results from diaphragmatic paralysis. If this plane is not corrected immediately, stage 4 quickly ensues.

<table>
<thead>
<tr>
<th>STAGE</th>
<th>PUPIL</th>
<th>RESP</th>
<th>PULSE</th>
<th>B.P.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1ST INDUCTION</td>
<td>USUAL SIZE</td>
<td>REACTION TO LIGHT</td>
<td>RRIRREGULAR</td>
<td>NORMAL</td>
</tr>
<tr>
<td>2ND EXCITEMENT</td>
<td></td>
<td></td>
<td>IRREGULAR AND FAST</td>
<td>HIGH</td>
</tr>
<tr>
<td>3RD OPERATIVE</td>
<td></td>
<td></td>
<td>STEADY SLOW</td>
<td>NORMAL</td>
</tr>
<tr>
<td>4TH DANGER</td>
<td></td>
<td></td>
<td>WEAK AND THREADY</td>
<td>LOW</td>
</tr>
</tbody>
</table>

Figure 12-1.—Stages of anesthesia
Recovery Stage or phase consists of the period that begins at the completion of the operation and extends until the patient has recovered from anesthesia. The recovery phase generally takes place in a specialized area called the recovery room or post-anesthesia care unit (PACU). This unit is usually located near the operating room and has access to the following:

- Surgeons and anesthesiologists or anesthetists
- Nurses and HMs specially prepared to care for immediate postoperative patients
- Special equipment, supplies, medication, and replacement fluids

From the time of admission to patient discharge, routine care in the recovery room consists of the following:

- Measuring temperature and vital signs (taken immediately upon admission and as ordered by the physician thereafter)
- Maintaining airway patency
  - Patients having an artificial airway in place will automatically expel it as they regain consciousness
  - Have a mechanical suction apparatus available to remove excess secretions from the patient’s airway
- Ensuring the integrity of dressings, tubes, catheters and casts
  - Locate the presence of any of the above
  - Make notations regarding all drainage, including TACO: type, amount, color, and odor
  - Immediately report the presence of copious amounts of drainage to a nurse or physician
- Monitoring intravenous therapy (including blood and blood components)
  - Make notations including type of infusion, rate of flow, and condition of the infusion site
  - Observe patients receiving blood or blood components closely for untoward reactions
- Monitoring skin color changes
  - Check dressings and casts frequently to ensure they are not interfering with normal blood circulation to the area
  - Notify a physician or nurse of general skin color changes that may indicate airway obstruction, hemorrhage, or shock
- Assessing level of responsiveness
  - For general anesthetics, check for orientation to the environment each time vital signs are taken
  - For other anesthetics, check for return of sensory perception and voluntary movement each time vital signs are taken
- Observing for side effects of the anesthetic agent
  - Each agent has the potential for causing specific side effects. Some common major side effects that may occur following the administration of both spinal and general anesthesia consist of the following:
    - Hypotension/shock
    - Respiratory paralysis
    - Neurological complications
    - Headache
    - Cardiac arrest
    - Respiratory depression
    - Bronchospasm/laryngospasm
    - Diminished circulation
    - Vomiting/aspiration
POSTOPERATIVE PHASE

After the patient’s condition has been stabilized in the recovery room, a physician will order the patient’s transfer to another area of the facility. Generally, this transfer is to the unit that the patient was assigned to preoperatively such as the Same Day Surgery (SDS) unit or ward. With surgery and anesthesia having unavoidable temporary ill effects on normal physiological functions, every effort must be made to prevent postoperative complications.

Postoperative Goals

From the time the patient is admitted to the recovery room to the time recovery from the operation is complete, there are definite goals of care that guide the entire postoperative course. These goals are as follows:

- Promoting respiratory function
- Promoting cardiovascular function
- Promoting renal function
- Promoting nutrition and elimination
- Promoting fluid and electrolyte balance
- Promoting wound healing
- Encouraging rest and comfort
- Encouraging movement and ambulation
- Preventing postoperative complications

The physician will write orders for postoperative care that are directed at accomplishing the above goals. Although the orders will be based on each individual patient’s needs, there will be some common orders that apply to all patients. These orders will focus on the promotion of certain physiological functions.

Cardiovascular function is assisted by frequent position changes, early movement and ambulation, and in some cases, intravenous (IV) therapy. Renal function is promoted by adequate fluid intake and early movement and ambulation. Nutritional status is promoted by ensuring adequate oral and intravenous intake and by maintaining accurate intake and output records. Elimination functions are promoted by adequate diet and fluid intake. Carefully monitor patients on opioids as these slow down gastrointestinal recovery. Postoperative patients should be advanced to a normal dietary regimen as soon as possible, since this, too, promotes elimination functions. Early movement and ambulation also help to restore normal elimination activities.

In addition to various medications and dressing change procedures ordered by the physician, wound healing is promoted by good nutritional intake and by early movement and ambulation. Rest and comfort are supported by properly positioning the patient, providing a restful environment, encouraging good basic hygiene measures, ensuring optimal bladder and bowel output, and promptly administering pain-relieving medications. Early movement and ambulation are assisted by offering pre-medication, ensuring maximum comfort for the patient, and providing the encouragement and support for ambulating the patient. As indicated in the above discussion, the value of early movement and ambulation, when permissible, cannot be overemphasized.

Respiratory function is promoted by encouraging frequent coughing and deep breathing. Early movement and ambulation also help improve respiratory function. For some patients, oxygen therapy may also be ordered to assist respiratory function.
Postoperative Complications

During the early postoperative phase, the major complications to be guarded against are respiratory obstruction, shock and hemorrhage. As the patient progresses in the postoperative period, other complications to avoid are the development of pneumonia, phlebitis and subsequent thrombophlebitis, gastrointestinal problems ranging from abdominal distention to intestinal obstruction, and wound infections.

Accurate implementation of the physician’s orders and careful observation, reporting, and recording of the patient’s condition will contribute markedly to an optimal and timely postoperative recovery course for the patient.

THE ORTHOPEDIC PATIENT

LEARNING OBJECTIVE:

Explain the needs of the orthopedic patient.

Patients with fractures, deformities, injuries, or diseases of some part of the musculoskeletal system, receive treatment from orthopedic services. Some patients will require surgery, immobilization, or both to correct their condition.

GENERAL CARE

The fundamentals of care for the surgical patient and medical patient apply to orthopedic patients as well. The majority of patients not requiring surgical intervention will be managed by bed rest, immobilization, and rehabilitation. In the military, the typical orthopedic patient is fairly young and in good general physical condition. For these patients, bed rest is prescribed only because other kinds of activity are limited by their condition on admission.

Immobilization

Rehabilitation is the ultimate goal when forming the orthopedic patient’s care plan. Whether the patient requires surgical or nonsurgical treatment, immobilization is often a part of the overall therapy. Immobilization may consist of applying casts or splints, or using traction equipment such as an orthopedic frame called a trapeze. During the immobilization phase, simple basic patient care is extremely important. Such things as skin care, active-passive exercises, position changes in bed (as permitted), good nutrition, adequate fluid intake, regularity in elimination, and basic hygiene contribute to both the patient’s physical and psychological well-being.

Lengthy periods of immobilization are emotionally stressful for patients, particularly those who are essentially healthy except for the limitations imposed by the condition. Prolonged inactivity contributes to boredom that is frequently manifested by various kinds of acting-out behavior.

Often, the orthopedic patient experiences elevated levels of pain. Orthopedic pain is commonly described as sore and aching. This condition requires long periods of treatment and hospitalization, effective pain management is an important aspect of care. Constant pain, regardless of severity, is energy consuming. The HM should make every effort to assist the patient in conserving this energy. There are times when the patient’s pain can and should be relieved by medications. There are numerous occasions when effective pain relief can be provided by basic patient-care measures such as proper body alignment, change of position, use of heat or cold (if permitted by a physician’s orders), back rubs and massages, and even simple conversation with the patient. Meaningful activity also has been found to help relieve pain. Whenever possible, a well-planned physical/occupational therapy regimen should be an integral part of the total rehabilitation plan.
CAST FABRICATION

As mentioned previously, immobilization is often a part of the overall therapy of the orthopedic patient, and casting is the most common and well-known form of long-term immobilization. The HM may be required to apply or assist in cast application. This section will discuss the method of applying a short and long arm cast, and a short leg cast.

In applying any cast, the basic materials are the same: webril or cotton bunting, plaster of Paris, a bucket or basin of tepid water, a water source (tap water), protective linen, gloves, a working surface, a cast saw (if removing old cast), and seating surfaces for the patient and the HM. Some specific types of casts require additional material.

NOTE:
When fabricating a cast ensure items used to directly support the casted extremity are made of fabric. Plastics and rubbers, such as the plastic covering on hospital pillows, will melt due to the chemical heat reaction of the cast as it sets.

Short Arm Cast

A short arm cast extends from the base of the metacarpal-phalangeal joints of the hand to one inch below the antecubital space. Depending on the location and type of fracture, the physician may order a specific position for the arm to be casted. Generally, the wrist is in a neutral (straight) position, with the fingers slightly flexed in the position of function.

1. Beginning at the wrist, apply two to three layers of webril (Fig. 12-2A).
2. Then apply webril to the forearm and the hand, making sure that each layer overlaps the other by a half (Fig. 12-2B).
3. Check for lumps or wrinkles and correct any by tearing the webril and smoothing it.
4. Dip the plaster into the water for approximately 5 seconds or until completely submerged in water.
5. Gently massage and squeeze to remove excess water. Do not wring it out as this is called the lamination process.
6. Beginning at the wrist (Fig. 12-2C), wrap the plaster in a spiral motion, overlapping each layer by one-third to one-half.
7. Smooth out the layers with a gentle palmar motion.
8. When applying the plaster, make tucks by grasping the excess material and folding it under as if making a pleat. Successive layers cover and smooth over this fold.
9. When the plaster is anchored on the wrist, cover the hand and the palmar surface before continuing up the arm (Figs. 12-2D and 12-2E).
10. Repeat this procedure until the cast is thick enough to provide adequate support, generally 2 to 3 layers.
11. The final step is to remove any rough edges and smooth the cast surface (Fig. 12-2F).
12. Turn the ends of the cast back and cover with the final layer of plaster, and allow the plaster to set for approximately 15 minutes.
13. Trim with a cast saw, as needed.
Figure 12-2.—Short Arm Cast
**Long Arm Cast**

The procedure for a long arm cast is basically the same as for a short arm cast, except the elbow is maintained in a 90° position, the cast begins at the wrist and ends on the upper arm two inches below the axilla, and in some situations the hand is not wrapped.

**Short Leg Cast**

In applying a short leg cast follow these guidelines:

1. Seat the patient on a table with both legs over the side, flexed at the knee.
2. Instruct the patient to hold the affected leg, with the ankle in a neutral position (90°). Make sure that the foot is not rotated medially or laterally.
3. Beginning at the toes, apply webril (Figs. 12-3A-D) in the same manner as for the short arm cast, ensuring that there are no lumps or wrinkles.
4. Apply the plaster beginning at the base of the metatarsals (Fig. 12-3E), using the same technique of tucks and folds and smoothing as for the short arm cast.
5. Before applying the last layer, expose the toes and fold back the webril (Fig. 12-3F).
6. As the final step, apply a footplate to the plantar surface of the cast, using a generous thickness of plaster (5-7 layers) splints secured with one or two rolls of plaster (Fig. 12-3G). This area provides support to the cast and a weight-bearing surface when used with a cast shoe.

![Figure 12-3.—Short Leg Cast](image-url)
Whenever a cast is applied, the patient must be given written and verbal instruction for cast care and circulation checks (i.e., numbness, cyanosis, tingling of extremities). Instruct the patient to return immediately should any of these conditions occur.

When a leg cast is applied, the patient must also receive instructions in the proper use of crutches. Depending upon the rehabilitation plan and co-occurring illnesses and injuries, other ambulation tools such as canes and or walkers may also be implemented. The cast will take 24 to 48 hours to completely dry, and it must be treated gently during this time. Since plaster is water-soluble, the cast must be protected with a waterproof covering when bathing or during wet weather.

Nothing must be inserted down the cast (e.g., coat hangers) since this action can cause bunching of the padding and result in pressure sores. If swelling occurs, the cast may be split and wrapped with an elastic wrap to alleviate pressure. Additionally, the object may compromise the skin integrity with a scratch or laceration on skin that will not be cleaned until the cast is removed creating a habitat for bacteria and an opportunity for infection.

**Cast Removal**

A cast can be removed in two ways: by soaking in warm vinegar-water solution until it dissolves, or by cutting. To remove by cutting, cast cutters, spreaders, and bandage scissors are necessary. Cuts are made laterally and medially along the long axis of the cast, and then widened with the use of spreaders. The padding is then cut with the scissors.

**CANES, CRUTCHES AND WALKERS**

Humans have contrived tools or devices that provided them support when they became injured. Upon recovery from a lower extremity orthopedic injury the use of assistive devices can prevent harmful falls. Selection for each individual is based upon the amount of stability and support required as well as the patient's strength, cognition, balance, and coordination.

Patients are often instructed in the use of an assistive device when recovering from an injury or disease during their rehabilitation. To correctly use the device a specific gait pattern, which requires great concentration to learn initially, is required in order to learn how to walk correctly.

**Uses of assistive devices include the following:**

- Redistribute and unload a weight-bearing lower limb
- Improve balance
- Reduce lower limb pain
- Provide sensory feedback
- Assist propulsion
- Enable the individual with paralysis to obtain the physiological benefits of upright posture and to maneuver in places inaccessible to a wheelchair
- Notify passersby that the user requires special considerations, such as additional time when crossing streets or taking a seat on the bus

**Types of Assistive Devices**

The following are assistive devices ranked in order of least stable to most stable:

- Canes
- Crutches
- Walkers

**Canes**

Canes are often used to widen the base of support and decrease stress on the opposite lower extremity. Canes can unload the lower limb weight by bearing up to 25% of a patient's body weight. Canes can be made of wood or aluminum; tubular aluminum is lighter than wood. Aluminum canes are adjustable, which is a characteristic that facilitates their use by patients of all sizes.
Types of canes

Generally, the following three types of canes are used, shown in Figure 12-4:

- **C-cane**
  - Most commonly used cane; other names used: the crook-top cane, the J cane, and the single-point cane

- **Functional-grip cane, or Straight-handled canes**
  - Provides better grip and more controlled balance for patients
  - The grip is more comfortable than that of a C cane
  - One example is the ortho cane

- **Quad cane**
  - Provide more support than other standard canes
  - Narrow and wide-based forms are available.
  - For patients with hemiplegia
  - Slow gait is one disadvantage of quad canes.

Fitting

- Keep elbow flexed at side to 15° to 30°
- Use the unaffected side, approximate cane height can be determined by measuring distance from wrist to floor, when standing with arms at the sides (Fig. 12-5)

Figure 12-4.— Types of canes (left-to-right) C-cane, Straight-handled cane, Quad Cane


Figure 12-5.—Cane Fitting

*Photograph provided by HM1 James Q. Royal, Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD.*

Techniques for Cane Use

- Cane should support 15-25% of patient's body weight
- Hold the cane in the hand on the unaffected side to provide support to the opposite lower limb
- Advance cane simultaneously with the affected leg
- The phrase “up with the good, down with the bad” is often used to help patients recall the appropriate step pattern for stair climbing or traversing a street side curb
Stair-climbing

To climb up stairs (Fig. 12-6):
- Put the cane in the hand closest to the unaffected (i.e. healthy or good) leg
- Step up on the good leg first or
- If possible, grasp the handrail and step up on the good leg first
- Step up on the injured leg and the cane at the same time

To come down stairs (Fig. 12-7):
- Put the cane in the hand closest to the unaffected leg
- Put the cane on the step first
- Step down with the injured leg
- Finally, step down with the good leg

Precautions
- If the cane tip gets wet while the patient is outside, make sure the patient dries it off before walking inside on a potentially slick surface. This will help prevent the cane from slipping out from under the patient
- Try to avoid placing the cane on a small rug which can slide out from under the patient
- Check the rubber tip for cracks or excessive wear or the lodging of pebbles and dirt from the outdoors which will make the cane slide on slick surfaces
Advantages

- Adds support and improves balance
- Helps maintain stability and prevent slips and injuries
- Assists in distributing weight evenly
- Can help a patient distribute weight onto the cane and away from hips, knees, and ankles
- Can reduce stress on weak joints and help reduce soreness
- Disadvantages
- Limited weight-bearing capacity
- Much less stable than a walker for moderate to severe balance disorders
- Requires cognition and coordination to use appropriately

Crutches

Crutches provide better stability than do canes and have 2 points of contact with the body.

Types of crutches

There are two basic types of crutches:

- Axillary Crutches - this is the most common type (Fig. 12-8)
  - Wooden or aluminum models can be adjusted easily to the overall height and hand height
  - For temporary use (acute injuries)
  - Requires significant upper body strength
- Forearm Crutches (Canadian crutch, Lofstrand crutch)
  - The increased flexion allows the arm to bear greater weight
  - For active patients with severe leg weakness
  - Offers easier mobility than with axillary crutches

Disadvantages

- Limited weight-bearing capacity
- Much less stable than a walker for moderate to severe balance disorders
- Requires cognition and coordination to use appropriately
- Brace fixes crutch to forearm and hands grasp handles
- Allows use of hands without dropping crutches

Fitting

Axillary Crutches (Fig. 12-8):

- Axillary, or underarm, crutches are measured with the crutch tips flat on the ground and approximately 6 inches lateral to and 6 inches in front of the foot
- Adjust the handgrip to allow for an approximate 20° to 30° bend at the elbow
- Proper crutch height should allow two to three fingers space between top of the crutch and axilla
- Axilla should not rest on top of the crutch

Figure 12-8.—Axillary Crutch Fitting Position

Photograph provided by HM1 James Q. Royal, Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD.
Forearm Crutches (Canadian crutch, Lofstrand crutch):

- Plant crutch end in front of foot by 6 inches
- Keep elbow slightly flexed to $15^\circ$ to $30^\circ$
- Place cuff at proximal forearm just distal to elbow

Gait Patterns Techniques for crutch use

- **Two-Point Gait**: Similar to the four-point gait. However, it is less stable because only two points of floor contact are maintained. Thus, use of this gait requires better balance
  - Right crutch and left leg together, then
  - Left crutch and right leg together
  - Repeat
  - Allows for natural arm and leg motion during gait, good support and stability from two opposing points of contact

- **Three-Point Gait**: In this type of gait, three points of support contact the floor. It is used when a non-weight-bearing status is required on one lower extremity
  - First move both crutches and the weaker lower limb forward
  - Then bear all your weight down through the crutches
  - Move the stronger or unaffected lower limb forward through the crutches
  - Repeat

- **Four point Gait (most stable)**: This gait provides a slow, stable gait as three points of floor contact are maintained. Weight is borne on both lower extremities and typically is used with bilateral involvement due to poor balance, in coordination, or muscle weakness
  - Crutches and legs move independently
  - Advance right crutch
  - Advance left leg
  - Advance left crutch
  - Advance right leg
  - Repeat

- **Swing-Through Gait**: Used for bilateral lower extremity involvement, and trunk disability, e.g. patient with paraplegia, spina bifida. Not as safe as swing-to gait
  - Advance both crutches forward together
  - Weight is shifted onto the hands for support and swing both legs forward at the same time beyond the point of crutch placement
  - Repeat

- **Swing-To Gait**: Requires the use of two crutches or a walker. Indicated for individuals with limited use of both lower extremities and trunk instability
  - Advance both crutches forward together
  - Weight is shifted onto the hands for support and swing both legs forward to meet (not past) the crutches.
  - Repeat

- **Tripod Crutch Gait**: Similar to the Swing-to Gait except crutches are moved one at a time. Requires slightly more coordination and balance than Swing-to gait
  - Advance the right crutch
  - Then the left crutch
  - Then drag both legs to the crutches
  - Repeat
**Stair-climbing**

To negotiate steps, it is important to learn the safest techniques in ascending and descending stairs to avoid falls and injuries. The phrase “**up with the good, down with the bad**” is often used to help patients recall the appropriate step pattern for stair climbing or traversing a street side curb.

**Going up stairs (Fig. 12-9):**

- The uninjured or good leg steps up first as you bear weight through the crutches (“Up with the good”)
- The injured leg follows with the crutches
- Make sure that you are close to the step before you start and that the injured leg clears the step as you step up

**Going down stairs (Fig. 12-10):**

- Place the crutches on the step below, and then step down with the injured leg (“Down with the bad”)
- The good leg then follows
- Make sure the crutch tips are not too close to the edge of the step
- If a handrail is available, then the crutches can be used as one on the opposite side of the handrail
- The sequence remains the same as without using a handrail

![Figure 12-9.—Climbing Stairs with Crutches](Photograph provided by HM1 James Q. Royal, Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD.)

![Figure 12-10.—Descending Stairs with Crutches](Photograph provided by HM1 James Q. Royal, Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD.)
Sitting (Fig. 12-11):
- Back-up to a sturdy chair
- Put both crutches in one hand
- Put the injured foot in front
- With the other hand, feel for the chair arm rest or seat of the chair
- Slowly lower yourself into the chair

Standing (Fig. 12-12):
- Scoot to the front of the chair
- Hold both crutches with the hand closest to the unaffected leg
- Push up and stand on the good leg

Figure 12-11.—Sitting with Crutches

Photograph provided by HM1 James Q. Royal, Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD.

Figure 12-12.—Standing up with Crutches

Photograph provided by HM1 James Q. Royal, Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD.
Precautions

- If the crutches are not new, check the handgrips or rubber crutch tips for signs of wear or cracks
- Go slowly on uneven surfaces such as sidewalks, gravel driveways, grass, etc.
- Be careful while walking over thick carpet. The crutch tips may catch on the carpet, causing you to pitch forward
- If the crutch tips get wet outside, dry them off before walking on tile or linoleum floors inside
- Pick up small throw rugs around the apartment or house. Watch out for objects or cords lying on the floor
- Wear supportive, non-slip shoes with low heels; avoid sandals or house slippers since they can fly off

Advantages

- Moderately stable
- Light weight
- Easily portable
- Appropriate for use on stairs

Disadvantages

- Requires more coordination and balance to use correctly than a walker as well as increased strength and endurance
- Forearm crutches are slightly more difficult to learn to use than standard crutches
- Not appropriate for patients with decreased trunk stability

Walkers

When patients require maximum stability and support from an ambulation device, walkers are typically indicated. Indications include the following:

- Generalized weakness
- Limited ability to bear weight on lower extremity
- Very poor balance particularly elderly people who are unsafe walking with a cane
- Confused patients
- Early gait training
- Other debilitating conditions

Types of walkers

There are five types of walkers:

- Standard Walkers (Figure 12-13A)
  - Very durable and Light-weight
  - Typically made of aluminum
  - For ambulation, these walkers require that the user lift the device and move it forward
  - Requires a certain degree of upper extremity strength and coordination

- Wheeled or Rolling Walkers (Fig. 12-13B)
  - Wheels on the front legs promote the walker’s movement
  - Because the patient does not have to lift it, it does not require as much strength and balance to maneuver as the standard walker
  - Users able to walk faster with less attention demand than a standard walker
  - Able to negotiate side-walk cracks easier
• Reciprocal Walkers\(^\text{11}\) (Fig. 12-13C)
  - Has swivel joints that allow each side of the walker to be advanced forward alternatively and independently of the other
  - Allows a more reciprocal gait pattern than other designs, and thus may provide faster and less awkward walking

• One-handed (Hemi Walker) (Fig. 12-13D)
  - Combines the features of a walker and a quad cane
  - Usually are made of tubular aluminum; adjustable, and can be folded
  - Provide a wider base and more lateral support than regular quad canes
  - Indications
    - Hemiplegics
    - Individuals requiring an intermediate step during gait training; often used during the period after use of the parallel bars and before ambulation, which is a time when the patient needs less restrictive assistive devices
  - Used by patients who have limited or no use of one arm or hand

• Stair-climbing Walkers\(^\text{8}\) (Fig. 12-13E)
  - Used to improve stair-climbing ability
  - Requires good balance and strong upper extremities

**Fitting:**
- Place the front of the walker 12 inches in front of the patient. The walker should partially surround the patient
- The hand grip of the walker should sit at the wrist crease, (ulnar styloid process), or greater trochanter of the patient standing erect with hands down at the side
- Measure the proper height of the walker by having the patient stand upright with elbows flexed 20°
- To confirm that a proper fit has been attained, the walker should be positioned so that the rear feet of the walker are set at about the midpoint of the patient’s shoes (viewed in the sagittal plane)
- The fit should be assessed as the user ambulates to ensure that the walker functions properly with the desired gait pattern

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**Figure 12-13.—Types of Walkers; A - Standard; B - Rolling; C - Reciprocal; D – Hemi; E – Stair-Climbing**

Techniques for walker use (Fig. 12-14):

- The user first advances the walker
- Then the patient steps forward with one foot, followed by the other

Advantages

- Provides the most support for body weight as compared to crutches
- Ease of application
- Provides support for balance (cerebral conditions) and reduced stress (arthritic conditions)
- Folding walkers make for easier storage
- Less exertion with rolling walkers

Disadvantages

- The user first advances the walker
- Slower walking speed
- Abnormal gait pattern
- Creates bad posture and walking habits
- Cannot be safely used to climb stairs
- Awkwardness in narrow passages or crowds
- More cumbersome than crutches, especially non-folding models
- Often have limited usability outdoors

CONCLUSION

Ambulatory devices can help people with disabilities regain strength and mobility as well as to function more freely. Careful consideration to the user’s needs, abilities, limitations, and environment is very important to achieve ideal results. Obtaining the correct style, and fit are also important factors to remember.

As the right fit will be helpful and maybe even speed recovery, the wrong choice may prolong the problem or introduce new ones. Being aware of these factors and having a better understanding of the clinical parameters involved with the proper selection of devices will allow the HM to train the patients to use the device most favorably.

Figure 12-14.—Techniques for Walker Use

Photograph provided by HM1 James Q. Royal, Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD.
THE TERMINALLY ILL PATIENT

LEARNING OBJECTIVE:

Explain the needs of the terminally ill patient.

The terminally ill patient has many needs that are basically the same as those of other patients: spiritual, psychological, cultural, economic, and physical. What differs in these patients may be best expressed as the urgency to resolve the majority of these needs within a limited time frame. Death comes to everyone in different ways and at different times. For some patients, death is sudden following an acute illness and for others death follows a lengthy illness. Death not only affects the individual patient; it also affects family and friends, staff, and even other patients. It is essential that all healthcare providers understand the process of dying and its possible effects on people.

INDIVIDUAL’S PERSPECTIVE ON DEATH

People view death from their individual and cultural value perspectives. Many people find the courage and strength to face death through their religious beliefs. These patients and their families often seek support from representatives of their religious faith. In many cases, patients who previously could not identify with a religious belief or the concept of a Supreme Being may indicate (verbally or nonverbally) a desire to speak with a spiritual representative. There will be patients who, through the whole dying experience, will neither desire nor need spiritual support and assistance. It is the responsibility of the healthcare provider to be attentive and perceptive to the patient’s needs and to provide whatever support personnel the patient may require.

CULTURAL INFLUENCES

An individual’s cultural system influences behavior patterns. When speaking of cultural systems, this refers to certain norms, values, and action patterns of specific groups of people to various aspects of life.

Dying is an aspect of life, and it is often referred to as the final crisis of living. Culturally approved roles frequently encourage specific behavior responses. For example, in the Caucasian, Anglo-European culture, a dying patient is expected to show peaceful acceptance of the prognosis; the bereaved is expected to communicate grief. When people behave differently, the healthcare provider frequently has difficulty responding appropriately.

FIVE STAGES OF DEATH

A theory of death and dying has developed that provides highly meaningful knowledge and skills to all persons involved with the experience. In this theory of death and dying (as formulated by Dr. Elizabeth Kubler-Ross in her book On Death and Dying), it is suggested that most people (both patients and significant others) go through five stages: denial, anger, bargaining, depression, and acceptance.

The first stage, denial, is one of non-acceptance. "No, it can’t be me! There must be a mistake!" It is not only important for the healthcare provider to recognize the denial stage with its behavior responses, but also to realize that some people maintain denial up to the point of impending death. The next stage is anger. This is a period of hostility and questioning: "Why me?" The third stage is bargaining. At this point, people revert to a culturally reinforced concept that good behavior is rewarded. Patients are often heard stating, "I’d do anything if I could just turn this thing around."

Once patients realize that bargaining is futile, they enter into the stage of depression. In addition to grieving because of their personal loss, it is at this point that patients become concerned about their family and "putting affairs in order." The final stage comes when the patient reaches acceptance of death and is prepared for it. It is usually at this time that the patient’s family requires more support than the patient.
It is important to remember that one or more stages may be skipped, the patient may alternate among the various stages in no particular order, and that the last stage may never be reached.

**SUPPORT FOR THE DYING**

Despite the fact that human beings all realize their mortality, there is no easy way to discuss death. To the strong and healthy, death is a frightening thought. The fact that sooner or later everyone dies does not make death easier. There are no procedure books that tell healthcare providers "how to do" death. The "how to" will only come from the individual healthcare provider who understands that patients are people, and that, more than any other time in life, the dying patient needs to be treated as an individual person.

An element of uncertainty and helplessness is almost always present when death occurs. Assessment and respect for the patient’s individual and cultural value system are of key importance in planning the care of the dying. As healthcare personnel, the HMs may approach a dying patient with some feelings of uncertainty, helplessness, and anxiety. The HM may feel helpless in being unable to perform tasks that will keep the patient alive, uncertain that they are doing all that can be done to either make the patient as comfortable as possible or to postpone or prevent death altogether. The HM may feel anxious about how to communicate effectively with patients, their family, or even among the healthcare team. This is a normal response since any discussion about death carries a high emotional risk for the patient as well as the healthcare provider. Communicating provides both strength and comfort to all if done with sensitivity and dignity, and it is sensitivity and dignity that is the essence of all healthcare services.

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**PATIENT SAFETY**

**LEARNING OBJECTIVE:**

Identify patient safety concerns in a medical treatment facility.

The primary goal of the healthcare provider is maintaining, sustaining, restoring, and rehabilitating the physical and/or psychological function of the patient. To achieve this goal, healthcare facilities and providers ensure a patient’s environmental and personal safety by developing policies and implementing mechanisms that ensure safe, efficient, and therapeutically effective care. While patient safety is important in all patient care areas, it is of particular importance in the inpatient care setting due to the twenty-four hour care provided in an unfamiliar environment for the patient.

**ENVIRONMENTAL SAFETY**

For purposes of this section, the environment is defined as the physical surroundings of the patient and includes such things as lighting, equipment, supplies, chemicals, architectural structure, and the activities of both patient and staff personnel. Maintaining safety becomes even more difficult when working with people who are ill or anxious and who cannot exercise their usual control over the environment. Loss of strength, decreased sensory input, and disability often accompany illness. Because of this, the HM must be constantly alert and responsive to maintaining a safe environment.

Both The Joint Commission (TJC) and the National Safety Council of the American Hospital Association (AHA) have identified four major types of accidents that continually occur to patients. These hazards consist of falls, electrical shocks, physical and chemical burns, and fire and explosions. Since accidents resulting in physical and chemical burns have initiated numerous consumer claims of healthcare provider and facility malpractice, all healthcare personnel must be thoroughly indoctrinated in the proper use of equipment, supplies, and chemicals.
PATIENT FALL PRECAUTIONS

The most basic item of hospital equipment, the patient’s bed, is a common cause of falls. Falls occur among oriented patients getting in and out of bed at night in situations where there is inadequate lighting. Falls occur among disoriented or confused bed patients when bedrails are not used or are used improperly. Slippery or cluttered floors contribute to patient, staff, and even visitor falls. Patients with physical limitations or patients being treated with sensory-altering medications fall when attempting to ambulate without proper assistance. Falls result from running in passageways, carelessness when going around blind corners, and collisions between personnel and equipment. Unattended and improperly secured patients fall from gurneys and wheelchairs.

Healthcare personnel can do much to prevent the incidence of falls by following some simple procedures. These preventive measures include properly using side rails on beds, gurneys, and cribs; locking the wheels of gurneys and wheelchairs when transferring patients; and not leaving patients unattended. Safety straps should be used to secure patients on gurneys or in wheelchairs. Maintaining dry and uncluttered floors markedly reduces the number of accidental falls. Patients with physical or sensory deficiencies should always be assisted during ambulation. Patients using crutches, canes, or walkers must receive adequate instructions in the proper use of these aids before being permitted to ambulate independently. The total care environment must be equipped with adequate night lights to assist orientation and to prevent falls resulting from an inability to see.

In addition to patient falls, the HM must use proper care in assisting patients in rising and ambulating so that the patient is properly supported and the HM’s back is properly guarded. If patient lift equipment is available, ensure proper training in its use is received. This lessens the chance of the patient or the HM falling.

Per the Bureau of Labor Statistics, healthcare workers often experience musculoskeletal disorders (MSDs) at a rate exceeding that of workers in construction, mining, and manufacturing.

ELECTRICAL SAFETY PRECAUTIONS
(ONAV 5100.23 SERIES)

The expanded variety, quantity, and complexity of electrical and electronic equipment used for diagnostic and therapeutic care have markedly increased the hazards of burns, shock, explosions, and fire. It is imperative that healthcare providers at all levels are alert to such hazards and maintain an electrically safe environment. Knowledge and adherence to the following guidelines will contribute significantly to providing an electrically safe environment for all personnel, whether they are patients, staff, or visitors.

- Do not use electrical equipment with damaged plugs or cords
- Do not attempt to repair defective equipment
- Do not use electrical equipment unless it is properly grounded with a three-wire cord and three-prong plug
- Do not use extension cords or plug adapters unless approved by the Medical Repair Department or the safety officer
- Do not create a trip hazard by passing electrical cords across doorways or walkways
- Do not remove a plug from the receptacle by gripping the cord
- Do not allow the use of personal electrical appliances without the approval of the safety officer
- NEVER put water on an electrical fire
- Do not work with electrical equipment with wet hands or feet
- Have newly purchased electronic medical equipment tested for electrical safety by Medical Repair before putting it into service
• Operate all electrical and electronic equipment according to manufacturer’s instructions

• Remove from service electrical equipment that sparks, smokes, or gives a slight shock. Tag defective equipment and expedite repair

• Call Medical Repair when equipment is not functioning properly or Public Works if there is difficulty with the power distribution system

NOTE:
Be aware that patients with intravenous therapy and electronic monitoring equipment are at high risk from electrical shocks.

PHYSICAL AND CHEMICAL BURN PRECAUTIONS

Patient education should address common causes, identify risks and list precautions to be taken to eliminate the occurrence of burn injuries.

Hot Water Bottles

A common cause of burns particularly in the elderly, diabetics, and patients with circulatory impairments is the hot water bottle. When filling the bottle, the water temperature must never exceed 125°F (51°C). Test the bottle for leaks and cover it so that there is a protective layer of cloth between the patient and the bottle itself.

Heating Pads

Heating pads present a dual hazard of potential burns and electrical shock. The precautions taken when using heating pads are the same for hot water bottles: temperature control and protective cloth padding.

Precautions to be observed to avoid shock include properly maintaining the equipment, conducting pre-use inspections, and ensuring periodic safety inspections are conducted by Medical Repair personnel.

Heat (Bed) Cradle

When using the heat (bed) cradle, protect the patient from burns resulting from overexposure or placement of the equipment too close to the area being treated. As with heating pads, heat cradles present the dual hazard of potential burns and electrical shock. Another hazard to keep in mind is that of fire. Ensure that the bedding and the heat source do not come in direct contact and cause the bedding to ignite.

Heat Lamps

Occasionally, heat lamps are used to accomplish the same results as a heat cradle. Do not use towels, pillow cases, or linen of any kind to drape over heat lamps.

Ice Bags or Cold Packs

Like hot water bottles, ice bags and cold packs (packaged chemical coolant) can cause skin-contact burns. This kind of burn is commonly referred to as local frostbite. The precautions taken for applying ice bags and cold baths are the same as those for hot water bottles with regard to attention to elderly, diabetic, and patients with circulatory impairments. Additionally, ice bags should have a towel or other fabric item wrapped around it providing a barrier between the ice bag and the skin.

Hypothermia Blankets

Like ice bags, hypothermia blankets can also cause contact burns. Check the patient’s skin frequently for signs of marked discoloration (indicating indirect localized tissue damage) when using hypothermia blankets. Ensure that the hypothermia blanket does not come in direct contact with the patient’s unprotected skin.

This precaution is easily accomplished by using sheets or cotton blankets between the patient and the blanket itself. When using this form of therapy, follow both the physician’s orders and the manufacturer’s instructions in managing the temperature control of the equipment.
Steam Vaporizers and Hot Foods and Liquids

Steam vaporizers and hot foods and liquids are common causes of patient burns. When using steam vaporizers ensure that the vapor of steam does not flow directly on the patient as a result of the initial equipment positioning or by accidental movement. Patients that are sensitive to hot foods and liquids are more likely burned. Because of lack of coordination, weakness, or medication, patients may be less able to handle hot foods and liquids safely without spilling them.

In the direct patient care units as well as in diagnostic and treatment areas, there is unlimited potential for inflicting burns on patients. When the modern electrical and electronic equipment and the potent chemicals used for diagnosis and treatment are used properly, they contribute to the patient’s recovery and rehabilitation. Used carelessly or improperly, these same sources may cause patients additional pain and discomfort, serious illness, or, in some cases, even death.

FIRE AND EXPLOSION PRECAUTIONS

Healthcare facilities have very strict safety features engineered and constructed into them, making them very safe. Along with building safety features, good housekeeping, maintenance, education, and good discipline all contribute to fire prevention. Good housekeeping entails keeping trash within the confines of its containers and emptying them when full. Keeping passageways cleared of clutter, furniture, and equipment. Never leave heat producing items unattended. Good maintenance includes checking, reporting, and ensuring correct repair of electrical equipment, and routine checking of firefighting equipment by qualified personnel.

The education and training of personnel are the most effective means of preventing fires. Good discipline means developing a fire plan to use as outlined in a fire bill, having periodic fire drills, and enforcing no-smoking regulations.

Fire Evacuation Procedures

Staff members should be familiar with the fire regulations at their duty station and know what to do in case of fire. Staff should know how to report a fire, use a fire extinguisher, and evacuate patients. When a fire occurs, there are certain basic rules to follow: (1) The senior person should take charge and appoint someone to notify the fire department and the officer of the day of the exact location of the fire. (2) Everyone should remain calm. (3) All oxygen equipment, vacuum lines, and electrical appliances must be turned off unless such equipment is necessary to sustain life. (4) All windows and doors should be closed and all possible exits cleared. (5) When necessary and directed by proper authority, patients should be removed in a calm and orderly fashion and mustered at the designated relocation area.

Smoking Regulations

By regulation (BUMEDINST 6200.12 series, Tobacco Use in Navy Medical Department Activities), smoking is no longer permitted in Navy treatment facilities. To ensure general safety and awareness of this prohibition, inform patients, visitors, and staff of the facility’s no-smoking status by prominently displaying “No Smoking” signs throughout the hospital especially in rooms and areas where oxygen and flammable agents are used and stored.

GENERAL SAFETY

In addition to the specifics presented earlier, other basic principles are relevant to patient safety including:

- Ensure the patients are familiar with their environment, thus making it less hazardous to them. This familiarization can be accomplished by showing the patients the floor plan of the ward they have been admitted to and by indicating key areas (lounge, bathrooms, nursing station, etc.) that may be of interest to them.
• Be aware of patient sensory impairment and incorporate precautionary procedures into their patient care plan. For example, this principle can be applied to patients who have been given a pain medication, such as morphine or Demerol®. Medications such as these dull body senses. If a patient in this condition wishes to walk around, precautionary actions dictate that the HM either accompany the patient with a patient belt to prevent accidental falls or that the HM does not permit the patient to ambulate until the effects of the medication have stopped.

• Understand that all diagnostic and therapeutic measures have the potential to cause a patient harm.

• Ensure that all accidents and incidents are documented and analyzed to identify and correct high-risk safety hazards.

**ENVIRONMENTAL HYGIENE**

**LEARNING OBJECTIVE:**

*Identify environmental hygiene concerns in a medical treatment facility.*

Today’s public is very much aware of the environment and its effect on the health and comfort of human beings. The healthcare setting is a unique environment and has a distinct character of its own. The HM needs to be aware of that character and ensure that the environment will support the optimum in health maintenance, care, and rehabilitation.

In the context of the environment, hygiene may best be described as practices that provide a healthy environment. Environmental hygiene practices include the following three areas of concern: safety (which has already been addressed); environmental comfort and stimuli; and infection control. HMs have certain responsibilities for helping to control the facility’s general environment as well as the patient’s immediate surroundings.

**CONCURRENT AND TERMINAL CLEANING**

Maintaining cleanliness is a major responsibility of all members of the healthcare team, regardless of their position on the team. Cleanliness not only provides for patient comfort and a positive stimulus, it also impacts on infection control. The HM is often directly responsible for the maintenance of patient care areas. The management of cleanliness in patient care areas is conducted concurrently and terminally.

**Concurrent cleaning** is the disinfection and sterilization of patient supplies and equipment during hospitalization. **Terminal cleaning** is the disinfection and sterilization of patient supplies and equipment after the patient is discharged from the unit or hospital. Both concurrent and terminal cleaning are extremely important procedures that not only aid the patient’s comfort and psychological outlook, but also contribute to both efficient physical care and control of the complications of illness and injury.

**AESTHETICS**

Aesthetically, an uncluttered look is far more appealing to the eye than an untidy one. Other environmental factors, such as color and noise, can also enhance or hinder the progress of a person’s physical condition. In the past, almost all healthcare facilities used white as a basic color for walls and bedside equipment. However, research has shown that the use of color is calming and restful to the patient. Rest is a very important healing agent in any kind of illness. Colors other than white are being added to the hospital palate to help aid in a restful recovery for the patients.

Noise control is another environmental element that requires the HM’s attention. The large number of people and the amount of equipment traffic in a facility serve to create a high noise level that must be monitored. Add to that the noise of multiple radios and televisions, and it is understandable why noise control is necessary if a healing environment is to be created and maintained.
CLIMATE CONTROL

Another important aspect of environmental hygiene is climate control. Many facilities use air conditioning or similar control systems to maintain proper ventilation, humidity, and temperature control. In facilities without air conditioning, windows should be opened from the top and bottom to provide for cross-ventilation. Ensure that patients are not located in a drafty area. Window sill deflectors or patient screens are often used to redirect drafty airflows. Maintain facility temperatures at recommended energy-conservation levels that are also acceptable as health-promoting temperatures. In addition to maintaining a healthy climate, good ventilation is necessary in controlling and eliminating disagreeable odors.

In cases where airflow does not control odors, room fresheners should be discretely used. Offensive, odor-producing articles (such as soiled dressings, used bedpans, and urinals) should be removed to appropriate disposal and disinfecting areas as rapidly as possible. Objectionable odors (such as bad breath or perspiration of patients) are best controlled by proper personal hygiene and clean clothing.

In isolation rooms ensure that there is proper negative pressure by checking wall gages and evaluating the airflow. Operating rooms are required to have positive pressure as regulated by gauges. If the gauges are not indicating proper pressures or operating properly, contact Industrial Hygiene and Facilities to verify airflow and to take corrective actions.

LIGHTING

Natural light is important in the care of the sick. Sunlight usually brightens the area and helps to improve the mental well-being of the patient. However, light can be a source of irritation if it shines directly in the patient’s eyes or produces a glare from the furniture, linen, or walls. Adjust shades or blinds for the patient’s comfort. Artificial light should be strong enough to prevent eyestrain and diffused enough to prevent glare.

Whenever possible, provide a bed lamp for the patient. As discussed earlier under "Safety Aspect," a dim light is valuable as a comfort and safety measure at night. This light should be situated so it will not shine in the patient’s eyes and yet provide sufficient light along the floor so that all obstructions can be seen. A night light may help orient elderly patients if they are confused as to their surroundings upon awakening.

In conclusion, it is important that the HM understand the effects of the environment on patients. People are more sensitive to excessive stimuli in the environment when they are ill, and they often become irritable and unable to cooperate in their care. This is particularly apparent in critical care areas (e.g., in CCUs and ICUs) and isolation, terminal, and geriatric units. HMs must realize and respond to the vital importance of the environment in the total medical management plan of their patients.

SUMMARY

This chapter introduced inpatient care for various types of patients that will be encountered. It has also introduced standard rules of hygiene, applying casts, ambulatory aids, safety, and environment hygiene. Having a good understanding of these areas of patient care will give the HM a good base from which to care for patients in a multitude of inpatient care settings.
CHAPTER 13

NUTRITION AND DIET THERAPY

NUTRITION

LEARNING OBJECTIVE:

Identify the essential elements of life-sustaining nutrition.

GENERAL OVERVIEW

Eating healthy is a primary key to maintaining health. With many years of an unhealthy diet, people tend to develop chronic diseases such as obesity, diabetes, and heart disease. Healthy eating may help prevent disease. Eating properly after being diagnosed with a nutrition related disease is critical in long term disease management.

When illness or disease strike, a person’s nutritional needs will change. Many times the need for calories and other nutrients go up. Other dietary needs may change as well depending on the person’s illness, injury, disease, or condition.

A Hospital Corpsman (HM) must recognize the importance nutrition plays in both health and disease. Eating well in a healthy state is just as critical as eating well in the diseased state. The HM’s diet can be an example to shipmates in demonstrating proper food choices. The HMs knowledge and expertise can help lead people to improving their own diets.

ENERGY BALANCE

The human body has basic needs for energy. Energy comes from the food people eat. This energy is measured in calories (actually kilocalories, the word calorie is for general reference). Figure 13-1 demonstrates energy balance or the point where a person can maintain a weight level by expending as many calories as are consumed.

If a person eats more calories than necessary and or does not burn enough calories, there will be a weight gain. Weight gain is a leading cause of nutrition related diseases along with genetics and the environment in which people live. The opposite is true for weight loss; additionally, there are many conditions that can cause unintentional weight loss.

![Energy Balance Diagram]

The number of calories each person needs varies by age, gender, and activity level. There is no “one size” fits all for calorie recommendations. Generally, males require more calories than females and the more active a person is, the more calories needed. If a person performs mostly general office tasks, they can be considered ‘sedentary’. If a person is engaged in performing manual labor, they may be considered ‘moderately active’. The ‘very active’ people are engaging in high levels of exercise, combat, or similar tasks.
Table 13-1 shows a general number of calories based on a person’s age and activity level.

<table>
<thead>
<tr>
<th></th>
<th>Sedentary</th>
<th>Moderately Active</th>
<th>Very Active</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19-30</td>
<td>2400-2600</td>
<td>2600-2800</td>
<td>3000</td>
</tr>
<tr>
<td>31-50</td>
<td>2200-2400</td>
<td>2400-2600</td>
<td>2800-3000</td>
</tr>
<tr>
<td>51-70</td>
<td>2000-2200</td>
<td>2200-2400</td>
<td>2600-2800</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31-50</td>
<td>1800</td>
<td>2000</td>
<td>2200</td>
</tr>
<tr>
<td>51-70</td>
<td>1600</td>
<td>1800</td>
<td>2000-2200</td>
</tr>
</tbody>
</table>

Table 13-1.—Generally Recommended Calories Based on Gender, Age, and Activity Level

A goal for the general population is to maintain a healthy weight. A healthy weight is defined by having a “healthy” Body Mass Index (BMI). BMI is calculated by dividing a person’s weight in kilograms (2.2# = 1 kg) by the person’s height in meters squared (2.54 cm = 1 inch) or kg/m². A normal weight BMI is 18.5 kg/m² to 24.9 kg/m². Persons below 18.5 kg/m² are considered underweight, persons with a BMI of 25.0 – 29.9 kg/m² are overweight, and persons with a BMI ≥ 30 g/m² are considered obese. Table 13-2 shows the categories of BMI.

<table>
<thead>
<tr>
<th>BMI</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 18.5 kg/m²</td>
<td>Underweight</td>
</tr>
<tr>
<td>18.5 – 24.9 kg/m²</td>
<td>Normal weight</td>
</tr>
<tr>
<td>25.0 – 29.9 kg/m²</td>
<td>Overweight</td>
</tr>
<tr>
<td>30.0 – 34.9 kg/m²</td>
<td>Class I Obesity</td>
</tr>
<tr>
<td>35.0 – 39.9 kg/m²</td>
<td>Class II Obesity</td>
</tr>
<tr>
<td>≥ 40.0 kg/m²</td>
<td>Class III Obesity</td>
</tr>
</tbody>
</table>

Table 13-2.—Categories of BMI

Data from 2005-2006 demonstrates that over one-third of the United States population is obese. The Centers for Disease Control and Prevention (CDC) have demonstrated obesity rates in the U.S. have steadily risen since 1985. The CDC maintains an active website on overweight and obesity located at www.cdc.gov.

The Physical Fitness Assessment (OPNAVINST 6110.1 series, Physical Readiness Program) is one way of preventing overweight and obesity in the Navy. Resources are available to assist sailors in managing their weight through OPNAVINST 6110.1 and various other Health Promotion programs available at both local commands and at the Navy & Marine Corps Public Health Center website located at http://www.nehc.med.navy.mil.

HEALTHY EATING

Healthy eating starts with the Food Guide Pyramid (Fig. 13-2). The five food groups eaten in adequate amounts daily are designed to maintain the health of the population of the United States. The principles of the Food Guide Pyramid are proportionality, variety, moderation, personalization, activity, and gradual improvement. For a full review of the Food Guide Pyramid, go to www.mypyramid.gov.
Each color of the pyramid represents a food group. The small yellow sliver represents fats and oils, which are not a food group but are essential in small quantities. The five food groups from left to right are Grains (orange); Vegetables (green); Fruit (red); Fats, oils, and discretionary calories (yellow); Milk (blue); and Meat and Beans (purple). The grain group consists of breads, rice, crackers, cereal, pasta and similar items. It is recommended at least half of grains consumed be whole grains, such as whole wheat bread or pasta, brown rice, and whole grain cereals.

A variety of different color vegetables and fruits are recommended each day. The milk group is a main supplier of protein, calcium, and vitamin D. When choosing from the meat and beans group, people should choose lean meats. Table 13-3 demonstrates the quantity of each group associated with an amount of calories a person may consume in a day.

### NUTRIENTS

A nutrient is a substance that contributes to growth or maintenance of the body. There are six essential nutrients: water, carbohydrates, protein, fat, vitamins, and minerals. Three of these contain calories: carbohydrates, protein, and fat. Carbohydrates have four calories per gram, protein has four calories per gram, and fat has nine calories per gram. Water, vitamins, and minerals do not contain calories. The food guide pyramid demonstrates the categories of food to eat to meet the average daily nutrient needs; a variety of foods should be eaten from all five groups.

### Water

Water is THE most important nutrient. A person cannot survive for very long without water, an average of three days. Water is the medium in which all chemical reactions in the body take place. It is the main component of blood, which transports nutrients to the entire body and the means by which the body excretes many of the waste products it generates (i.e. urine).

Recommendations for water needs vary by gender. On the average a male needs more water on a daily basis than a female. According to the National Academy of Science a male needs to consume 3.7 liters of water daily vice that of the 2.7 liters needed to be consumed daily by females. Water is found in food to a wide degree making the average free water need (non-food-bound water or liquid) 3 liters for men and 2.2 liters for females.

Water needs will increase based on the environment and activity level. The hotter it is, the more work the body performs to keep the body cool through sweating. Water losses due to sweat vary from person to person and also due to the environment. Water (and other essential nutrients) can also be lost by vomiting and diarrhea. It is critical to prevent or stop these losses and replace fluids and electrolytes as quickly as possible.

<table>
<thead>
<tr>
<th>Calorie Level</th>
<th>Grain</th>
<th>Vegetables</th>
<th>Fruit</th>
<th>Milk</th>
<th>Meat and Beans</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200</td>
<td>4 oz</td>
<td>1.5 cups</td>
<td>1 cup</td>
<td>2 cups</td>
<td>3 oz</td>
</tr>
<tr>
<td>1400</td>
<td>5 oz</td>
<td>1.5 cups</td>
<td>1.5 cups</td>
<td>2 cups</td>
<td>4 oz</td>
</tr>
<tr>
<td>1600</td>
<td>5 oz</td>
<td>2 cups</td>
<td>1.5 cups</td>
<td>3 cups</td>
<td>5 oz</td>
</tr>
<tr>
<td>1800</td>
<td>6 oz</td>
<td>2.5 cups</td>
<td>1.5 cups</td>
<td>3 cups</td>
<td>5 oz</td>
</tr>
<tr>
<td>2000</td>
<td>6 oz</td>
<td>2.5 cups</td>
<td>2 cups</td>
<td>3 cups</td>
<td>5.5 oz</td>
</tr>
<tr>
<td>2200</td>
<td>7 oz</td>
<td>3 cups</td>
<td>2 cups</td>
<td>3 cups</td>
<td>6 oz</td>
</tr>
<tr>
<td>2400</td>
<td>8 oz</td>
<td>3 cups</td>
<td>2 cups</td>
<td>3 cups</td>
<td>6.5 oz</td>
</tr>
</tbody>
</table>

Table 13-3.—Quantity of Food per Food Group by Calorie Level

13-3
Water needs may increase 2.5 to 4.5 liters per day based on sweat losses, temperature, activity level, and other water depleting factors. Upper tolerance levels for water intake are approximately 8 liters. Water toxicity, which can result in death, is quite possible with intakes above 8 liters.

The human body is approximately 60% water. Loss of body water, or dehydration, can be life threatening. As little as a 1 to 2% loss can cause decreases in overall body performance and a loss of 5 to 7% can lead to heat injury or death.

The old saying “a pint’s a pound the world around” is a simple, yet effective way to stay hydrated or rehydrate. For every one pound loss of body weight, a person should drink one pint, or 16 fluid ounces. Weight is the best way to check for dehydration, but in the absence of a scale, urine color can be a crude measure of hydration status, the more color in the urine or ‘darker’ yellow it is, the more fluid one needs. Both methods can be used to help a person remain hydrated.

**Carbohydrates**

Carbohydrates are made by green plants through photosynthesis. The sun’s energy, combined with water absorbed by the plant from the environment and carbon dioxide absorbed through the plant make sugar in the presence of chlorophyll. Plant sugar in its simplest form is called glucose, a monosaccharide. Sugars are simple forms of carbohydrates. Fructose, galactose, and glucose are monosaccharides. Sucrose, lactose, maltose are disaccharides. Starches, glycogen, and fiber are polysaccharides.

Starches are plant-based long chains glucose molecules. Starches occur in foods such as potatoes, rice, pasta, corn, peas, and wheat. Glycogen is the storage form of glucose in animals and humans. The body makes glycogen through the process of glycogenesis and stores it in the muscles and liver. There is usually between 2000 and 3000 calories in body stores of glycogen. Maximizing glycogen stores in the body can be accomplished through a proper balance of eating well and exercising; this can increase a person’s physical performance, usually allowing the person to exercise longer.

Fiber is a non-digestible, non-essential, plant-based polysaccharide that plays a significant role in digestion and elimination. Fiber can be further defined as soluble or insoluble. Fruits, vegetables, and whole grain products vary in type of fiber. Good soluble fiber sources are oatmeal, beans, and nuts. Soluble fiber has been linked to helping people lower blood cholesterol levels. Insoluble fiber is usually found in whole grains and most vegetables. The general recommendation for fiber intake is 25 grams for women and 37 grams for men; most Americans do not usually consume these levels of fiber. Exceeding these levels can be detrimental to one’s health, leading to nutrient malabsorption and constipation or impaction.
Carbohydrates should consist of between 40 and 60% healthy person’s diet. The food guide pyramid is proportioned to assist a person to achieve this level of carbohydrate. Excess calories from carbohydrates are easily stored as fat.

Another commonly used source of carbohydrate is dextrose. Usually used in intravenous fluids, dextrose has 3.4 calories per gram. One liter of D5 is a 5% dextrose solution. To determine how many calories that is, multiply 1000mL (1L) by .05 (5%) which equals 50 grams of dextrose. Multiply 50 grams by 3.4 calories per grams and there are 170 calories in 1 liter of D5.

Protein

Proteins are commonly referred to as the "building blocks" of the body. Proteins have many functions in the body such as enzymes and hormones and are the main component of most body tissues. Skin, hair, blood, muscles, and all of the body's organs are made of protein. Proteins are made of carbon, hydrogen, and an amine (a nitrogen containing molecule). Proteins contain 4 calories per gram.

Proteins are made up of amino acids. There are 20 amino acids that make up all the proteins the body needs. Of these, 9 are considered essential amino acids, meaning the body cannot make them itself. The essential amino acids are tyrosine, valine, tryptophan, isoleucine, leusine, lysine, phenylalanine, methionine, and histidine. They can be remembered by the pneumonic (TV TILL PM H). The 11 other amino acids can be synthesized by the body. Amino acids are connected by peptide bonds to form proteins. Many proteins are interdependent on other proteins and some on minerals such as iron with the protein in the blood, e.g., hemoglobin.

In general, proteins support growth and maintenance of the body, build enzymes, hormones, and antibodies to defend the body. Additionally, proteins maintain fluid and electrolyte balance, preventing edema, and thus maintaining acid-base balance in the blood.

Animals are the main consumable source of protein. They include such items as meat, milk, and eggs which are 'complete' proteins. Plants also contain various amounts of protein, but plant sources of protein are not complete proteins, meaning they do not contain enough of a variety of amino acids to build the proteins people need. If a variety of plants are eaten, the mix of amino acids would supply the body with all the essential amino acid combinations and allow it to make the necessary proteins.

Protein that is consumed can be qualified on a scale of high biological value; referred to as the protein digestibility corrected amino acid score (PDCAAS). High biological value protein provides the most useful mix of amino acids. Egg whites have the highest value followed by beef, chicken, and other animal products to include milk. Grains, vegetables, legumes, and beans also contain protein, but are of lower biological value.

The recommended amount of protein for all adults is 0.8g/kg/day. For a person who weighs 176 pounds or 80 kg (pounds divided by 2.2), the person requires 64 g of protein per day. Protein needs are higher for infants and children and vary widely among different disease states. For example, a patient with renal disease may only require 0.6g/kg/day to maintain kidney function, whereas a trauma patient may require upwards of 2.0 to 2.5g/kg/day to heal. Always defer disease-specific protein needs for a patient to a Registered Dietitian or adequately trained medical professional.
The protein of meat is approximately 7g per oz, milk has 8g per 8 fluid oz, bread products have approximately 3g per slice or equivalent, vegetables contain approximately 2g per 1 cup raw or ½ cup cooked. Fruits contain virtually no protein.

The role of protein in disease is critical. Under-nutrition and protein-energy malnutrition typically indicate the need for more protein in a person’s diet. These states are commonly seen in underdeveloped countries where food is scarce and poverty is widespread. Although under-nutrition is seen in the United States, it is not common. Over-nutrition is more common and is expressed in disease states such as obesity and arteriosclerosis. Protein is not directly responsible for these diseases, but a main source of protein, meat is also a good source of saturated fat which has been shown to contribute to many diseases and chronic conditions.

Fat

Fats or lipids are as equally important to the body as carbohydrates and protein. The main role of fat in the body is to supply energy. Fat is the main energy source of aerobic metabolism and sustained exercise and is reliant on glucose, or carbohydrates, to be metabolized. Fat serves in thermoregulation of the body, cushions the organs, is a source of the 4 fat soluble vitamins – vitamins A, D, E, and K, provides us with a feeling of satiety when eaten, is the main molecule of the cell walls, and provides the body with essential fatty acids.

Fat is calorically dense and at 9 calories per gram is more than double the calories per gram of both carbohydrates and protein. Using any oil as an example, 1 tablespoon of fat contains approximately 45 calories, the equivalent of about 2 oz of meat or a little less than a half a cup of fruit.

Fat is found in plants and animals. Animal fats (chicken skin, the marbling in beef, butter, and milk fat) are saturated fats or fatty acid chains that are ‘saturated’ with hydrogen atoms. Saturated fats have been closely linked to heart disease.

There are two other types of fats, monounsaturated and polyunsaturated. Monounsaturated fats contain one double bond between two carbon molecules, which in turn eliminates a hydrogen from each of the carbon atoms. Olive oil, peanut oil, and sesame oil are examples. Monounsaturated fats are generally healthy fats, but burn easily when used in cooking. Polyunsaturated fats contain two or more double bonds among the carbon atoms. Canola oil, safflower oil, and soybean oil are examples. Polyunsaturated fats are used widely for frying foods.

The general recommendation for fat intake is to consume between 20 and 35% of one’s total caloric intake as fat. To calculate grams of allowable fat per day, multiply the total estimated calorie need, 1800 calories for example, by .2 or .35, which results in a range of 40 to 70 grams of fat per day. Lower amounts are encouraged for overall general health. Extreme avoidance of fat can lead to fatty acid deficiencies. Most Americans meet or exceed the recommended amount and should limit high fat foods that contribute to obesity and related diseases such as whole milk, cheese, cream, high fat meats, fried foods, butter, and oils.

Trans fats are not naturally occurring fats and are generally not considered a healthy fat. Trans fats, or hydrogenated fats, are chemically formed using naturally occurring fats and possess properties appealing to make foods more crispy, crunchy, taste better, or last longer. Trans fats are similar to saturated fats in structure and have been linked to obesity and heart disease.
Omega-3 fatty acids are a naturally occurring polyunsaturated fat that have been linked to lessening the risk for heart disease and improving joint health. Omega-3 fatty acids can be found in salmon, halibut, walnuts, and flax seed. Grass fed beef and eggs from grass fed chickens are also worthy sources. An easy way to consume adequate amounts of omega-3 fatty acids is through supplementation. A person should verify that the supplement contains adequate amounts of both omega-3 fatty acids eicosapentanenoic acid and docosahexaenoic acid.

Cholesterol, a sterol, is also a member of the lipid family. It is mentioned in a negative way related to increasing the risk for heart disease, but it is actually a critical part of many hormones to include testosterone and estrogen. It is also part of every cell in the body and is a part of brain structure and nerve cells. It is not essential in diets since the body can easily manufacture the amount needed. Cholesterol is only found in animal products.

Phospholipids are also considered lipids and are manufactured by the human body. Phospholipids are mainly emulsifiers in the body, aside from being part of cell structure. The most common phospholipid is bile which is made in the liver and allows fat to be digested in the body.

Vitamins are essential, non-calorie containing compounds found in food and needed in the body in small amounts. Vitamins mainly act as enzymes or catalysts and they assist in making necessary chemical reactions occur in the body.

Vitamins are either fat soluble or water soluble. Fat soluble vitamins include vitamins A, D, E, and K. Water soluble vitamins include vitamin C, thiamin, riboflavin, niacin, B6, B12, folic acid, pantothenic acid, and biotin.

Table 13-4 is a guide to the role of the most common vitamins. It is designed as a guide and more advanced texts are recommended to discuss specific roles of the vitamins. The National Academies Press is a valuable reference on these essential micronutrients and can be accessed at www.nap.edu or through the USDA’s Food and Nutrition Information Center at http://fnic.nal.usda.gov.

Minerals

Minerals serve many functions in the body much like vitamins. Minerals are substances found in the Periodic Chart of the Elements which can be found in any basic chemistry book. Calcium, phosphorus, magnesium, sodium, chloride, potassium, and sulfur are commonly referred to as the major minerals. Iron, zinc, iodine, selenium, copper, manganese, fluoride, chromium, molybdenum are referred to as trace minerals. Both the major and trace minerals serve critical functions in the body. All of the mineral needs can be met through eating a wide variety of foods from all the food groups.

Table 13-5 lists information on the minerals and just like the vitamins, more advanced texts are recommended to discuss their specific roles. The National Academies Press is a valuable reference on these essential micronutrients and can be accessed at www.nap.edu or through the USDA’s Food and Nutrition Information Center at http://fnic.nal.usda.gov.
<table>
<thead>
<tr>
<th>Vitamin</th>
<th>Recommended daily amount (19–30 year olds)</th>
<th>Sources</th>
<th>Role</th>
<th>Deficiency</th>
<th>Toxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>900 μg</td>
<td>Milk, cheese, eggs, liver As beta-carotene: leafy green vegetables, carrots, apricots, cantaloupe, sweet potato, pumpkin</td>
<td>Vision, skin health, immunity, bone and tooth health</td>
<td>Night blindness, (small-cell) anemia, corneal degeneration</td>
<td>Red blood cell lysis, bone pain, abdominal pain, dry skin and rashes, loss of hair, enlargement of spleen and liver</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>200 μg</td>
<td>Sunlight, milk, eggs, liver, sardines</td>
<td>Mineralization of bones</td>
<td>Rickets, osteomalacia</td>
<td>Raised blood calcium</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>15 mg</td>
<td>Plant fats, green leafy vegetables, whole grains, nuts, seeds</td>
<td>Antioxidant</td>
<td>Red blood cell lysis, weakness</td>
<td>Uncommon</td>
</tr>
<tr>
<td>Vitamin K</td>
<td>120 μg male 90 μg female</td>
<td>Synthesized in digestive tract, liver, eggs, green leafy vegetables, milk, green tea</td>
<td>Blood clotting</td>
<td>Hemorrhaging</td>
<td>Interferes with anticlotting medications (warfarins)</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>90 mg male 75 mg female</td>
<td>Citrus fruits, peppers, tomatoes, potatoes, dark green vegetables, cantaloupe, strawberries</td>
<td>Collagen synthesis, wound healing, antioxidant, assist absorption of iron</td>
<td>Scurvy</td>
<td>Nausea, diarrhea</td>
</tr>
<tr>
<td>Thiamin</td>
<td>1.2 mg male 1.1 mg female</td>
<td>Pork, liver, whole grains, legumes, nuts</td>
<td>Energy metabolism, nervous system function</td>
<td>Beriberi</td>
<td>None</td>
</tr>
<tr>
<td>Riboflavin</td>
<td>1.3 mg male 1.1 mg female</td>
<td>Milk, yogurt, meat, green leafy vegetables, whole grain and enriched breads and cereals</td>
<td>Energy metabolism, vision and skin health</td>
<td>Cheilosis, photophobia, rash</td>
<td>None</td>
</tr>
<tr>
<td>Niacin</td>
<td>16 mg male 14 mg female</td>
<td>Milk, eggs, meat, poultry, fish, whole grain and enriched breads and cereals, nuts, protein containing foods</td>
<td>Energy metabolism, DNA, skin, nervous system, and digestive health</td>
<td>Pellagra, smooth tongue, diarrhea</td>
<td>Painful flushing and rash</td>
</tr>
<tr>
<td>B6</td>
<td>1.3 mg</td>
<td>Green leafy vegetables, meat, shellfish, legumes, fruit, whole grains</td>
<td>Amino acid and fatty acid metabolism, converts tryptophan to niacin, helps make red blood cells</td>
<td>Anemia, smooth tongue</td>
<td>Damage to nerves, bloating, impaired memory, loss of reflexes</td>
</tr>
<tr>
<td>B12</td>
<td>2.4 μg</td>
<td>Animal products</td>
<td>New cell synthesis, maintains nerve cells</td>
<td>Anemia, smooth tongue, fatigue</td>
<td>None</td>
</tr>
<tr>
<td>Folic Acid</td>
<td>400 μg</td>
<td>Green leafy vegetables, legumes, seeds, liver</td>
<td>New cell synthesis</td>
<td>Anemia, smooth, red tongue, masks B12 deficiency</td>
<td>None</td>
</tr>
<tr>
<td>Pantothenic Acid</td>
<td>5 mg</td>
<td>Abundant in food</td>
<td>Energy metabolism</td>
<td>Vomiting, intestinal distress, insomnia, fatigue</td>
<td>None</td>
</tr>
<tr>
<td>Biotin</td>
<td>30 μg</td>
<td>Abundant in food</td>
<td>Energy metabolism, fat and glycogen synthesis, amino acid metabolism</td>
<td>Heart abnormalities, fatigue, rash, loss of hair</td>
<td>None</td>
</tr>
</tbody>
</table>

Table 13-4.—The Vitamins
<table>
<thead>
<tr>
<th>Mineral</th>
<th>Recommended daily amount (19–30 year olds)</th>
<th>Sources</th>
<th>Role</th>
<th>Deficiency</th>
<th>Toxicity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>1000 mg</td>
<td>Milk, oysters, tofu, green leafy vegetables, legumes</td>
<td>Principle mineral of bones and teeth, muscle function, blood clotting, blood pressure</td>
<td>Stunted growth, bone loss</td>
<td>Rare</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>700 mg</td>
<td>Animal tissue</td>
<td>Energy transfer, genetic material, buffering systems, bone and teeth formation</td>
<td>Unknown</td>
<td>May cause calcium excretion</td>
</tr>
<tr>
<td>Magnesium</td>
<td>400 mg male 310 mg female</td>
<td>Nuts, legumes, whole grains, dark green leafy vegetables, seafood, chocolate, cocoa</td>
<td>Bone mineralization, protein synthesis, enzymes, muscle contraction, transmission of nerve impulses</td>
<td>Weakness, confusion, depressed pancreatic hormone secretion, growth failure, hypocalcemia</td>
<td>Usually with laxative abuse, confusion, lack of muscle coordination, coma, death</td>
</tr>
<tr>
<td>Sodium</td>
<td>1.5 g</td>
<td>Salt, soy sauce, processed foods, meat, cured meats</td>
<td>Normal fluid balance, nerve impulses, major extracellular ion</td>
<td>Muscle cramps, changes in mental status</td>
<td>Hypertension</td>
</tr>
<tr>
<td>Chloride</td>
<td>2.3 g</td>
<td>Salt, processed foods</td>
<td>Part of hydrochloric acid used in digestion</td>
<td>Muscle cramps, changes in mental status</td>
<td>Rare, vomiting</td>
</tr>
<tr>
<td>Potassium</td>
<td>4.7 g</td>
<td>Milk, many fruits and vegetables, whole grains, legumes</td>
<td>Normal fluid balance, protein and glycogen synthesis, nerve impulses, smooth muscle function, including the heart</td>
<td>Usually associated with dehydration, muscle weakness, mental status changes, death</td>
<td>Muscle weakness, vomiting, if given IV, death</td>
</tr>
<tr>
<td>Sulfur</td>
<td>Not determinable</td>
<td>Protein containing foods</td>
<td>Part of some amino acids, biotin, thiamine, insulin, stabilizes proteins</td>
<td>None</td>
<td>Rare</td>
</tr>
<tr>
<td>Iodine</td>
<td>150 μg</td>
<td>Iodized salt, seafood, bread</td>
<td>Thyroid function, which regulates growth, development and metabolic rate</td>
<td>Goiter, cretinism</td>
<td>Depressed thyroid activity</td>
</tr>
<tr>
<td>Iron</td>
<td>8 mg male 18 mg female</td>
<td>Red meat, fish, shellfish, poultry, eggs, dried fruits, legumes</td>
<td>Carrying oxygen via hemoglobin, part of myoglobin, energy metabolism</td>
<td>Anemia</td>
<td>Liver injury</td>
</tr>
<tr>
<td>Zinc</td>
<td>11 mg male 8 mg female</td>
<td>Meats, fish, shellfish, poultry, grains, vegetables</td>
<td>Part of many enzymes, immunity, wound healing, taste</td>
<td>Growth failure in children, sexual retardation, loss of taste, poor wound healing</td>
<td>Fever, nausea, vomiting, diarrhea, muscle dysfunction, anemia, kidney failure</td>
</tr>
<tr>
<td>Selenium</td>
<td>55 μg</td>
<td>Seafood, organ meats, whole grains</td>
<td>Works with vitamin E as an antioxidant</td>
<td>Cardiomyopathy, muscle discomfort, weakness</td>
<td>Nausea, abdominal pain, nail and hair changes, nerve damage</td>
</tr>
<tr>
<td>Fluoride</td>
<td>4 mg male 3 mg female</td>
<td>Fluorinated drinking water, milk, egg yolks, seafood</td>
<td>Bone and teeth health</td>
<td>Tooth decay</td>
<td>Fluorosis, nausea, vomiting, diarrhea, chest pain, itching</td>
</tr>
<tr>
<td>Chromium</td>
<td>35 μg male 25 μg female</td>
<td>Meat, unrefined grains, vegetable oil</td>
<td>Works with insulin to regulate blood glucose levels, fat metabolism</td>
<td>Abnormal glucose metabolism</td>
<td>Unknown</td>
</tr>
<tr>
<td>Copper</td>
<td>900 μg</td>
<td>Meat, drinking water, nuts, beans, whole grains</td>
<td>Part of hemoglobin, collagen, and some enzymes, wound healing</td>
<td>Anemia</td>
<td>Vomiting, diarrhea</td>
</tr>
</tbody>
</table>

Table 13-5.—The Minerals

13-9
DIET THERAPY

LEARNING OBJECTIVE:

Select the appropriate diet for various medical conditions.

It is inevitable people will get conditions or diseases that require diet modification. Some conditions may be temporary such as a tonsillectomy, pregnancy, or trauma and others will require food vigilance for a lifetime, such as diabetes, obesity, heart disease, kidney disease, or cancer. Regardless of the condition or disease, the goal is the same, to improve or maintain health.

Many hospitalized patients will require diet modifications. A diet order from a physician is required for any person admitted to a hospital. It is prudent to be familiar with common diet orders and to check a patient’s diet order prior to that patient consuming anything by mouth. If a patient receives or consumes food not in accordance with a physician’s diet order it may result in patient dissatisfaction, further illness, delays in procedures or surgeries, and in rare cases, death.

Cleanliness and hygiene are important parts of feeding. Personal hygiene must be maintained, washing hands frequently and maintaining appropriate food sanitation. (Check with the local Preventive Maintenance Authority and the NAVMED P-5010, Chapter 1, Food Safety). Every patient should have clean hands and a clean oral cavity prior to and after eating, as well as a clean area to place the tray upon its arrival to a patient’s room. A patient should be sitting up comfortably in bed or in a chair while eating. When the tray arrives at the patient’s room set it where the patient can reach it. Ensure the patient can perform normal duties of eating such as cutting up meat and holding a spoon or fork; assist if the patient is vision or otherwise impaired. Do the best to make the patient’s eating experience functional and enjoyable.

Many patients may be on special precautions while eating to prevent choking or aspiration. Signs of aspiration are choking, gagging, or coughing, but aspiration can also be silent. If aspiration is suspected, report it to the medical team.

Patients are commonly on ‘calorie counts’ to assist the dietary staff in assessing the patient’s calorie and protein intake. If a patient is on a calorie count, record what and how much a patient consumes at each meal and snack. This information can be valuable in the development of a patient’s nutritional care plan.

Another important aspect of a patient’s dietary needs is the personal preferences. It is notable that many of a patient’s food preferences may not be congruent with their diet order or disease state. In these situations, achieving patient compliance and being familiar with the food and services available through the hospital’s food service department can make a significant difference in a patient’s recovery as well as his or her overall hospital experience.

NOTE:

If a patient requests or has delivered a food item not on the approved diet, authorization MUST be obtained from the Nurse in charge or the Registered Dietician in order for the patient to be allowed to consume that item.

THERAPEUTIC DIETS

Dietary modifications can be used in hospitalized patients, patients with acute conditions, and ambulatory patients who have chronic diseases such as diabetes, obesity, or heart disease. Special diets are used in the treatment of disease are often referred to by specific names that show a special composition (Low sodium, Low cholesterol) and often indicate the purpose for which the diet is intended (Cardiac Diet). Regardless of the diet ordered, it should meet the patient’s overall treatment goals.
Such goals could be the maintenance, loss, or increase of weight; restriction of a particular nutrient to manage a chronic disease; return of normal gastrointestinal tract function; correction of elimination issues; or heal wounds with the overarching goal of maintaining or improving baseline health. All diet types when properly developed by a Registered Dietitian will comply with the food guide pyramid and all other general healthy dietary guidelines.

**Regular Diet/General Healthy Diet**

The regular diet or general healthy diet is composed of all types of foods from the food guide pyramid and is well balanced and capable of maintaining a state of good nutrition. It is intended for convalescing patients who do not require a therapeutic diet or for the general nutritional health of the crew.

**Modified or Therapeutic Diets**

Modified or therapeutic diets are designed to meet specific disease-related nutritional needs. Modified diets still meet all the general healthy recommendations with modifications to improve a patient’s disease or condition. Changes can be in specific nutrients such as fat or sodium, or in texture depending on the patient’s disease or condition. Many patients on modified diets will need to be on them for the rest of their lives.

**CLEAR LIQUID DIET.**—A clear liquid diet is very common and is usually the first diet ordered for people who have not eaten in a few days or are recovering from surgery; it is used to determine a patient’s readiness for solid food. Clear liquid diets are NOT nutritionally complete because they do not contain foods from all food groups. Foods allowed on a clear liquid diet may not be clear, but are all thin liquids (water like consistency). Juices, broth, gelatin, popsicles, tea, coffee, soft drinks (as tolerated), water, and ice are all allowed. A patient is not typically on a clear liquid diet for more than 2-3 days. If a patient is on clear liquids more than 3 days then the patient should be evaluated for nutritional supplements.

**FULL LIQUID DIET.**—A full liquid diet includes all the liquids served on a clear liquid diet, with the addition of strained cream soups, milk and milk drinks, ice cream, puddings, and custard. The full liquid diet does not consist of all five food groups, lacks meats and beans, and is inadequate in iron, niacin, B12, and thiamin. A full liquid diet can be used when a patient is tolerating a clear liquid diet, but may not be quite ready for a regular or modified diet. A full liquid diet is similar to a clear liquid diet; it is not intended for more than 2-3 days.

**DENTAL LIQUID, BLENDERIZED LIQUID DIET.**—A dental liquid diet is usually indicated with patients whose jaw is wired. It includes regular foods blended and strained to be able to go through a straw. It includes all foods allowed on clear and full liquid diets. Vitamin and mineral supplements may be necessary with the dental liquid diet if the recommended amounts of food are not tolerated. Some patients may be able to drink from a cup while others may need to use of a 60cc catheter tip syringe with a 10-12” piece of tubing which is helpful to facilitate getting food past the dental wires. Patients with wired jaws should usually have a wire cutting device with them in case of emergencies.

**SOFT OR BLAND DIET.**—The soft diet is modified in texture and consists of non-crunchy or crispy foods that may injure the gastrointestinal tract starting with the mouth. It includes all liquids and semi-solid foods. It is indicated in certain post-operative cases, patients with gastrointestinal disorders such as GERD (gastroesophogeal reflux disease), immediately following an acute illness, or patients who cannot tolerate spicy or highly seasoned foods.

A soft diet is an intermediate step between a liquid and regular diet and is low in connective tissue and indigestible dietary fiber. Little or no spices are used. Foods that may be incorporated into a soft diet include well-cooked cereals, pastas, untoasted bread, eggs, cottage cheese, tender meats, fish, poultry, canned fruits, and well cooked vegetables.
Further modifications of the soft diet include mechanical soft or dental soft. A mechanical soft may be indicated when a person has difficulty chewing. With a mechanical soft diet, hard to chew items such as meats should be ground and usually kept moist with gravy. A dental soft diet is indicated after many dental procedures and would include foods that require little or no chewing or that will not put much pressure on the teeth when bitten. A soft or bland diet is considered nutritionally complete since all five food groups would be represented.

PUREED DIET.—The pureed diet is a texture modification of the regular diet. It is typically indicated with patients who are edentulous or partially edentulous, recovering from a stroke, have failed a Modified Barium Swallow, or who may not be cognitively aware enough to chew. Many elderly and mentally disabled patients need a pureed diet. The pureed diet is nutritionally complete, but the patient may benefit from a general multivitamin. The diet is usually lower in fiber, therefore the patient’s bowel movements should be monitored more closely on a pureed diet as the stool may be harder and be excreted less frequently.

HIGH CALORIE/HIGH PROTEIN DIET.—A high calorie and/or high protein diet is most typically indicated with trauma, underweight, failure to thrive (at any age), burns, wound healing, and occasionally after major surgery. Along with the higher calorie diet, research indicates vitamin C, zinc, and glutamine (an amino acid) may aid in wound healing. Research is ongoing so check with the local registered dietitian for the latest data.

This diet is also a variant of the regular diet, with the high calorie part including more ‘calorically’ dense foods such as whole milk, gravy, butter, cream, additional desserts or sweets, or hard candies. When combined with the high protein part extra meat or egg entrees, additional milk, or cheese can be provided. Both modifications can be accomplished through double portions at each meal, in-between meal snacks, homemade milkshakes, or through commercially available liquid or powder supplements.

CALORIE-RESTRICTED DIET.—The calorie restricted diet is intended to promote slow weight loss. In the hospitalized patient it is important to monitor for patient improvements in order to not nutritionally compromise a patient who may need more calories. Calorie restrictions should be no lower than 1200 calories and still include foods from all five food groups. Foods on the calorie restricted diet include lower calorie and lower fat versions of those on the regular diet. Examples are sugar free gelatin, pancake syrup or jelly; lean meats; skim milk; and other low fat food items. Foods excluded on a calorie restricted diet are usually desserts, fried foods, gravies, sauces, cheese, whole or 2% milk, and fruit juices. Most hospitalized patients on a calorie restricted diet should be followed by a nutrition professional. People commonly calorie restrict to lose weight and should be encouraged to follow the general healthy diet using the appropriate food guide pyramid calorie pattern.

PROTEIN RESTRICTED DIET.—A protein restricted diet is indicated in patients with renal disease or hepatic disease. Many of these patients require other nutrient modifications as well and should be followed by a nutrition professional. A typical protein restriction is 60 grams per day. At times the restriction may be lower depending on the level of renal or hepatic dysfunction. Low protein diets are almost always below the recommended protein level of 0.8 g/kg. With appropriate nutritional counseling, patients should be able to meet all their other nutritional requirements. The main foods excluded or limited with a low protein diet are meat, milk, cheese, eggs, and at times grains and vegetables. Other nutrients typically restricted along with protein are phosphorus, sodium, and potassium depending on the stage of disease.

RESIDUE/FIBER RESTRICTED DIET.—Some gastrointestinal conditions require a modification in residue or fiber. Residue refers to anything that increases stool volume or frequency or that is not digested by the body that is not plant fiber. This can be tough, fibrous meats, milk products, spicy food, or caffeinated items.
Fiber is found in whole grains, beans, nuts, and all vegetables and fruits, especially those with an edible peel. A low residue diet is indicated during times where minimal stool production is warranted. A low residue diet is usually more restrictive than a low fiber diet. Both are nutritionally complete with foods such as well-cooked vegetables, peeled fruits, tender meats, milk as prescribed or in small amounts, non-whole grain breads, cereals, white rice, or pasta. A low residue diet and or a low fiber diet may be ordered for patients with diverticulitis, active ulcerative colitis, irritable bowel syndrome (IBS) flare ups, or post gastrointestinal surgery. A typical fiber restriction is approximately 10-15 grams per day.

HIGH FIBER DIET.—A high fiber diet can also be helpful in the chronic management of many gastrointestinal diseases. Conditions such as diverticulosis and non-acute irritable bowel syndrome or ulcerative colitis usually benefit from a higher fiber diet. The normal fiber recommendation is approximately 25g for women and 37g for men. A high fiber diet would include a variety of foods such as whole grain breads, cereals, and pastas; brown rice; and fresh fruits and vegetables. It is also important to encourage an adequate fluid intake while on a high fiber diet to prevent constipation and encourage regular, easily to eliminate stools.

CARBOHYDRATE CONSISTENT / CONTROLLED, DIABETIC DIET.—A carbohydrate consistent/controlled diet is mainly used in the nutritional treatment of diabetes. Classically it has been called the diabetic diet and sometimes referred to as an ‘ADA’ diet, as in American Diabetes Association®. The diet itself is designed to help manage a patient’s blood sugar levels. As implied, a consistent level of carbohydrate should be consumed at each meal.

This diet is usually combined with a calorie restricted diet, not always to promote weight loss, but more for general management and energy balance.

For instance, if a patient is ordered an 1800 calorie carbohydrate consistent diet, their level of carbohydrate may be 75 grams of carbohydrate at each of the three main meals, breakfast, lunch, and dinner, and may also include a bedtime snack (HS) of 30 grams of carbohydrate. The consistent amount of carbohydrate at consistent times each day along with healthy fat and protein choices will promote adequate blood sugar management. Each hospital will have its own meal patterns for patients to follow. On carbohydrate consistent/controlled diet foods such as juice, desserts, regular syrup or jelly, sugar, and candy are eliminated. Additional information is available at www.diabetes.org.

LOW SODIUM, LOW CHOLESTEROL, LOW FAT, CARDIAC DIET.—Sodium, cholesterol, and fat (specifically saturated fat) are the three nutrients usually restricted when a patient has any kind of heart or cardiovascular condition. It can be used to prevent conditions such as hypertension, congestive heart failure, hyperlipidemia, heart attacks, and strokes. It is often times used in conjunction with a carbohydrate consistent diet because many patients who have diabetes also have heart disease and may be overweight or obese.

Sodium is salt. Salt is found in most foods, but is concentrated in processed foods, canned foods, lunch meats, processed meats (hot dogs), cheese, canned tomato products, salted crackers, and pretzels. Salt is often added during cooking.

Cholesterol and saturated fat have been linked to heart disease. Both are lipids that are consumed in the diet and that are made in the body. These two substances are limited in the diet to both prevent and manage high blood cholesterol and are useful to be consumed only in small amounts in the general healthy diet. Cholesterol is found only in animal products including egg yolks; meat; dark meats of poultry; liver and other organ meats; cheese; and whole, 2%, and 1% milk. A cholesterol restriction starts at 300 mg and can be as low as 200 mg per day.
To put this in perspective, one egg yolk contains approximately 225 mg of cholesterol and 3 oz of beef contains approximately 90 mg of cholesterol.

Saturated fat is 9 calories per gram just like any other kind of fat. Saturated fat mainly comes from animals, but avocados and coconuts also contain saturated fat. Chicken skin, butter, the marbling and white edges of beef or pork, bacon grease, and the solid film that forms on top of cooled gravy, stews, and meat containing soups are all examples of saturated fat. The American Heart Association (AHA) recommends most people limit their saturated fat to no more than 7% of their total fat intake. Additional information is available at www.americanheart.org.

**GLUTEN FREE DIET.**—A gluten free diet is used when a person has Celiac’s Disease, an inflammatory disease of the bowel. Gluten is found in wheat, barley, rye, sometimes oats, and products that contain these ingredients. Many processed foods and seasoning contain gluten and should be avoided in this population. Label reading is critical to assist the patient in choosing gluten-free products. Common foods that need to be avoided are bread, pasta, crackers, cereal, beer, gravy, hydrolyzed vegetable protein, malted products, modified food starch and most products not labeled gluten-free. Foods allowed on a gluten-free diet are fresh fruits and vegetables, unprocessed meats, potatoes, rice, soy, quinoa, corn, beans, eggs, fish, and all products labeled gluten-free. Milk and milk products are sometimes limited or eliminated depending on the patient’s tolerance. Additional information is available at www.celiacs.org.

**DRUG-NUTRIENT INTERACTIONS**

Many medications patients take to manage their diseases or conditions interact with foods, specific nutrients, or timing of meals. For instance, ibuprofen should be taken with a meal, statin medications for hyperlipidemia should not be taken with grapefruit juice, and warfarins need a consistent oral intake of vitamin K.

Use a reliable drug reference manual to check for specific guidelines.

**NUTRITION SUPPORT**

**Oral Supplementation**

Oral supplements are necessary at times to assist a patient in meeting calorie, protein, or overall nutrient needs. Oral supplements range from homemade milkshakes, to commercially available beverages such as Ensure® or Boost®. Other supplements include modulars or single nutrient substances to increase a patient’s protein, fat, or carbohydrate intake, and they can include vitamin or mineral supplements. The nutrition professional at the facility or a physician should approve any oral supplements a patient may be consuming. Many oral supplements are contraindicated based on the disease or condition.

**Enteral Nutrition**

Enteral nutrition is used in cases where patients are unable to meet their nutritional needs by mouth and the patient has a functioning gastrointestinal tract. Enteral refers to feeding a patient using a tube that leads to the gastrointestinal tract. Enteral feeds can be provided via a nasogastric (NG) tube, a nasoduodenal (ND) or nasojejunal (NJ) tube, or can be inserted directly into the stomach (G tube), or the small intestine (J tube).

Enteral feedings usually involve a pump specifically designed for tube feeding products. Tube feeding products come in a variety of formulations to match the disease or condition, just like diet orders. Enteral safety guidelines are published by the American Society of Enteral and Parenteral Nutrition.
It is important to monitor the rate of the feeding, flushing the tube with sterile water at least three times per day, document and report bowel movements, check the patient’s lungs for aspiration of the tube feed, and keep the patient’s head elevated 30-45 degrees as an aspiration precaution. Typically tube feeding residuals are checked; review the local enteral safety guidelines at the facility. Each patient on enteral feeds should be followed by a nutrition professional, check the medical record for the most recent recommendations.

**Parenteral Nutrition**

Parenteral nutrition is most commonly used in cases where patients are unable to meet their nutritional needs by mouth and DO NOT have a functioning gastrointestinal tract. There are rare instances when parental nutrition is paired with enteral nutrition. Parenteral refers to feeding a patient via a vein, usually the subclavian vein, but peripheral veins can be used as well.

Parenteral nutrition is the most aggressive nutritional therapy used. Solutions are usually individualized and provide all of the patient’s nutrient needs. It is imperative a Registered Dietitian and a Pharmacist are involved in all patients before and while receiving parenteral nutrition. Parenteral nutrition requires close monitoring of the infusion, the patient’s response, the patient’s weight, laboratory tests, urine, and other outputs.

**SUMMARY**

Eating healthy is a goal every Sailor should pursue daily. Nutrition plays a critical role in preventing and managing diseases and conditions. Modifications in the nutrient content of a person’s diet can mean the difference between maintenance of health and having disease. The base of a good diet always starts with the food guide pyramid, focusing on the five main food groups, and the avoidance or reduction of foods low in nutrient content such as sodas and snack foods.

Sailors who eat healthy are less likely to be diagnosed with a chronic disease and more likely to add quality to their lives. The Navy Corpsman plays a key role in promoting healthy eating with the crew and an even more critical role in improving the health of patients who are hospitalized or have chronic conditions. For further information, contact the local Navy Dietitian or visit the Navy Dietetics website in NKO.
CHAPTER 14

PHYSICAL EXAMINATIONS

INTRODUCTION

The Department of Defense (DoD) and the Department of the Navy (DoN) have established uniform physical standards for entry and sustainment of military service, DoD Directive 6130.3, DoD Instruction 6130.4 series, and NAVMED P-117, Manual of the Medical Department (MANMED). Physical examinations are conducted to interpret each individual’s physical qualification for initial entry, mobilization, retention, assignment to special duties, and training programs that lead to enlistment and commissioning. The purpose of the examination is to identify physical defects and psychological problems that would compromise a member’s ability to perform duties normally assigned. Physical standards are intended to preclude acceptance of those individuals who present contagious or infectious hazards to other personnel, would be unable to perform assigned duties, or who have conditions likely to be aggravated by naval service.

This chapter will review the various types of physical examinations and their requirements, provide a general understanding of how physical examination forms and reports are completed, and cover some of the testing procedures and equipment which Hospital Corpsmen (HM) may be responsible. HMs function as both clerical and medical assistants to the medical practitioner. To do this properly, HMs must be familiar with administrative regulations that apply to physical examinations. They ensure the patient’s health record is accurate and complete, all tests and laboratory results are recorded, and the completed physical examination documents are properly filed in the member’s health record.

Physical examinations, whether routine or special duty, are mandatory for members at certain times during their military careers.

The first of these examinations is the entrance (enlistment, appointment, or commissioning) physical examination, and the last is the physical examination that occurs upon separation from the service. In addition to these two, there may be several others, depending on the length of the member’s service or special duty requirements.

A Licensed Independent Practitioner, Physician Assistant, or Independent Duty Corpsman (IDC) may perform all physical examinations covered in this chapter unless otherwise indicated (i.e. an IDC may complete a physical examination but must have all documents co-signed by a licensed physician). A General Medical Officer may independently perform examinations upon successfully completing an accredited internship. All examiners, regardless of clinical specialty, performing and recording physical examinations must be familiar with the standards outlined herein. Some special duty examinations (e.g., Aviation) must be performed or co-signed by examiners with specific training and/or qualifications, as an example, a Physician’s Assistant may perform and record an aviation physical examination but must have the documents co-signed by a licensed aviation physician. Review MANMED, Chapter 15, Section IV for further guidance.

Most physical examinations will require special studies (tests) which are performed prior to the physical examination. These special studies may include laboratory tests to detect syphilis (RPR), HIV, and cholesterol levels; optometric evaluation to determine visual acuity; audiometric testing for hearing capabilities; and dental examination to determine dental fitness. For more information on special study requirements for each type of physical examination, refer to the MANMED, Chapter 15 and directives that address specific physical examinations.
LEARNING OBJECTIVE:

Differentiate between the types of physical examinations.

ROUTINE PHYSICAL EXAMINATIONS

Essentially, there are four types of routine physical examinations. They are the Entrance, Periodic Health Assessment (PHA), Reenlistment, and Separation physicals. The MANMED provides specific instructions on how and when each type of physical is to be conducted.

Entrance (Enlistment, Appointment, and Commissioning) Examination

Entrance physical examinations are normally performed at Military Entrance Processing Stations (MEPS). Entrance physical examination results are documented on the Report of Medical Examination (DD 2808) and Report of Medical History (DD 2807-1). The original completed physical examination forms are permanently filed in the member’s health record. Copies of the completed examination forms are filed by the examining facility for a specified period of time. This policy applies to all of the physical examinations service members may have throughout their career. Entry physical standards for training programs leading to officer appointment are more stringent than the basic physical qualifications for enlistment or commissioning ensuring qualification of the member at the time of the appointment. The forms used for the entrance physical (DD 2807-1 and DD 2808) are also used for many of the routine and special duty physical examinations reviewed later in this chapter.

Periodic Health Assessment (SECNAVINST 6120.3 series)

The Periodic Health Assessment will be conducted annually, IAW SECNAVINST 6120.3 series, Periodic Health Assessment for Individual Medical Readiness, for all active duty and reserve service members. It is a face-to-face assessment with the patient’s primary healthcare provider to determine individual medical readiness and correct any deficiencies. While conducting the PHA, the healthcare provider must factor in the member’s age, gender, family history, occupation, deployment status, health status, and behavioral status. A PHA is considered complete when the member has met all individual medical requirements (IMR) and either satisfied health requirements or received a continued plan of care for any ongoing conditions.

Reenlistment Examination

Reenlistment examinations are conducted for the purpose of ensuring no new medical conditions have developed or previously diagnosed conditions have materially changed thus preventing a member from completing Active Duty service. A complete medical examination is not required if there is a valid examination (i.e., entrance, periodic, or special duty physical) in the service member’s health record. The reenlistment examination consists of a face to face with a medical provider, a medical record review, and documentation of new medical conditions or materially changed conditions since the last physical examination. The results of the reenlistment physical examination are recorded on form DD 2807, Report of Medical History and DD 2808, Report of Medical Examination. The healthcare provider will indicate on the DD 2808 if the service member is physically qualified for reenlistment. Ensure the DD 2808 is properly filed in the member’s health record.
Separation Examination

Separation examinations are required for personnel separating from the Navy, the Marine Corps, and Activated Reservists serving 31 consecutive days or greater on active duty. A thorough physical examination must be completed not less than 180 days from the last day served on active duty. This comprehensive examination is conducted to ensure the service member has not developed any medical conditions that may constitute a disability and should be processed through a Physical Evaluation Board (PEB) or Medical Evaluation Board (MEB). If the separation is the result of an evaluation by a MEB or PEB, that documentation serves as the separation examination.

Members who separate from the service for any reason (i.e., retirement, end-of-enlistment, or administrative discharge) are required to read the following statement at the time of their physical examination:

You have been evaluated because of your planned separation or retirement from active duty service. You have been found physically qualified to separate or retire, which means that no medical condition has been noted that disqualifies you from the performance of your duties or warrants disability benefits from the Department of the Navy, you must be unfit to perform the duties of your office, grade, or exacerbated while in receipt of base pay. Some conditions, while not considered disqualifying for separation or retirement, may entitle you to benefits from the Department of Veteran’s Affairs. If you desire additional information regarding these benefits, contact the Department of Veteran’s Affairs at 1-800-827-1000 or view the Website at: http://www.va.gov.

For service members separating from service after serving 30 or fewer consecutive days on active duty, a different separation process applies. An authorized examiner will interview each service member focusing on any new or materially changed medical conditions occurring since the start of active duty and, if indicated, conduct a focused physical examination. An SF 600 entry will be made stating: “I have evaluated this service member and reviewed available medical record entries and found him or her physically qualified for release from active duty.” For members found not qualified due to a service-incurred or service-aggravated injury or illness, a Notice of Eligibility (NOE) may be appropriate, see SECNAVINST 1770.3 series, Management and Disposition of Incapacitation and Incapacitation Benefits for Members of Navy and Marine Corps Reserve Components.

For service members found “unfit for continued naval service” an SF 600 will be generated stating member found unfit and processed for separation. See MILPERSMAN Article 1910-216 (enlisted), MILPERSMAN 1920 (officers), and Marine Corps Separations Manual section 1011-8508 for requirements about conducting examinations on discharges or separation characterized as adverse.

SPECIAL DUTY PHYSICAL EXAMINATIONS

Military personnel who are assigned to or applying for special duty such as aviation duty, diving duty, submarine duty, etc., are required to meet physical requirements above the basic entrance examination requirements. In addition, personnel are required to have a special duty physical if they have psychosocial considerations, are exposed to extreme physical hazards, or if they are to be assigned to sites with inadequate medical facilities. Other special duties requiring pre-placement examinations include handling explosives, operating explosives vehicles, and duty as a fire fighting instructor.
As with routine physicals, special duty examinations are performed by medical officers or DoD civilian physicians. For operational units (squadrons or groups), the medical officer assigned will normally perform special duty examinations. If there is not a unit medical officer, a medical officer assigned to a supporting clinic, hospital, or related operational unit should perform the examination.

Physician assistants (PAs) and nurse practitioners may perform special duty examinations if a medical officer or DoD physician is not available or if the examination workload is too great. When a PA or nurse practitioner performs special duty examinations, the DD 2808 must be co-signed by proper authority, MANMED, Article 15-4.

OVERSEAS/OPERATIONAL SUITABILITY SCREENING EXAMINATIONS

These examinations are used to determine suitability of Navy and Marine Corps service members and their families upon receipt of orders overseas or to a remote assignment. They identify special needs medical, dental or educational requirements determining the enrollment into the Exceptional Family Member Program (EFMP), BUMEDINST 1300.2 series, Suitability Screening, Medical Assignment Screening, and Exceptional Family Member Program (EFMP) Identification and Enrollment. Suitability screenings prevent the arrival of service members and families at a duty station with special requirements beyond the capability of the local medical, dental, educational, or community facilities. This may result in decreased quality of life, early return from assignment, and billet gaps. Proper screening helps ensure a positive and productive tour for the service member. All screening should be completed within 30 days of receipt of orders.

OCCUPATIONAL HEALTH MEDICAL SURVEILLANCE EXAMINATIONS

The Navy uses many materials in its work places, some of which are potentially hazardous to personnel. To minimize the risk associated with these hazardous substances, the Navy developed the OPNAVINST 5100.23 series, Navy Occupational Safety and Health (NAVOSH) Program. Within the NAVOSH Program is the Medical Surveillance Program.

The Medical Surveillance Program provides physical examination and medical monitoring guidelines for personnel who are exposed to or work with/in hazardous materials or hazardous environments.

Medical surveillance examinations assess the health status of individuals as it relates to their work. Although these exams are not physical examinations as described in this chapter, they are actually surveillance examinations that produce specific information with regard to an individual’s health during actual or potential exposure to hazardous materials (i.e., the Asbestos Medical Surveillance Program [AMSP]). Specific guidance on the Asbestos Medical Surveillance Program is provided in OPNAVINST 5100.23 series. Another example of a medical surveillance program is the Occupational Noise Control and Hearing Conservation Program. Personnel who work in areas of high sound generation (e.g., flight deck of a carrier) are required to be evaluated annually for hearing loss. Specific guidance on the Occupational Noise Control and Hearing Conservation Program is provided in NAVMEDCOMINST 6260.5 series and OPNAVINST 5100.23 series.

MEDICAL EVALUATION BOARD (MEB) EXAMINATIONS

Medical evaluation boards are the single most important factor in determining fitness for duty in today’s Navy. Medical boards are convened and reviews are conducted to determine the various degrees of fitness for military service.
There are two purposes for the MTF Convening Authority (CA) to convene an evaluation of a military member:

- Placing a patient on temporary limited duty (TLD or LIMDU)
- Referring a patient to Physical Evaluation Board (PEB) for determination of the patient’s fitness for continued Naval service
- An MEB shall be initiated when a physician or authorized personnel who have been trained and certified for MEB membership by the MTF CA determine that:
  - A member has a condition that appears to significantly interfere with performance of duties
  - A member has a condition that will prohibit returning the patient to the parent command
  - A member has a condition that may seriously compromise the member’s health or well-being if the member were to remain in the military service
  - A member has a condition that may prejudice the best interests of the Government if the member were to remain in the military service
  - A member has a condition that requires assignment limitations
  - An inactive reservist incurs or aggravates an injury or illness during a period of active service and the period of required treatment, rehabilitation, or convalescence is expected to exceed 12 weeks or require retention beyond authorized active duty service orders
  - A member refuses reasonable medical or dental treatment (including surgery) and the member’s ability to perform medically unrestricted duty is suspect
  - A member who has “self-referred” for elective care outside the direct Military Health System (MHS)

The SECNAVINST 1850.4 series, Department of the Navy Disability Evaluation Manual, provides a listing of “Medical Conditions and Physical Defects Which Normally are Cause for Referral to the Physical Evaluation Board.”

**ABBREVIATED TEMPORARY LIMITED DUTY (TLD) MEDICAL BOARD AND REPORT**

The abbreviated board report is used only when a member is expected to return to full duty after an adequate period of treatment. Processing time should not exceed 5 working days to report TLD. The LIMDU Coordinator is responsible for reviewing the medical board, verifying the content, and verifying the processing time ensuring consistency with current policy. The Abbreviated Medical Board Report (MEBR) is a local action taken by an appropriate medical or dental officer and does not require external departmental review by NAVPERSCOM. The form (NAVMED 6100/5), “Abbreviated Limited Duty Medical Board Report”, is used for this report. It is a vehicle for recording basic medical findings, plans, and expectations in terms of prognosis and length of medical restriction of activity. It also authorizes for the parent command to provide acknowledgment and comments. The MEBR, NAVMED 6100/5, is to be used when all of the following criteria are met:

- The member is enlisted in the U.S. Navy or Marine Corps
- The member suffers from an uncomplicated illness or injury which makes them temporarily unable to fully perform duties to which they are assigned or expected to be assigned, but will most likely be returned to medically unrestricted duty after an adequate period of treatment not exceeding 6 months
- The member’s health or clinical record contains adequate documentation on the nature and circumstances of the illness or injury, its course, prognosis, and treatment
LEARNING OBJECTIVE:

Identify the appropriate form(s) used for specific types of physical examinations.

While there are several forms used to record physicals, the scope and purpose of the physical dictates which form or forms should be used. For example, the pre-placement and annual physical evaluation of food service personnel or personnel exposed to hazardous materials can be adequately documented on a SF 600.

This section discusses the most commonly used physical examination forms.

REPORT OF MEDICAL HISTORY, DD 2807-1

This form (Fig. 14-1) is used to complete Routine, Special Duty, and Medical Evaluation Boards examinations.

Figure 14-1.—Form DD 2807-1 (Page 1)
Fi

gure 14-1.—From DD2807-1 (Page 2)

14-7
30. EXAMINER’S SUMMARY AND ELABORATION OF ALL PERTINENT DATA (Physician shall comment on all positive answers to questions 10 - 29. Physician may develop any additional medical history deemed important, and record any significant findings here.)

b. COMMENTS

c. SIGNATURE

d. DATE SIGNED (YYYYMMDD)

DD FORM 2807-1, AUG 2000

Page 3 of 3 Pages
This form (Fig. 14-2) is used to complete Routine, Special Duty, and Medical Evaluation Boards examinations.
<table>
<thead>
<tr>
<th>LAST NAME</th>
<th>FIRST NAME</th>
<th>MIDDLE NAME (SUFFIX)</th>
<th>SOCIAL SECURITY NUMBER</th>
</tr>
</thead>
</table>

**LABORATORY FINDINGS**

<table>
<thead>
<tr>
<th>45. URINALYSIS</th>
<th>47. H/R</th>
<th>48. BLOOD TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Albumin</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Sugar</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TESTS**

<table>
<thead>
<tr>
<th>49. HIV</th>
<th>50. DRUGS</th>
<th>51. ALCOHOL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**MEASUREMENTS AND OTHER FINDINGS**

<table>
<thead>
<tr>
<th>61. HEIGHT</th>
<th>62. BLOOD PRESSURE</th>
<th>66. TEMPERATURE</th>
<th>67. PULSE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>63. RED OCHER (Army Only)</th>
<th>64. OTHER VISION TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>81. AFB VISION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

**DISTANCE VISION**

<table>
<thead>
<tr>
<th>Right</th>
<th>Left</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**HETEROPHORIA** (Specify distance)

<table>
<thead>
<tr>
<th>C</th>
<th>Ex</th>
<th>R.H.</th>
<th>L.H.</th>
<th>Prim Div.</th>
<th>Prim Conv</th>
<th>N.B.</th>
<th>P.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</table>

**ACCOMMODATION**

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</table>

**COLOR VISION** (Test used and result)

<table>
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<tr>
<th>Right</th>
<th>Left</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

**DEPTH PERCEPTION** (Test used and scored APVT)

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<tr>
<th>Right</th>
<th>Left</th>
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</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

**FIELD OF VIEW**

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<thead>
<tr>
<th>Right</th>
<th>Left</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**AUDIOMETER**

<table>
<thead>
<tr>
<th>Unit Serial Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

**READING ALONG TEST**

<table>
<thead>
<tr>
<th>Hz</th>
<th>500</th>
<th>1000</th>
<th>2000</th>
<th>3000</th>
<th>4000</th>
<th>6000</th>
<th>Hz</th>
<th>500</th>
<th>1000</th>
<th>2000</th>
<th>3000</th>
<th>4000</th>
<th>6000</th>
<th>SAT</th>
<th>UNSAT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**NOTES** (Continued and significant or interval history) (Use additional sheets if necessary.)

Figure 14-2.—Form DD 2808 (Page 2)
Figure 14-2.—Form DD 2808 (Page 3)
REPORT OF MEDICAL ASSESSMENT, DD 2697

This form (Fig. 14-3) is used to complete Separation examinations.

Figure 14-3.—Form DD 2697 (Pages 1 and 2)
ABBREVIATED MEDICAL EVALUATION BOARD REPORT, NAVMED 6100/5

This form (Fig. 14-4) is used to as the findings established by the Medical Evaluation Board.

Figure 14-4.—Form NAVMED 6100/5
This form (Fig. 14-5) is used to complete the suitability screening for members that have orders for overseas and remote duty locations.
### PART II

**Dental Screening**
Completed by the dental screener to assess and match the dental needs of service or family member to the support capabilities during an overseas, remote duty, or operational assignment.

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>N/A</th>
<th>ITEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>All dental records (military and civilians) reviewed?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Dental examinations are current?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Is a reexamination required by a DTF if examined or treated at a non-Navy facility?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>If service/family member is in Dental Class 3 or 4, can dental treatment or examination be completed before the transfer?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Is there a requirement for follow-on care such as orthodontics, implants, prosthodontics, etc.?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Are there any chronic dental conditions requiring routine or continuing access to care or access to specialized dental care?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Other concerns? (specify)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Dental Classifications:**

- **Class 1:** Patients who do not require dental treatment.
- **Class 2:** Patients who have dental conditions that are unlikely to result in a dental emergency within 12 months.
- **Class 3:** Patients who have dental conditions that are likely to cause a dental emergency in the next 12 months.
- **Class 4:** Patients who require a dental examination either because: (1) No type 1 (comprehensive) or type 2 (annual or periodic oral) examination by a dental officer within the past 12 months or; (2) A patient's dental record does not exist or the dental record is not held by the responsible dental treatment facility or Medical Department activity.

---

**IF ANY OF THE ABOVE SHADED BLOCKS ARE CHECKED, QUERY THE GAINING DENTAL TREATMENT FACILITY OR MEDICAL DEPARTMENT SUPPORTING THE OVERSEAS, REMOTE DUTY OR OPERATIONAL LOCATION CONCERNING LOCAL CAPABILITIES TO PROVIDE REQUIRED SUPPORT.**

(attach reply)

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
<th>IS THE SERVICE/FAMILY MEMBER SUITABLE FOR THE OVERSEAS, REMOTE DUTY OR OPERATIONAL ASSIGNMENT? (completed by a DTF designated military dental screener only)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Military Dental Screener (Signature) Date**

**Civilian Dental Screener (Signature) Date**

**Printed Name, Rank or Grade**

**DTF or Duty Station**

**Telephone Number (include area/country code)**

**DSN Number**

**Telefax Number (include area/country code)**

**E-mail Address**

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NAVMED 1300/1 (Rev. 02-00)

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Figure 14-5.—Form NAVMED 1300/1 (Page 3)
PHYSICAL EXAM TESTING PROCEDURES AND EQUIPMENT

LEARNING OBJECTIVE:

Identify visual acuity, color vision, audiometric, and EKG test equipment and procedures.

Some of the basic procedures used to gather information for a physical examination are taught in Hospital Corpsman "A" School (e.g., vital signs, venipuncture, and height and weight measurements). Other tests require advanced technical expertise, such as serological testing, and pressure and oxygen-tolerance testing. Some testing procedures may be learned by on-the-job training (OJT) or by short courses of instruction. Common physical exam testing procedures and the equipment used will be reviewed here.

VISUAL ACUITY

Visual acuity testing determines the ability of the eye to discriminate fine detail. It is the most important test of eye function. Throughout the Navy, there are three accepted methods for testing visual acuity: the Snellen chart, Jaeger cards, and the Armed Forces Vision Tester (AFVT).

The Snellen chart and Jaeger cards are used together to test visual acuity. The Snellen charts test distant visual acuity; the Jaeger cards are used to evaluate near visual acuity. The Armed Forces Vision Tester (AFVT) checks both distant and near visual acuity, and assists in evaluating other optical conditions.

The first step in testing for visual acuity is to find out if the patient wears corrective eyewear. On the day of the visual acuity testing, patients should bring their glasses. Contact lenses are not recommended for use during visual acuity testing. Contact lenses cause an increase in time needed for testing purposes creating an inconvenience for both the patient and healthcare provider.

Acuity testing is performed with and without the glasses being worn and the results are documented in blocks 61 and 63 on the DD 2808. Visual acuity requirements are discussed in the MANMED.

Snellen Charts

The most familiar of the visual testing equipment, Snellen charts, are the preferred method for testing distant visual acuity, and can test both monocular and binocular visual acuity. Operational guidelines for Snellen charts are provided by the chart’s manufacturer. The local military optometrist or eye clinic can also provide operational guidelines for this chart. Specific details and current conditions for testing with Snellen charts are as follows:

- If the examinee wears corrective lenses, have them remove the lenses before the examination
- Test the examinee first without corrective lenses, and then with the corrective lenses in place
- Hang the chart on the wall so the 20/20 line is 64 inches from the floor. Direct the examinees to stand 20 feet from the chart
- Test each eye individually, then both eyes together. Do not allow the examinee to squint or tilt their head
- With the graduation of the size of the letters advocated by Snellen, the visual acuity is expressed according to the classical formula \( V = \frac{d}{D} \), where as \( d \) (the distance at which the letters are read), is divided by \( D \) (the distance at which the letters should be read)
- Then record the smallest line read on the chart from the 20-foot distance in block 61 of the form DD 2808 as the distant vision; e.g., 20/20, 20/200
Jaeger Cards

When the AFVT is not available, Jaeger cards are used to test near vision. There are six paragraphs on each card, each paragraph is printed in a different font (size) and labeled as J-1 (the smallest print size) through J-6.

When testing with these cards, hold the card at a distance of 14 to 16 inches from the examinee and tell the examinee to read the paragraphs. Record the visual acuity as the smallest type that can be comfortably read and record the distance in block 63 of the form DD 2808 as the near vision; e.g., J-2 at 14 inches.

NOTE:
The distance of the card from the examinee may be converted to centimeters, but ensure the results of the test are also recorded in centimeters. ACCURACY is key!

Armed Forces Vision Tester

The Armed Forces Vision Tester (AFVT) is a semi-portable machine that has the capability to test near and distant visual acuity, horizontal and vertical phorias, and stereopsis (depth perception). It consists of two rotating drums that hold illuminated slides. The handles on the side of the machine rotate the drums to change the slides. For a scoring key refer to the instructional manual provided by the manufacturer.

COLOR VISION TESTING

The Manual of the Medical Department requires that all applicants for the naval service receive a color vision test. The Navy has two methods of testing color discrimination: the Farnsworth Lantern Test (FALANT) and the Pseudoisochromatic Plates (PIP). The FALANT is the preferred test, and in many cases it is the test prescribed by the MANMED as the only acceptable method for testing color vision.

Farnsworth Lantern Test

The purpose of the Farnsworth Lantern Test (FALANT) is to evaluate color perception. The Farnsworth Lantern is a machine with a light source directed at the examinee. What the examinee sees are two lights in a vertical plane. These lights appear in two of three possible colors, red, green, or white, shown in varying combinations.

The examinee is asked to identify the color combinations from top to bottom at a distance of 8 feet; the examiner rotates the drum to provide the different combinations. The examinee must identify a total of nine different combinations to pass the FALANT test. A passing FALANT score is obtained by correctly identifying 9 out of 9 presentations on the first test series. If any incorrect identification is made, a second consecutive series of 18 presentations is administered. On the second series, a passing score is obtained by correctly identifying 16, 17, or 18 presentations.

NOTE:
If examinees wear corrective lenses for distant vision, they should wear them during this test.

Pseudoisochromatic Plates

If the FALANT is not available, pseudoisochromatic plates (PIP) are used to determine color vision. Personnel receiving PIP testing must be retested with the FALANT at the first activity they report to that has one. Two tests are available, the 18-plate test and the 15-plate test, each of which includes one demonstration plate not used for scoring.

When administering the PIP examination, hold the plates 30 inches from the examinee. Allow 2 seconds for the identification of each plate. Do not allow the examinee to touch the plates. Correctly identifying 12, 13, or 14 out of 14 and 16, 17, or 18 out of 18 is considered passing on the PIP. Applicants failing the PIP should be tested via the FALANT.
AUDIOMETER

An audiogram is a record of hearing thresholds an individual has for various sound frequencies. By evaluating an individual’s frequency thresholds, hearing deficiencies can be detected. To test an individual’s frequency thresholds, the technician will use an instrument called an audiometer (manual or computerized). Audiometers used by the Navy are calibrated to American National Standards Institute (ANSI) specifications.

Upon entry into the service, a baseline audiogram is performed and recorded on a DD 2215, Reference Audiogram. Subsequent audiometric test results are recorded on a DD 2216, Hearing Conservation Date, and performed as directed by OPNAVINST 5100.19 series, NAVOSH Program Manual for Forces Afloat and the MANMED.

Audiometric testing shall be performed only by personnel who have attended an audiometric training course and have been certified. All audiometric tracings or readings are recorded on the DD 2808 in blocks 71a and 71b or other medical documentation and should contain the certification number of the person performing the audiometric test.

ELECTROCARDIOGRAM

An electrocardiogram (ECG or EKG) is a record of electrical impulses as they travel through the heart. They are produced by an instrument called an electrocardiograph. In normal patients the electrical impulse for each beat originates from the sinoatrial (SA) node to the right and left atriums, through the atrioventricular (AV) node, and throughout the right and left ventricles (Fig. 14-6). As the impulse traverses the conduction system, it penetrates the surrounding myocardial muscle and provides the electrical stimuli for atrial and ventricular contraction. This electrical impulse creates a signal that can be measured and recorded from the surface of the body via the electrocardiograph.

Impulses that originate in sites other than the SA node, or impulses that are prevented from traversing the conduction system (i.e. disease or drugs) interrupt the normal order of electrical sequences in the myocardium. An EKG may be used to record these abnormal patterns of impulse formation or conduction. This is a visual record of the abnormal pattern from which to identify the dysrhythmia or abnormal rhythm.

An abnormal EKG tracing may result from diseased myocardial cells, injury to myocardial tissue, or conduction abnormalities. These abnormal EKG tracings may present in various different morphologies, or patterns. For example, in patients with left ventricular hypertrophy (LVH), the impulse takes longer to traverse the larger muscle mass of the left ventricle producing a larger, wider tracing than normal. In patients having a heart attack, or myocardial infarction (MI), certain segments of the EKG tracing will be elevated and indicate a need for emergent care. EKG testing is helpful in the diagnosis of conduction abnormalities such as atrial fibrillation, atrioventricular blocks, and ventricular dysrhythmias.

Figure 14-6.—The Heart

The standard 12 lead EKG is named because of the usual electrode placement and how the recording device receives and interprets the electrical signal from 12 different views. The four limb leads and six precordial leads, or chest leads, are attached to the patient as depicted in Figure 14-7.

The recording device alternates the combination of electrodes that are active during the recording of electrical signals from the heart and from the four limb leads. This results in six standard views, or leads (I, II, III, aVR, aVL, and aVF) that are recorded in the hearts frontal plane. The six precordial leads (V1, V2, V3, V4, V5, and V6) are arranged across the chest to record electrical activity on the horizontal plane of the heart.

Abnormal localized areas of myocardial conduction, such as those that occur with ischemia (a lack of blood flow to myocardium), or infarction (myocardial tissue death) may be identified in the leads that are nearest to the affected part of the heart. For example, abnormalities in leads II, III, and aVF are indications that there is a blockage of blood flow to the inferior (bottom) portion of the heart.

Placement of 12 lead EKG leads are as follows; The four limb leads, Right Arm (RA), Left Arm (LA), Right Leg (RL), and Left Leg (LL) are attached to the forearms, above the wrists, and the calf muscles above the ankles. The precordial leads are placed on the chest in the horizontal plane across the heart. Lead V1 is to be placed on the right sternal border at the 4th intercostal space, V2 is to be placed on the left sternal border at the 4th intercostal space, V4 is to be placed along the mid-clavicular line in the 5th intercostal space V3 is to be placed diagonally between V2 and V4, V5 is to be placed along the anterior axillary line in the 5th intercostal space, V6 is to be placed along the mid-axillary line in the 5th intercostal space (Fig. 14-8 A-B).
EKGs are performed only as clinically indicated or as required for special duty and they are interpreted by physicians or cardiologists. Refer to the Manual of the Medical Department Chapter 15 for current information on EKG testing. The Naval Medical Department routinely uses EKGs with 12 leads for physical examinations performed on Navy and Marine Corps personnel.

**SUMMARY**

The physical examination is a key component of the Navy Medical Department’s efforts to maintain the health of Sailors and Marines during times of war and peace. The importance of the physical examination cannot be overstated. The combination of medical history, medical testing, and medical examination furnishes the healthcare provider with a complete picture of the individual’s health. Any indications of medical problems can be evaluated and managed more expeditiously and effectively through the use of the physical examination. Medical testing and detailed documentation will ensure the patient receives the best possible medical evaluation by the medical provider. More in-depth information is contained in the *Manual of the Medical Department, NAVMED P-117*.

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**Figure 14-8A.—Lead EKG Placement**

*Photograph provided by HM2 Pablo A. Mercado of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD.*

**Figure 14-8B.—Modified Lead EKG Placement**

*Photograph provided by HM2 Pablo A. Mercado of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD.*
INTRODUCTION

The dental examination is one of the basic professional services provided by the Navy dental team. Soon after recruits entered the military service, they received their first dental-oral examination to determine their dental health. Throughout their service with the Navy, they will receive annual or periodic dental examinations. The results of these examinations are recorded in their individual U.S. Navy Medical Outpatient and Dental Treatment Record (NAVMED 6150/21-30). The Forensic Examination Section, which is located on the inside back cover of the NAVMED 6150/21-30; will be discussed in this chapter since it covers an examination.

The Hospital Corpsman’s (HM’s) responsibility is to assist the dentist in all areas of dental examinations. The HM must be able to understand and complete various dental forms used in the examination process that become a part of the NAVMED 6150/21-30. Information on dental examinations and related forms can be found in the Manual of the Medical Department, NAVMED P-117, Chapters 6 and 15.

Dental examinations are performed by dentists in different areas of the dental clinic. The Oral Diagnosis Department has the responsibility of providing dental examinations and holding "sick-call" hours, while dentists and auxiliary personnel (hygienists and HMs) in other departments of the dental clinic also perform oral examinations. This chapter concentrates on the HM’s duties in pre-examination, examination types, occasions for dental examinations, dental classifications, designations, charting and abbreviations, recording dental treatment, additional dental treatment forms, and patient dismissal.

PRE-EXAMINATION DUTIES

LEARNING OBJECTIVE:

Explain the pre-examination duties required to be performed prior to each dental examination.

Before seating a patient for a dental examination, ensure that the Dental Treatment Room (DTR) is neat and professional in appearance. Make sure the area is clean and the equipment is disinfected.

PATIENT PREPARATION

The HM introduces himself/herself and asks the patient for his or her dental record. Open the record and scan the Dental Health Questionnaire, NAVMED 6600/3. Look specifically for "yes" answers if the questions concerning contagious or infectious diseases, such as Hepatitis, Human Immunodeficiency Virus (HIV), cold sores (herpes, etc.) were checked. When a patient has a "yes" answer, notify the dentist before treatment.
When the patient is seated, make him or her as comfortable as possible. Adjust the headrest and place the chair in the working position favored by the dentist, usually the fully reclined position shown in Figure 15-1. In this position, the patient's head is level with the dentist's elbow when the dentist is seated on the dental stool.

The dentist will need them standing by to evaluate proper fit and condition during the exam.

A patient who is wearing corrective glasses should be asked to leave them in place during the exam, while a patient not wearing corrective glasses should be given eye protection.

**INSTRUMENT/EQUIPMENT PREPARATION**

Once the patient is ready, prepare the necessary examination instrument and equipment for use. The HM must maintain aseptic technique in the DTR or other treatment room used for dental care. Throughout the procedure, take care to prevent sterile instruments from being contaminated. Place the sterile instrument pack on the bracket table. Open the oral exam instrument pack, leaving the items on the sterile wrapping paper as shown in Figure 15-2.

A patient who is wearing corrective glasses should be asked to leave them in place during the exam, while a patient not wearing corrective glasses should be given eye protection.

**INSTRUMENT/EQUIPMENT PREPARATION**

Once the patient is ready, prepare the necessary examination instrument and equipment for use. The HM must maintain aseptic technique in the DTR or other treatment room used for dental care. Throughout the procedure, take care to prevent sterile instruments from being contaminated. Place the sterile instrument pack on the bracket table. Open the oral exam instrument pack, leaving the items on the sterile wrapping paper as shown in Figure 15-2.

Some commands use peel packs for the exam pack. In this case, the instruments should be placed on bracket table covers (paper sheets). At this point the HM should have completed all of the preparation procedures. After double checking the area ensuring everything is ready, notify the dentist that the patient is ready.
OCCASIONS FOR DENTAL EXAMINATIONS

Dental examinations are performed on various occasions. The type of the examination performed will depend on what the patient needing an examination requires (i.e. retirement, annual, etc.).

ACCESSION

All Navy and Marine Corps personnel who enter the military service will have a dental record established with an accession examination and radiographs.

PERIODIC DENTAL EXAMINATIONS

Dental examinations of all active duty Navy and Marine Corps personnel must be conducted annually and on other appropriate occasions to establish the need for dental treatment and verify dental records. Periodic dental examinations access the readiness status of active duty Navy personnel. The annual examination should normally be a Type 2 examination.

Type 1, Comprehensive Examination

This is the ideal examination, for it is the most extensive dental examination. The dentist will perform a comprehensive hard and soft tissue examination that includes: oral cancer screening examination; mouth-mirror, explorer, and periodontal probe examination; adequate natural or artificial illumination; panoramic or full-mouth periapical, and posterior bitewing radiographs; blood pressure recording; and when indicated, percussive, thermal and electrical test, transillumination, and study models. Included are those lengthy clinical evaluations required to establish a complex clinical diagnosis and the formulation of a total treatment plan. For example: treatment planning for full-mouth reconstruction; determination of the etiology or differential diagnosis of a patient's chief complaint.

Type 2, Oral Examination

Comprehensive hard and soft tissue examination, which will include: oral cancer screening examination; mouth-mirror, explorer, and periodontal probe examination; adequate natural or artificial illumination; appropriate panoramic or intraoral radiographs as indicated by the clinical examination; and blood pressure recording. An appropriate treatment plan will be recorded. This type is the routine examination, which is normally done only one time per treatment regimen per patient, unless circumstances warrant another complete examination.

Type 3, Other Examination

This examination consists of diagnostic procedures as appropriate for: consultation between staff or staff residents; observation where no formal consult is prepared; certain categories of physical examinations; and emergency oral examinations for evaluation of pain, infection, trauma, or defective restorations.

Type 4, Screening Evaluation

This type of examination consists of a mouth-mirror and explorer or tongue depressor examination with whatever illumination is available. This category includes the initial dental processing of recruits without necessarily being examined by a dentist or other screening procedures. A qualified dental assistant or dental hygienist may perform a Type 4 examination.

SUITABILITY FOR OVERSEAS ASSIGNMENT (OVERSEAS SCREENING)

The procedures for the medical and dental evaluation of Navy and Marine Corps members and their accompanying family members, who are undergoing suitability processing for overseas assignment, are provided in NAVMEDCOMINST 1300.1 series. Based upon the findings of the dental examination, a dental officer recommends suitability or unsuitability of a member and family members for overseas assignment.
This is documented on a NAVMED 1300/1, Medical and Dental Overseas Screening Review for Active Duty or Dependent. The examining dentist will complete Part II: Dental Screening (Fig. 15-3) on the NAVMED 1300/1.

The ultimate responsibility rests with the member’s commanding officer to approve or disapprove the member or family members for overseas assignment.

SEPARATIONS, RETIREMENTS AND SPECIAL PROGRAMS

Dental examinations are required for personnel who separate from the Naval Service, retire, or apply for special programs. The *Manual of the Medical Department, NAVMED P-117*, Chapters 6 and 15, outlines procedures for these examinations.
DENTAL CLASSIFICATIONS

LEARNING OBJECTIVES:

Describe the different dental classes.

Identify the abbreviations used in dental charting.

The Navy Dental Corps has a uniform system for recording the results of a dental examination. It is a classification system that lets the provider determine the dental status of each individual and establishes priorities of treatment. Numbers are used to record one of four possible dental classifications. Each classification is carefully determined using prescribed criteria and is accurately recorded. The following is a description of each classification.

CLASS 1

This classification is for patients who do not require dental treatment or reevaluation within 12 months. Class 1 patients must meet these conditions:

- No dental caries or defective restorations
- Arrested caries for which treatment is not indicated
- Healthy periodontium, no bleeding on probing; oral prophylaxis not indicated
- Replacement of missing teeth not indicated
- Unerupted, partially erupted, or malposed teeth that are without historical, clinical, or radiographic signs or symptoms of pathosis and are not recommended for prophylactic (preventive) removal
- Absence of temporomandibular disorders; stable occlusion

CLASS 2

Class 2 is the classification for patients who have oral conditions that the examining dentist feels if not treated or followed up, have the potential but are not expected to result in dental emergencies within 12 months.

CLASS 3

Class 3 is the classification for patients who have oral conditions that the examining dentist expects will result in dental emergencies within 12 months if not treated. Patients should be placed in class 3 when there are questions in determining classification between class 2 and class 3.

CLASS 4

Class 4 is the classification for patients who require a dental examination. This includes patients who require annual or other required dental examinations and patients whose dental classifications are unknown.

DESIGNATIONS, CHARTING, AND ABBREVIATIONS

The designations and abbreviations are to be used when making entries in a patient's EZ603 or EZ603A (dental continuation sheet). The names of permanent and deciduous teeth and numbers that correspond with them have been discussed in Chapter 7, “Oral Anatomy.”
TOOTH SURFACES

The following designation of tooth surfaces are used to record pathologic conditions and subsequent restoration of teeth. (Information on pathologic conditions and restorations of teeth can be found in Chapter 24). Table 15-1 outlines tooth surface designations.

<table>
<thead>
<tr>
<th>Surface</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facial (labial and buccal)</td>
<td>F</td>
</tr>
<tr>
<td>Lingual</td>
<td>L</td>
</tr>
<tr>
<td>Occlusal</td>
<td>O</td>
</tr>
<tr>
<td>Mesial</td>
<td>M</td>
</tr>
<tr>
<td>Distal</td>
<td>D</td>
</tr>
<tr>
<td>Incisal</td>
<td>I</td>
</tr>
</tbody>
</table>

Table 15-1.—Tooth Surface Designations

Combinations of the designations must be used to identify and locate caries, and to record treatment plans, operations, or restorations in the teeth involved; for example, 8-MID would refer to the mesial, incisal, and distal aspects of a right maxillary central incisor; 22-DF, the distal and facial aspects of a left mandibular cuspid; and 30-MODF, the mesial, occlusal, distal, and facial aspects of a right mandibular first molar.

GENERAL CHARTING

A large portion of the Corpsman’s time during an examination involves recording existing restorations and current diseases and abnormalities in the patient’s dental records. The HM must fully understand how and where to record this information. Dental chart markings have been standardized so the original dental condition, diseases and abnormalities (treatment needed), and treatments completed may be identified. This assists in efficient continuity of treatment and may establish identification in certain circumstances.

STANDARD ABBREVIATIONS AND ACRONYMS

The use of standard abbreviations and acronyms is not mandatory, but it is desirable for expediency. Dental forms used to record dental treatment have limited amounts of space to write. Use only abbreviations and acronyms that will not be misinterpreted. When recording treatment, ensure to correctly spell all terms. Well known medical and scientific signs and symbols such as: Rx (prescription), WNL (within normal limits), BP (blood pressure) and O₂ (oxygen) may be used in recording dental treatment. The following abbreviations and acronyms are commonly found in dental charting as noted in Table 15-2.
<table>
<thead>
<tr>
<th>Objective</th>
<th>O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operative</td>
<td>Oper</td>
</tr>
<tr>
<td>Oral cancer screening examination</td>
<td>OCSE</td>
</tr>
<tr>
<td>Oral diagnosis</td>
<td>OD</td>
</tr>
<tr>
<td>Oral Health Instruction</td>
<td>OHI</td>
</tr>
<tr>
<td>Oral surgery</td>
<td>O S</td>
</tr>
<tr>
<td>Panoramic radiograph</td>
<td>Pano</td>
</tr>
<tr>
<td>Patient</td>
<td>P t</td>
</tr>
<tr>
<td>Patient Informed of Examination Findings and Treatment Plan</td>
<td>PTINF</td>
</tr>
<tr>
<td>Periapical</td>
<td>PA</td>
</tr>
<tr>
<td>Pericoronitis</td>
<td>PCOR</td>
</tr>
<tr>
<td>Periodontal Screening and Record</td>
<td>PSR</td>
</tr>
<tr>
<td>Periodontics</td>
<td>Perio</td>
</tr>
<tr>
<td>Plan</td>
<td>P</td>
</tr>
<tr>
<td>Plaque Control Instructions</td>
<td>PCI</td>
</tr>
<tr>
<td>Porcelain</td>
<td>Porc</td>
</tr>
<tr>
<td>Post Operative Treatment</td>
<td>POT</td>
</tr>
<tr>
<td>Preparation</td>
<td>Prep</td>
</tr>
<tr>
<td>Preventive dentistry</td>
<td>PD</td>
</tr>
<tr>
<td>Prophylaxis</td>
<td>Pro</td>
</tr>
<tr>
<td>Prosthodontics</td>
<td>Pros</td>
</tr>
<tr>
<td>Removal partial denture</td>
<td>RPD</td>
</tr>
<tr>
<td>Restoration(s)</td>
<td>Rest</td>
</tr>
<tr>
<td>Return to clinic</td>
<td>RTC</td>
</tr>
<tr>
<td>Subjective</td>
<td>S</td>
</tr>
<tr>
<td>Scaled (ing)</td>
<td>Scl</td>
</tr>
<tr>
<td>Surgical (ery)</td>
<td>Surg</td>
</tr>
<tr>
<td>Suture (s) (d)</td>
<td>Su</td>
</tr>
<tr>
<td>Temporary</td>
<td>Temp</td>
</tr>
<tr>
<td>Topical</td>
<td>Top</td>
</tr>
<tr>
<td>Treatment (ed)</td>
<td>TX</td>
</tr>
<tr>
<td>Zinc oxide and Eugenol</td>
<td>ZOE</td>
</tr>
</tbody>
</table>

**Table 15-2.—Abbreviations and Acronyms**
RECORDING DENTAL TREATMENT

When the HM is involved in recording dental treatment from an examination or charting treatment that has been completed, certain markings are charted on the examination form being used. The five forms that will be discussed in this section are the Forensic Examination, located on the inside back cover of the NAVMED 6150/21-30, and Current Status Form located on the inside back cover section of NAVMED 6150/21-30 (Dental Record Jacket) underneath the record identifier for Personnel Reliability Program (if applicable). The last three forms are the Dental Exam Form (EZ603), Dental Continuation Form (EZ603A), and the Report of Medical Examination (DD 2808).

FORENSIC EXAMINATION

This examination is pre-printed in the Dental Record Jacket, NAVMED 6150/21-30. It is intended that the forensic exam be completed only once (usually at accession) during the member's military career. If a replacement record is made, a new forensic exam will be completed.

CHARTING/MARKINGS

The teeth are separated on the exam form to facilitate illustrating supernumerary (extra) teeth, mixed dentition, and interproximal restorations. If a restoration exists interproximally with no occlusal component, use the space to draw the restoration. When indicating fixed partial dentures ignore the spaces. Draw the prosthesis and indicate the materials and teeth involved in the Remarks section as usual. Use the following symbols and notations to complete the top section of the Forensic Examination form to record existing restorations, existing teeth, missing teeth, prosthetic appliances, and variation of normal conditions (non-disease). Use black ink with the following symbols and notations. MANMED Chapter 6 also gives details on these symbols and notations. Note: These same symbols are used for Box 2 on the Current Status Form.

Missing Teeth

Draw a large "X" on the root or roots of teeth not visible in the mouth. Figure 15-4 illustrates teeth #6, #11, and #12 as missing or extracted teeth.

Edentulous Arch

Make crossing lines each running from the uppermost aspect of one third molar to the lowermost aspect of the third molar on the opposite side. Figure 15-4 illustrates an edentulous mandibular arch.

Edentulous Mouth

Inscribe crossing lines (Fig. 15-5) one extending from the maxillary right third molar to the mandibular left third molar and the other line from the maxillary left third molar to the mandibular right third molar.
Figure 15-4.—Missing Teeth and Edentulous Mandibular Arch

Figure 15-5.—Edentulous Mouth
Partially Erupted Tooth

In the diagram of the tooth, draw an arcing line through the long axis. Figure 15-6 illustrates teeth #17 and #32 as partially erupted.

Amalgam Restorations

In the diagram of the tooth, draw an outline of the restoration showing size, location, and shape, and block in solidly. The following are different types of amalgam restorations:

- **Occlusal (O):** Chart along the grooves on the occlusal surface (Fig. 15-7, teeth #1, #2, and #5)
- **Double Occlusal (O):** This restoration is often referred to as "snake eyes." Chart along the two separate grooves on the occlusal surface (Fig. 15-7, tooth #4)
- **Facial (F):** Chart along the facial groove, in the facial pit (Fig. 15-7, tooth #14), or at the gingival margin of the facial surface (Fig. 15-7, tooth #13)
- **Lingual (L):** Chart these along the lingual groove, in the lingual pit (Fig. 15-7, tooth #14), or at the gingival margin on the lingual surface (Fig. 15-7, tooth #15). On anterior teeth, chart these restorations in the lingual pit (Fig. 15-7, tooth #9)
Figure 15-6.—Partially Erupted Teeth

FORENSIC EXAMINATION

Existing restoration, existing teeth, missing teeth, prosthetic appliances, and variation of normal conditions (nondisease) as of ____________________

Figure 15-7.—Single Surface Amalgam Restorations
- **Mesial-Occlusal (MO):** Chart by beginning at the mesial surface and following the grooves on the occlusal surface to the central pit or groove (Fig. 15-8, tooth #18). There can be two amalgam restorations (e.g., an MO and a DO) on the same tooth. In this case the restoration will reach into the central groove, but not include the central pit (Fig. 15-8, tooth #20). Rarely will a restoration cross the oblique ridge (Fig. 15-8, tooth #2, #3, #14, and #15)

- **Distal-Occlusal (DO):** Chart by beginning at the distal surface, and follow the grooves on the occlusal surface to the central pit or groove (Fig. 15-8, tooth #28)

- **Occlusal-Facial (OF):** Chart starting at the central groove on the occlusal surface and down the facial groove on the facial surface. Occlusal-facial restorations are usually placed only on molars. On some molars, all of the occlusal pits will be included in the restoration (Fig. 15-8, tooth #17)

- **Occlusal-Lingual (OL):** Chart starting at the central groove on the occlusal surface and down the lingual groove on the lingual surface (Fig. 15-8, tooth #31). Like (OF) amalgams, (OL) amalgams are usually placed only on molars

- **Mesial-Occlusal-Distal (MOD):** Chart starting at the mesial surface and follow the grooves on the occlusal surfaces to the distal surface (Fig. 15-8, tooth #13 and #19). Think of a (MOD) amalgam restoration as an (MO) and a (DO) amalgam restoration joined together through the central groove on the occlusal surface

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**FORENSIC EXAMINATION**

Existing restoration, existing teeth, missing teeth, prosthetic appliances, and variation of normal conditions (nondisease) as of __________________

![Figure 15-8.—Two and Three Surface Amalgam Restorations](image-url)
• **Mesial-Occlusal-Distal-Facial (MODF):** Chart the same way as a (MOD) amalgam restoration, but include the facial surface. The facial surface may be charted in several ways. It may be charted in the facial groove (Fig. 15-9, tooth #3), or it may be wrapped around the mesial or distal facial surface (Fig. 15-9, tooth #14). The (MODF) amalgam may include a part of the facial surface (Fig. 15-9, tooth #1), or it may include the entire facial surface (Fig. 15-9, tooth #15). Some (MODFs) include the coronal third of the facial surface (Fig. 15-9, tooth #16)

• **Mesial-Occlusal-Distal-Lingual (MODL):** Chart the same way as a (MOD) amalgam restoration, but include the lingual surface. The lingual aspect may be charted in the lingual groove (Fig. 15-9, tooth #18) or it may wrap around the mesial and distal surfaces in the same manner as that discussed for the (MODF). Figure 15-9, tooth #30 and tooth #31, illustrates examples of the (MODL) restorations that include various portions of the lingual surfaces

• **Mesial-Occlusal-Distal-Facial-Lingual (MODFL):** Chart by combining the (MODF) and (MODL) restorations. These restorations may include carious portions of the facial and lingual surfaces. Figure 15-10 illustrates the different types of (MODFL) restorations
FORENSIC EXAMINATION

Existing restoration, existing teeth, missing teeth, prosthetic appliances, and variation of normal conditions (nondisease) as of

A B C D E F G H I J

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17

T S R Q P O N M L K

Figure 15-9.—Four Surface Amalgam Restorations

FORENSIC EXAMINATION

Existing restoration, existing teeth, missing teeth, prosthetic appliances, and variation of normal conditions (nondisease) as of

A B C D E F G H I J

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17

T S R Q P O N M L K

Figure 15-10.—Five Surface Amalgam Restorations
Non-Metallic Permanent Restorations

Nonmetallic Permanent Restorations include filled and unfilled resins, glass ionomer cement, and pit and fissure sealants. In the diagram of the tooth, draw an outline of the restorations showing size, location, and shape. Do not block in. The following paragraphs explain how to chart nonmetallic restorations.

- Mesial (M) and distal (D): Chart these single surfaces on the mesial or the distal side of the facial surface. Figure 15-11, illustrates a mesial restoration (M) on tooth #8, and a distal restoration (D) on tooth #9
- Incisal (I): These restorations include the incisal surface and/or one or more of the other surfaces (MI or DI). Tooth #10 in Fig. 15-11, shows an (MI) restoration; tooth #7 in the same figure shows a (DI) restoration
- Facial (F): Chart along the gingival margin of the facial surface unless otherwise instructed by the dentist. Tooth #6 in Fig. 15-11 shows a facial (F) restoration
- Lingual (L) on anterior teeth: Usually charted in the lingual pit (Fig. 15-11, tooth #11) or at the gingival margin line of the tooth
- Nonmetallic restorations with two or more surfaces: Chart these restorations as shown in the mandibular arch in Figure 15-11. Tooth #26 shows a mesial-facial (MF) restoration; tooth #23, a distal-facial (DF) restoration; tooth #22, a mesial-facial-distal (MFD) restoration; tooth #25, a mesial-incisal-lingual (MIL) restoration; and tooth #24, a distal-incisallinguial (DIL) restoration
- Porcelain, Acrylic Resin, Glass Ionomer, Artificial Crowns, Facings, and Pontics: Chart these nonmetallic restorations by outlining all aspects of the crown or facing as shown on tooth #27 in Figure 15-11. In the "Remarks" section, indicate the material used

Gold Restorations

Outline and inscribe horizontal lines within the outline. If made of an alloy other than gold (chrome), the same charting applies. Indicate in "Remarks" section on the Forensic Exam form the type crown and metal used.

Figure 15-12 shows examples of gold restorations. Tooth #4 has a facial (F) gold restoration, tooth #7 has a (DIL) gold restoration, and tooth #31 has a (MODFL) gold restoration.

To chart a full gold crown, outline each aspect of the crown, and then draw horizontal lines in the outlined area (Fig. 15-12, tooth #19). Gold crowns may have a tooth-colored facial surface made of acrylic resin or porcelain called "facings." These facings are inserted to give the restoration a natural appearance. Tooth #5 and tooth #9 in Figure 15-12 show full gold crowns with nonmetallic facings. The nonmetallic facing is only outlined. Where a full crown is not needed, a three quarter gold crown may be used as shown on tooth #28 in Figure 15-12.
Figure 15-11.—Non-Metallic Restorations

Figure 15-12.—Gold Restorations and Crowns
Combination Restoration

Outline the area showing the approximate overall size, location, and shape; partition at junction of materials used. Indicate each type of material used.

Removable Partial Dentures (RPDs) and Complete Dentures (CDs)

Mark the missing teeth as previously described. Place a horizontal line between the outline of the teeth and the numerals designating teeth replaced by the RPD or CD (Fig. 15-13).

**NOTE:**

On the Forensic Examination form in the "Remarks" section, describe the RPD or CD, indicating whether they are maxillary or mandibular and the type of restoration and material used. An example of this would be Man RPD (acrylic, gold, or chrome-cobalt).

Fixed Partial Dentures (FPDs)

Outline each aspect, including abutments and pontics. Show partition at junction of materials and indicate each type of material used. Inscribe diagonal parallel lines to indicate gold. In the "Remarks" section, indicate each FPD type of material used (gold or chrome). Figure 15-14 illustrates gold or chrome fixed partial dentures and what they look like charted.

Post Crown

Chart the type of crown attached to the post. Outline each nonmetallic material and show restorative metallic materials. Outline approximate size and position of post or posts. In the "Remarks" section, indicate the material used.
Figure 15-13.—Removable Partial Dentures

Figure 15-14.—Gold or Chrome Fixed Partial Dentures
Root Canal Filling (RCF)

Chart this specialized filling by drawing a line(s) in the area of the root(s) where the root canal(s) would normally be located. Teeth #3, #7, and #8 in Figure 15-15, show examples of root canal fillings. Note: Root canal fillings will always be accompanied by a restoration, usually a crown, amalgam, or composite restoration.

Apicoectomy

This procedure involves the surgical removal of the apex of the tooth. Chart an apicoectomy by drawing a small triangle on the root of the tooth involved (Fig. 15-15, tooth #11). Next chart the RCF on the root of the tooth beginning at the level of the root amputation where the apicoectomy has been performed. The dentist will read the patient's radiograph to determine the level of the root amputation. Also note the (L) amalgam restoration on tooth #11.

Deciduous Teeth

Occasionally, a primary or deciduous (baby) tooth will be retained in the adult mouth. Circle the appropriate alphabetical designation on the Forensic and Current Status forms if deciduous teeth are present. Figure 15-16 illustrates a deciduous tooth #11.

Supernumerary Teeth

These are extra teeth other than the normal 32 teeth that are present in the mouth. To chart a supernumerary tooth, draw an outline of the tooth in its approximate location. Then insert an "S" in the proper location on the tooth number line as shown in Figure 15-16.

Drifted Teeth

To chart a drifted tooth, draw an arrow from the number of the drifted tooth as shown in Figure 15-16 (teeth #19, #20, #32 and #31). The point of the arrow should indicate the approximate position to which the tooth has drifted. Drifting usually occurs when teeth move toward the space of an extracted tooth.
FORENSIC EXAMINATION

Existing restoration, existing teeth, missing teeth, prosthetic appliances, and variation of normal conditions (nondisease) as of

Figure 15-15.—Root Canal Fillings and Apicoectomy

FORENSIC EXAMINATION

Existing restoration, existing teeth, missing teeth, prosthetic appliances, and variation of normal conditions (nondisease) as of

Figure 15-16.—Deciduous, Supernumerary, and Drifted Teeth
**Temporary Restorations**

In the diagram of the tooth, draw an outline of the restoration showing size, location, and shape. If possible, describe the material in the remarks section.

**REMARKS SECTION**

Use this section to indicate the restorative materials and to differentiate between sealants, composites, and temporaries.

**Soft Tissue Remarks Section**

This is just a partial list of some of the more common non-pathologic findings to facilitate charting. For each condition indicate approximate size or extent and location. Leave blank if a condition does not exist.

**Occlusion Section**

The examining dentist will tell the HM what Angle's class the patient has. The three classes are I, II, or III. Each side of the patient's mouth may be different. Record the results in the space provided.

In the overjet and overbite section of occlusion, the dentist will let the HM know in millimeters the extent of the abnormality. Leave blank if normal.

In the crossbite section, the dentist will let the HM know the teeth involved to be written in the space provided.

The dentist will use the Remarks section of the occlusion section to record any other occlusal condition not listed above.

**Hard Tissue Remarks Section**

This is just a partial list of some of the more common non-pathologic findings to facilitate charting. Leave section blank if the condition does not exist.

- **Intrinsic Staining**: Indicate teeth involved. Check tetracycline, if appropriate
- **Tori (Bony Prominences)**: Indicate location and approximate size of projection
- **Rotated Teeth**: Indicate teeth involved and approximate number of degrees to the nearest 45 degrees
- **Malposed (Faulty Position Of) Teeth**: Indicate teeth involved and whether facio or linguo-version
- **Other**: Use this space when noting other hard tissue conditions not listed above

**EXAMINING DENTIST NAME STAMP AND SIGNATURE SECTIONS**

Use the examining dentist's name stamp to mark this section and ensure the signature line is signed. In a non-dental environment the provider who completed the exam (IDC) does the same.

**CURRENT STATUS FORM**

This form (Fig. 15-17) will last the entire service career of the patient. It is placed in the NAVMED 6150/21-30 in the same way the Personnel Reliability Program warning form is so that it may be folded up when not in use. If a new Current Status form is ever needed, the information from the previous forms must be transferred to the new form. The form is dated at the top when placed in use by the initial examiner and dated again when replaced by the final provider. The Current Status form contains 4 boxes that explain the instructions for charting symbols used in Boxes 1 and 2.
Box 1

Box 1, Accession and Subsequent Diseases and Abnormalities. All carious lesions, indications for extraction, indications for root canal treatment, and periradicular lesions that the examining dentist recommends for the patient are drawn in pencil using the charting symbols listed in this section. When the indicated treatment is completed, the pencil entry is erased.

Charting Symbols (Box 1)

Use the following instructions for charting in the section, Accession and Subsequent Diseases and Abnormalities Section (Box 1). Do not enter these symbols in Box 2, Missing Teeth at Time of Accession and Treatments Completed After Accession. Entering these symbols in the wrong area would prevent differentiation between the caries and the restorations. Figure 15-18 illustrates charting symbols for Box 1.
On the diagram of the tooth affected, draw an outline of the carious portion, showing approximate size, location, and shape; block in solidly.

Defective Restoration

Outline the defective restoration, including the carious or otherwise defective area, and block in solidly.

- **Unerupted Tooth**: Outline all aspects of the tooth with a single oval. This includes impacted teeth
- **Inclination (Tilt) of Impacted Teeth**: Draw an arrow of the facial aspect of the crown portion of the diagram that indicates the direction of the long axis of the tooth
- **Extraction (Removal) Indicated**: Draw two parallel vertical lines through all aspects of the tooth and roots involved. This applies also to unerupted teeth when removal is necessary
- **Retained Root**: Draw a horizontal line on the root showing the level of retention. Place an "X" on the missing area. Draw two parallel lines in the direction of the long axis of the root through the part that is retained if extraction is indicated
- **Fractured Tooth**: Trace a jagged fracture line in the relative position on the crown or roots affected
- **Periapical Radiolucency**: Outline approximate size, form, and location of the periapical radiolucencies, such as an abscess or cyst
- **Fistula:** Draw a straight line from the involved area, ending in a small circle in a position on the chart corresponding to the location of the tract orifice (opening) in the mouth.

- **Underfilled Root Canal:** Draw a vertical line from the crown toward the apex showing the extent of the filling.

- **Resorption of Root:** Draw an even line on the root showing the extent of resorption of the root.

- **Periodontitis and Alveolar Resorption:** Indicate the extent of gingival recession by drawing a continuous line across the roots to approximate the extent of involvement. Draw another continuous line at the proper level across the roots of the teeth to indicate the extent of alveolar resorption. Base this finding on the dentist’s clinical and radiographic findings.

**Box 2**

Box 2, Missing Teeth at Time of Accession and Treatments Completed After Accession:

- The information is cumulative on this form throughout the patient’s military career.

- Missing teeth from the accession exam are also included in this box. By including this information, the DD2808, Box 18 can be completed by looking at Boxes 1 and 2 of the Current Status Form.

All extractions, restorations and root canal treatment completed during the patient’s service career are entered using the symbols mentioned previously in this chapter under designations, abbreviations, and charting.

When indicating fixed partial dentures, ignore the spaces on the form in between the teeth and draw the prosthesis on each tooth as usual. Only use black ink to make entries in Box 2.

**Charting Symbols (Box 2)**

Use the same instructions and symbols from the Forensic Examination section for charting missing teeth at Time of Accession and Treatments Completed after Accession (Box 2). When charting existing restorations, draw the restoration and show the approximate size, location, and shape in the diagram of the tooth. Identify missing teeth and restorative materials as previously shown in the Forensic Examination section (Charting/Markings).

**NOTE:**
No remarks are made on the Current Status form to indicate materials used.

**Box 3**

Box 3, Medical Alert, is readily seen by all clinicians when opening the record. If a medical alert exists, the word "ALERT" is written or stamped in large red letters with a brief explanation following (i.e. ALLERGIC TO PENICILLIN). The use of red ink stamps is mandated.

**Box 4**

Box 4 is used to record the patient's last name, first name, middle initial, and the sponsor's Social Security Number.

**DENTAL EXAM FORM**

The Dental Examination form (EZ603) is illustrated in Figure 15-19. It is intended to be used on the initial, subsequent periodic, annual, recall, DD2808, and separation exams. It is not intended for emergency or specialty consult exams. All entries are made in black ink except as noted. During the dental exam, the examining dentist may direct the HM to fill out the EZ603 and associated boxes on the form with information.
Figure 15-19.—Dental Examination Form, EZ603
The front page of the Dental Exam Form contains the "S," "O," "A," and "P" sections of the exam that are briefly discussed next.

- **Subjective Section (S):** This section of the form is used to fill out the reason for the examination and the patient's chief complaint.

- **Objective Section (O):** This section is generally meant to record findings and not a diagnosis. The major exception is the caries section where the findings and diagnosis are one and the same.

- **Assessment Section (A):** This section is generally used by the examiner to make a diagnosis.

- **Plan Section (P):** This section is the "Treatment Plan" for the patient.

Instructions for the completion of the EZ603 can be found in MANMED, Chapter 6, or current BUMED instructions.

**INSTRUCTIONS FOR COMPLETING THE BACK OF THE EZ603**

The reverse side of the EZ603 (which is blank) is provided for recording the narrative comments associated with the dental exam and related consultation. Commands are authorized to overprint this section with command specific formats that will facilitate the completion of the dental examination. It is usually overprinted with the EZ603A form.

For placement in the Dental Record, the EZ603 is placed with the Plan or "P" side facing up. It is located on top of any accompanying EZ603As and under the Current Status Form.

**INSTRUCTIONS FOR COMPLETING THE EZ603A**

Record the completion of all dental treatment such as the treatment plan, dental emergencies and any other narrative dental findings on the EZ603A (Fig. 15-20).

An additional column has been added on the far left side to indicate the tooth number (s) of the treatment provided on that date. This will facilitate piecing together a treatment history of a particular tooth.

A medical alert, if present, is written in red ink at the top of the EZ603A. All entries, except for the medical alert, are made per MANMED Chapter 6, Section 13 through 15, in black ink. Complete the patient identification box as indicated at the bottom portion of the EZ603A.
Figure 15-20.—Dental Examination Form, EZ603A
REPORT OF MEDICAL EXAMINATION, (DD 2808)

Frequently, patients needing a dental examination will need it in conjunction with a medical physical. The DD2808 (Fig. 15-21) is used to record the findings of a dental examination. Only boxes 43, 44, and 83 will require dental entries. Although this form is self-explanatory and quite simple to complete, it is important that the entries made are neat and accurate in every detail.

Box 43 and 44

Box 43-Dental Defects and Disease- check the acceptable or not acceptable block and record the current dental class. Box 44-Include here a summary of the patient's dental defects and the dentist's diagnosis.

Box 83

Block 83a- Type, print or stamp the examining dentist's name, rank, DC, and USN (or USNR) or civilian title (DDS/DMD) if a civil service or contract dentist performs the examination. Block 83b- The dentist or physician signs his or her signature.

Figure 15-21.—Medical Examination Report, Page 1 (Left) and Page 3 (Right), DD 2808
MEDICAL CONSULTATION SHEET

Consultation Sheet, SF 513

Dental Treatment Facilities (DTFs), Medical Treatment Facilities (MTFs), and shipboard medical and dental departments use the SF 513 (Fig. 15-22) to refer patients from one DTF/MTF, or department to another. Please note that SF 513 refers patients with both dental and medical conditions needing a second opinion or a referral to a specialist for further evaluation or treatment. Here are guidelines for filling out the SF 513:

- **To:** Enter the name of the DTF/MTF, or department to which the patient is being referred
- **From:** The name of the requesting facility
- **Date of Request:** The date the Consultation Sheet is prepared
- **Reason for Request:** The reason as stated by the requester
- **Provisional Diagnosis:** The diagnosis as stated by the requester
- **Doctor's Signature:** Type, print, or stamp the name, rank, title of the requester with his or her signature in this space
- **Place of Consultation:** Check "bedside" or "On Call." Also mark the next box as "Routine," "Today," "72 Hours," or "Emergency"
- **Consultation Report:** Leave blank. This section will be filled in by the person receiving the form
- **Patient's Identification:** The patient's name (last, first, and middle initial), branch of service and status, rank/rate, family prefix code, social security number, and the activity to which the patient is assigned

![Figure 15-22.—Consultation Sheet, SF 513](image-url)

15-29
PATIENT DISMISSAL

Once the examination is completed, return the patient’s dental prosthesis if it was removed for the exam. The dentist may have instructions for the patient; for example, information regarding medications or future appointments. Make sure that the patient understands the instructions given by the dentist. Remove the patient napkin from the patient and place it over the contaminated instruments.

Push the dental operating light and the bracket table out of the way so the patient will not bump against them. Return the dental chair to its lowest upright position, raise the arm of the chair, and assist the patient from the chair. Direct the patient to the front desk to make future appointments if needed. Remove all instruments and prepare the DTR for the next patient.

SUMMARY

This chapter has introduced the basics in Dental Examinations, such as Patient Preparation, Dental Examinations, Dental Classifications, Standard Abbreviations and Acronyms, Charting/Markings, and Medical/Dental Forms. Having a strong working knowledge in these areas of Dental Examinations will give the Hospital Corpsman a good base from which to grow with dental skills and abilities.
CHAPTER 16

OPERATIVE DENTISTRY

INTRODUCTION

Operative dentistry is the area of dental concern with the prevention and treatment of defects in tooth enamel and dentin. Operative dentistry includes the treatment and restoration of carious teeth with metallic and nonmetallic dental materials. These materials are usually amalgam, composite resins, and glass ionomer restorations. Since many patients need treatment that is provided in operative dentistry, this is where most of the dental assistants are assigned.

PURPOSE

Operative dentistry provides treatment to restore a patient’s dental condition to a healthy, functional, and high level of esthetic quality. Operative dentistry is primarily responsible for the restoration of decayed or fractured teeth. This chapter provides information and procedures that the Hospital Corpsman (HM) may be required to perform in operative dentistry.

RESPONSIBILITIES

Listed below are a few responsibilities vital to the HM’s role in operative dentistry:

- Be familiar with the procedure and anticipate the dentist’s needs
- Prepare the setup for the restorative procedure
- Provide moisture control and better visualization for the dentist by using high-volume evacuation and air-water syringe
- Transfer dental instruments and accessories
- Mix and transfer dental materials
- Maintain appropriate infection control precautions

DENTAL SPECIALTIES

Each operative procedure may not be performed in the same manner. Basic procedures are usually performed during each operative appointment. Some of these procedures are also used in other dental specialties. Dental specialty areas are as follows:

- **“Preventive Dentistry**: The goal of preventive dentistry is to assist the patient in either establishing control of the dental disease or in continuing to maintain good oral health
- **Endodontics**: The specialty of dentistry that manages the prevention, diagnosis, and treatment of the dental pulp and the periradicular tissues that surround the root of the tooth (root canals)
- **Prosthodontics**: The specialized areas of dentistry involved in replacing missing teeth with gold or porcelain prosthesis (crown and bridge)
- **Oral and Maxillofacial Surgery**: Involved in the diagnosis and surgical treatment of diseases, injuries, and defects of the hard and soft tissues of the head and neck (extractions and reconstruction)
- **Periodontics**: The dental specialty involved in the diagnosis and treatment of diseases of the supporting tissues
- **Orthodontics**: The specialty of dentistry that is concerned with the supervision, guidance, and correction of growing and mature dentofacial structures (braces and retainers)
IDENTIFICATION OF OPERATIVE INSTRUMENTS

Because of the many hard to reach areas in the oral cavity and the various functions required, operative instruments come in a wide variety of sizes and shapes. To be an effective Hospital Corpsman, it is necessary to be able to anticipate what instrument the dentist would use next in the procedure. This chapter will discuss hand cutting instruments, amalgam instruments that consist of condensers, carvers and burnishers, and composite (resin) instruments.

HAND CUTTING INSTRUMENTS

Many dental procedures require the use of hand instruments with sharp cutting edges. This cutting instrument group used in operative dentistry includes excavators, chisels, hatchets, hoes, and gingival margin trimmers. They are used in the cavity preparation of both amalgam and composite (resin) restorations.

Spoon Excavators

The spoon excavator is a double-ended instrument with a spoon, claw, or disk-shaped blade. Spoon excavators are used primarily to remove debris from tooth cavities. Their tips and sides are designed for cutting action. The most common sizes are the small and the large spoon excavators (Fig. 16-1).
Chisels

Dental chisels are commonly referred to as miniature chisels. Chisels are used to cleave (split) tooth enamel, smooth cavity walls, and sharpen cavity preparations. The two most common types used in operative dentistry are the wedelstaedt and biangle chisels (Fig. 16-2). The wedelstaedts have slightly curved shanks and are used primarily on anterior teeth. The biangle chisels have two distinct angles—one at the shank and one at the working end. This design allows access to tooth structures that would not be possible with straight chisels.

Hatchets

A dental hatchet (Fig. 16-3) resembles a camper's hatchet, except much smaller. Like dental chisels, some dental hatchets have single cutting ends, and others have cutting edges on both ends of the handle. Hatchet blades are set at a 45- to 90-degree angle from the shank. These instruments have different lengths and widths of blades. Hatchets are used on the wall of the cavity preparation to cleave enamel and cut dentin so there will be a sharp cavity outline.

Hoes

Dental hoes (Fig. 16-4) look like a miniature garden hoe. They are used with a pulling motion to smooth and shape the floor and sides of cavity preparations. Hoe blades are set at a 45- to 90-degree angle from their handle.
Gingival Margin Trimmers (GMTs)

The gingival margin trimmers (GMTs) (Fig. 16-5) are modified hatchets that have working ends with opposite curvatures and bevels. As the name implies, GMTs are used to trim, smooth, and shape the gingival margin of a cavity preparation. GMTs are available in double-ended styles and are used in pairs, such as the #26 and #27. The working ends of the even-numbered instruments are designed for use on the distal surfaces, and the odd numbered instruments are used on the mesial surfaces.

AMALGAM RESTORATION INSTRUMENTS

Amalgam carriers (Fig. 16-6) transport the freshly prepared amalgam restorative material to the cavity preparation. These carriers have hollow working ends called barrels, into which the amalgam is packed for transportation. Both single and double-ended carriers are available with a variety of barrel sizes including: mini, large, and jumbo. When the lever (located on the top of the carrier) is depressed, the amalgam is ejected into the cavity preparation.

In order to save time during the amalgam placement procedure, two carriers are used simultaneously; the dentist is ejecting or condensing the carrier load while the HM is refilling the carriers.

A poorly packed carrier of amalgam handed to the dentist may fall out before it is ejected into the cavity preparation. It is the Hospital Corpsman’s responsibility to ensure that all carriers are properly packed before the transfer to the dentist. After amalgam material placement is completed, eject any remaining amalgam alloy from the carrier into the amalgam well. The carrier is no longer serviceable when the amalgam is allowed to harden in the barrel. Amalgam can be removed from the barrel by applying heat.
Condensers

Amalgam condensers, often called pluggers, are instruments used to condense or pack the amalgam filling materials into the cavity preparation. The hammer-like working end is large enough to compress the soft amalgam without sinking into it. Condensers come in single-and double-ended designs. The working ends are of different shapes and sizes, which may be smooth or serrated as shown in Figure 16-7.

Carvers

After the amalgam is condensed, it must then be carved to approximately the same original anatomical tooth structure. Carvers have sharp cutting edges that are used to shape, form, or cut tooth anatomy into amalgam restorations. Figure 16-8 illustrates these instruments that come in assorted shapes and sizes in double-ended designs. Many carvers were designed for carving specific tooth surfaces.

The Interproximal and #1/2 Hollenback were designed for carving mesial, distal, interproximal, lingual and facial tooth surfaces,

Figure 16-7.—Amalgam Condensers

whereas the discoid-cleoid # 89/92 and Wall Tanner #5 are used on occlusal surfaces. It is recommended the Corpsman know the dentist’s preference to ensure having the desired instrument ready when it is needed.

Burnishers

When the carving is complete, the dentist may use burnishers to smooth and polish the restoration. The dentist may also use burnishers

Figure 16-9.—Burnishers
to remove scratches left on the amalgam surface by a carving instrument. Burnishers have smooth rounded working ends and come in single- and double-ended types. Some of the more commonly used burnishers are shown in Figure 16-9.

**COMPOSITE RESIN INSTRUMENTS**

A variety of double-ended instruments make up this instrument group. They are used to transport and place dental cements, resins, temporaries, and insulating and pulp-capping materials. The working ends on composite resin instruments range from small cylinders to angled, paddle-like shapes. Figure 16-10 illustrates the Woodson #3, #W3, and #11 (also known as Stellite), which are some of the commonly used instruments in this category.

![Composite and Cement Instruments](image)

Other types of composite resin instruments are made of plastic. Plastic instruments can be steam sterilized and used on composites and cements. They either come included in the kit of resin material from the manufacturer or, in some cases, can be ordered as a set as shown in Figure 16-11. Some advantages to using plastic instruments are that they will not discolor or contaminate the composite restoration, and composite resin material will not cling to the instrument.

**Cement and Insulating Base Instruments**

The instruments in this group are used for mixing and handling restorative resin and various temporary restorative, insulating, and pulp-capping materials.

Another instrument frequently used with etching and bonding procedures associated with composite resins is a disposable brush that has a reusable handle (Fig. 16-12). Single-use disposal brushes are being used more frequently, aiding in good infection control practices.

![Disposable Brush and Handle](image)
Spatulas

Three different spatulas are available for mixing restorative materials, as shown in Figure 16-13. Some of these spatulas can cause discoloration in the material being mixed. The selection of a mixing spatula is not critical except when preparing a permanent anterior composite restoration. Some composite restoration material discolors easily. This can be prevented by using the spatulas provided by the manufacturer when working with it. The single-ended #322 and #324 are suitable for mixing materials other than composites. A smaller version for the #324 is the #313 spatula. The #313 is used for mixing small quantities of cement.

Insulating Base Instruments

Insulating base instruments have a small metal ball at the working end and are often referred to as calcium hydroxide (Dycal®) instruments. They are used to mix, carry, and place insulating bases, and are available as a single-ended or double-ended, shown in Figure 16-14.

Figure 16-14.—Double-Ended Calcium Hydroxide Instrument

MISCELLANEOUS INSTRUMENTS, MATERIALS, AND EQUIPMENT

A number of miscellaneous instruments, materials, and equipment are used in operative dentistry. Instruments in a diagnostic exam pack consist of a dental mirror, explorer, periodontal probe and cotton forceps are usually used in all dental specialties.

Aspirating Syringe

This syringe is used in dentistry to inject a local anesthetic. The aspirating syringe differs from most syringes in that it is designed to inject anesthetic from a carpule (Fig. 16-15). The parts of an aspirating syringe consist of a threaded tip where the needle attaches, a barrel where the carpule is placed, a piston rod (plunger) with a harpoon attached that embeds itself into the rubber stopper of the carpule, a finger grip, and a thumb ring (Fig. 16-16).

Figure 16-15.—Anesthetic Carpule
The harpoon allows the dentist to aspirate (draw back) the injection site to see if the needle tip is located in a blood vessel before injecting the anesthetic solution. Once the harpoon is engaged into the rubber stopper of the anesthetic carpule, the dentist can apply inward or outward pressure on the stopper by exerting pressure on the thumb ring. Pulling the thumb ring outward also pulls the plunger outward producing an aspirating effect; pushing inward forces the anesthetic solution through the needle.

**Aspirating Syringe Needle**

The aspirating syringe needles used in dental treatment are sterile and disposable. They are designed for a single use, and are available in different gauges and lengths (Fig. 16-17). The gauge of a needle refers to the diameter of the hollow shaft of the needle. The larger the gauge, the smaller in diameter the needle. The lengths of the needles vary and are classified as long (L) or short (S).
Each needle has either a plastic or metal hub designed to screw onto the threaded end of the syringe (Fig. 16-18). This hub is positioned to permit the needle to extend inward to penetrate the rubber seal portion of a loaded anesthetic carpule.

![Figure 16-18.—Parts of the Aspirating Syringe Needle](image)

The plastic caps covering the sterile needle are easily removed from both ends. When placing the needle onto the syringe, remove only the cap that covers the syringe end on the needle. This maintains the sterility of the needle portion used to inject the patient.

Generally, the Corpsman prepares the anesthetic syringe with a short needle (13/16 inch in length) for maxillary injections, and a long needle (1-3/16 inches in length) for mandibular injections. The tip of the needle has a beveled angle, which is turned toward the alveolus to accurately deposit the solution.

**RUBBER DAM INSTRUMENTS**

Rubber dam instruments include the rubber dam punch, clamps, clamp forceps, and frame. These instruments prepare and maintain the position of thin sheets of latex rubber (rubber dam material). The rubber dam itself is used to isolate a designated tooth or teeth in the mouth before certain operative, endodontic and preventive dentistry procedures are performed. The rubber dam provides a clean, dry field of operation and improves the dentist’s view of the operating site. It also keeps fluids, tissues, and the tongue away from the operating site and prevents the patient from accidentally swallowing or aspirating debris.

**Rubber Dam Punch**

The rubber dam punch is used to make necessary spaced holes in the rubber dam material. The working end is designed with a plunger on one side and a wheel on the other side (Fig. 16-19). This wheel has different sized holes on the flat surface facing the plunger. These features let the operator select and adjust the wheel to punch the desired diameter hole in the rubber dam. Figure 16-19 also illustrates the recommended holes on the wheel to use. The largest hole is used on the tooth that the clamp will go on. The last five remaining holes correspond to the teeth that are included in the isolation.

![Figure 16-19.—Two Styles of Rubber Dam Punches](image)
Rubber Dam Clamps

After the required numbers of holes are punched in the rubber dam, it is stretched to fit over each designed tooth. To maintain a snug fit around the neck of the tooth, a rubber dam clamp is used. These clamps are made of spring steel in various sizes (Fig. 16-20) to fit the general contours of the different teeth.

The clamps with "W" prefixes, such as the #W8A or W3, indicate that the clamps are without wings on the outer portions opposite the holes. The space between the gripping edges of the clamp is narrower than the diameter of the corresponding tooth. Thus, to place the clamp around the tooth, it is necessary to spread the gripping edges wider than the tooth's diameter. To spread the gripping edges, rubber dam clamp forceps are used.

Rubber Dam Forceps

The rubber dam clamp forceps (Fig. 16-21) are designed to spread the two working ends of the forceps apart when the handles are squeezed together. The working ends have small projections that fit into two corresponding holes on the rubber dam clamps. The area between the working end and the handle has a sliding lock device. This sliding lock device locks the handles in positions while the provider

Table 16-1.—Commonly Used Rubber Dam Clamps and Their Area of use

<table>
<thead>
<tr>
<th>Clamp #</th>
<th>Area of use in the mouth</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Primary teeth</td>
</tr>
<tr>
<td>2</td>
<td>Small bicuspsids</td>
</tr>
<tr>
<td>W3</td>
<td>Bicuspsids and small molars</td>
</tr>
<tr>
<td>7</td>
<td>Mandibular molars</td>
</tr>
<tr>
<td>W8A</td>
<td>Partially erupted molars</td>
</tr>
<tr>
<td>9</td>
<td>Anterior teeth</td>
</tr>
<tr>
<td>2 1 2</td>
<td>Anterior teeth</td>
</tr>
</tbody>
</table>

The HM will need to know some of the commonly used clamps and their area of use, which are shown in Table 16-1.
Rubber Dam Frame

In order to provide access to the tooth being treated and keep the area visible, the dentist must clamp a rubber dam around the tooth and hold the loose outer edges of the rubber dam in place with an instrument called a rubber dam frame. Most of the rubber dams used today are U-shaped.

One of the most popular is the Young frame, which is available in adult (Fig. 16-22) and pediatric sizes. When the edges of the rubber dam are connected to the small, sharp projections on this U-frame, there is adequate access and visibility of the treatment area.

DENTAL APPLICATIONS

LEARNING OBJECTIVES:

Describe the dental dam and application.

Describe matrix retainer and application.

RUBBER DAM APPLICATION

The use of the rubber dam is an important part of quality dental treatment and infection control. To save valuable chair side time, place the rubber dam following the administration of local anesthetic (as directed by the dentist). To place the rubber dam, the HM will need the rubber dam material, frame, punch, clamps, and clamp forceps.

Preparation

The first step in applying the rubber dam is to check the contact areas of the teeth to be isolated. Use a piece of dental floss to do this. The next step is to determine which tooth the rubber dam clamp will be placed upon. Upon determination, select a rubber dam clamp for a trial placement.

CAUTION:

To prevent the patient from aspirating or swallowing the rubber dam clamp, always tie dental floss (ligature) on the bow of the clamp before placing it in the patient’s mouth.

A simple and secure method is to put both ends of a piece of floss together and place them on a flat surface. This forms a looped end where the floss is folded in half. Place the clamp over the floss with the bow of the clamp facing up. Next, place the two loose ends through the looped end and carefully pull the loose ends through the loop until the floss is secured tightly over the bow of the clamp (Fig. 16-23). Now you should have a securely placed ligature (dental floss) on the clamp. You are now ready to place the clamp on the rubber dam forceps.

Hold the clamp with the bow facing upward and away from the forceps. Place the small projections on the working ends of the rubber dam forceps into the corresponding holes on the rubber dam clamp. Squeeze the handles of the forceps together to align projections with the corresponding holes on the clamp.
Once the clamp is placed on the forceps, tilt the forceps upright and slide the locking device on the forceps downward to lock the handles in position. Locking the forceps handles is necessary to maintain the tension required to keep the clamp attached to the forceps. The clamp is ready for trial placement.

Pass the rubber dam forceps, with the working end covered, with the palm of the hand and the clamp pointed toward the placement position of the tooth. Be sure to hold on to the ligature while the clamp is checked for proper fitting. The clamp should fit near or slightly below the cementoenamel junction. To stabilize the clamp, all the tips of the clamp must be in contact with the tooth to establish a facial lingual balance. Exercise care to ensure that the clamp tips do not impinge on the gingival tissues. If it does, it will cause the patient to experience pain. If the clamp is not placed properly, it may spring off the tooth and cause injury. Caution is advised to stabilize the clamp firmly on the tooth before the clamp forceps are loosened. Once the trial placement is complete, remove the forceps and attach the clamp until final placement.

To prepare the rubber dam material, the rubber dam punch is needed to make the appropriate number of holes of varying sizes. The punch has an adjustable wheel with holes of varying sizes. By adjusting the wheel, holes of different sizes are produced in the material when the cutting tip strikes the hole in the wheel. The holes in the rubber dam material must be punched firmly and cleanly. A ragged hole or tag will tear easily as the dam is placed over the crowns of the teeth. A ragged hole also may cause leakage of moisture around the tooth.

Ideally, the rubber dam material is marked with predetermined markings of an average arch using a rubber dam stamp and ink pad (Fig. 16-24). This makes punching the rubber dam material easier because there is a pattern to follow with the normal shape of the arch and spacing alignment of the teeth. Before punching the material, always check the oral cavity for any missing, misaligned, or extra teeth.

The HM will need to make adjustments from the standard pattern for these items. The first step is to punch the hole for the tooth to be treated. Next, determine what additional holes must be punched. Normally, the HM will punch holes for the two anterior and at least one tooth posterior to the tooth being treated. An exception to this is root canal therapy when only the involved tooth is exposed. After the holes are punched, apply a slight amount of water soluble lubricant to the back of the material over the crowns and contact areas of the exposed teeth. Now the rubber dam is ready for placement into the oral cavity.

**Placement**

The rubber dam material and clamp can be placed using several methods. The first method usually requires assistance. Place the rubber dam frame on the outside of the dam with the bow of the frame facing out. Stretch the dam material from side to side to secure the corners of the dam on the four projections at the corner of the frame. The rubber dam material should appear baggy on the frame rather than tight to allow easier placement in the oral cavity. Pass the rubber dam and attached frame to the dentist for placement in the oral cavity.
As the dentist stretches the rubber dam material over each tooth to be isolated, the assistant uses floss to slip the septum (rubber dam material between the holes) between the teeth without tearing the material. Always place the floss on the tooth, never directly on the rubber dam itself. Placement of the floss upon the tooth assists in bringing a single thickness of the dam through the proximal contact when the floss is carried through. Floss placed on the rubber dam itself tears the dam and requires the passing of two thicknesses of the dam through the contact.

Once the floss passes the contact of the teeth, release the lingual end of the floss. Loop this end toward the opposite end and floss through the contact again. Next, gently remove the floss by pulling it from the side horizontally; do not attempt to pull the floss back up through the contact vertically. Continue using the floss to invert the inter-proximal septum, mesially and distally as well. Inversion of the rubber dam turns the edges of the dam inward or under, around the isolated teeth, to provide a seal. After this is completed, pass the rubber dam clamp forceps and attached clamp to the dentist for final placement on the tooth.

Adjustment of the rubber dam material on the frame can be made at this time to ensure a smooth and stable fit. Wrap the ligature attached to the clamp around a projection on the side of the frame. This prevents the clamp from becoming a dangerous projectile if it should spring off the tooth. Pass a dull instrument, such as a stellite instrument, to the dentist for inversion of the rubber dam on the facial and lingual areas of the exposed teeth. Dry the exposed teeth with air from the three-way syringe as needed to assist in the inversion.

The second method places the rubber dam clamp on the tooth first. Then slip the rubber dam material over the clamp. Next, in either order, attach the frame and expose the remaining teeth through the holes. Secure the clamp ligature to the frame. Next invert the mesial and distal septum with floss, and the facial and lingual areas with a dull instrument accompanied by air from the three-way syringe.

In the third method, the clamp is held in the rubber dam forceps and the rubber dam is placed over the bow of the clamp. Holding the edges of the rubber dam with the fingers, use the forceps to carry the dam and clamp into the patient's mouth. Place the clamp on the tooth and remove the forceps. Continue the placement as in the second method. The last two methods of rubber dam placement are valuable when a rubber dam must be placed by one individual rather than two. After the restoration is placed, remove the rubber dam.

Removal

Before the rubber dam is removed, use the water syringe and high-volume evacuator (HVE) to flush out all debris collected during the procedure. Rather than pulling the septa through the contact of a newly placed restoration, the septa is cut. Stretch the rubber dam material outward in the facial area of the isolated teeth. This pulls the septa facially to provide access for cutting. Use a pair of small blunt-nose scissors to cut each septum of the rubber dam from the facial aspect (Fig. 16-25). When all the septa are cut, gently pull the dam lingually to free the rubber dam completely from the interproximal spaces. Use the clamp forceps to remove the clamp. Simultaneously, remove the clamp ligature from the frame. Set the clamp forceps and clamp aside. Next, remove the dam with the frame attached. Wipe the patient's mouth, lips, and chin with a tissue or gauze.
Carefully inspect the dam on a flat surface for missing pieces. If a fragment of the rubber dam is missing, check the corresponding interproximal area of the oral cavity with a mirror and explorer. Pieces of the rubber dam left under the free gingiva cause severe gingival irritation. Use dental floss to remove any material stuck between the teeth. Rinse the patient’s mouth with the water syringe and HVE or saliva ejector to remove all debris from the oral cavity.

MATRIX RETAINERS

Matrix retainers are used to hold the matrices (metal bands or strips) firmly in place around a tooth. Matrix retainers and metal bands are used in combination for a temporary mold while the filling material is being packed into place. The Tofflemire retainer (or matrix retainer) is available in three different designs: the universal straight, contra-angle, and contra-angle junior (pedodontic), all shown in Figure 16-26. These retainers are practically maintenance free.

Amalgam Matrices

Amalgam matrices are made of very thin flexible stainless steel available in either roll form or in bands. At times, the standard packaged matrix bands do not provide the necessary length, width, or shape for a particular cavity preparation. When this is the case, the dentist can cut the metal matrix strips to form the needed band. Bands used with the Tofflemire retainers completely encircle the tooth. Matrix bands come in assorted sizes and shapes, as shown in Figure 16-27. The most commonly used band is the Universal or Straight #1 size. The Junior #13 is the smaller pedodontic version of the #1 Universal. The Wide #2 and Junior #15, (which have extensions known as “aprons”) are used when additional length is needed for a preparation extending below the gingiva. A dentist usually prefers certain types of these bands over others. With practice, the Corpsman should become very proficient in having the preferred band on the appropriate retainer.

They can be sterilized along with other dental instruments. The HM’s part in maintaining matrix retainers is to check them periodically and replace those with badly worn screw threads. The HM is also expected to attach the correct matrix band to the appropriate retainer in anticipation of the dentist’s needs.
ASSEMBLING MATRICES

When multiple surfaces of the tooth are removed during the cavity preparation, a matrix is used to approximate the original surface and hold the restorative material in proper form and position until it sets. The type of matrices used depends on the type of restorative material placed. The HM will need to have the right type of matrix available and assembled ready for use during the procedure.

Amalgam matrices are made of very thin, flexible stainless steel available in either roll form or bands. The matrix band, retainer, and wedge are used in combination to form a temporary mold while the filling material is being packed.

The matrix is assembled and placed before the amalgam is mixed. After the amalgam has been packed, the matrix and wedge must be removed before the final carving can be accomplished. The most commonly used retainer is the universal straight Tofflemire.

To assemble the matrix (Fig. 16-28) hold the retainer in one hand with the slots in the guide posts and locking vise facing upward. Turn the large inner nut counterclockwise to position the locking vise close to the guidepost. Turn the small outer nut counterclockwise until the rod is not visible in the locking vise slot. In the other hand, grasp the band with the ends placed evenly together. Place the edge of the band with the larger circumference (occlusal edge) into the diagonal slot at the vise end of the retainer.

Figure 16-28.—Components of the Matrix Retainer
With the band placed in this manner, the larger circumference is toward the occlusal surface and the smaller circumference is toward the gingiva, as shown in Figure 16-29. Continue to ease the band through the inner guide post slot.

![OCCLUSAL EDGE-Large Circumference]

![GINGIVAL EDGE-Small Circumference]

**Figure 16-29.—Large and Small Circumferences of the Band**

As Figure 16-30 shows, position the band through the left guide post for teeth on the mandibular right or maxillary left quadrants. For teeth in the mandibular left or maxillary right quadrants, position the band through the right guide posts. Turn the outer nut clockwise until the rod tip presses firmly against the band in the lock vise to secure the band. Turn the inner nut counterclockwise to increase the size.

![Position for maxillary left or mandibular right quadrants.]

![Position for maxillary right or mandibular left quadrants.]

**Figure 16-30.—Positioning the Band to the Right or Left for the Appropriate Quadrants**

When the assembled matrix is placed over the prepared tooth, the slot opening of the retainer and the small circumference of the band are positioned toward the gingiva, and the retainer is placed along the facial surface of the tooth. The handle of the retainer extends out of the oral cavity at the corner of the lips.

The dentist gently manipulates the matrix band into the inter-proximal space on either side of the tooth. The dentist then places an index finger or thumb over the occlusal surface to hold the band in place and tightens the band by turning the inner nut clockwise to fit snugly around the tooth. At this time, the dentist may decide to place a wedge along the side of the matrix band.

**Wedges**

Wedges are small, tapering, triangular pieces of wood or clear plastic about ½-inch in length. Wedges are available in various sizes, which may be color coded. They are either plain (straight) or anatomically shaped (Fig. 16-31). Clear plastic anatomical wedges are designed for use with light-cured materials.

![CLEAR PLASTIC ANATOMICAL]

**Figure 16-31.—Wedges**

Since the general shape of tooth crowns vary, the matrix band around the tooth may not always produce a snug fit. This leaves space through which condensed restorative material can be pushed out to create an undesirable overhanging restoration. The dentist uses wedges to force the matrix band or strip tightly against irregular tooth surfaces to prevent these spaces. This snug fit then restricts the firmly condensed restorative material to the confines of the prepared cavity margins and the band itself.
Matrix Removal

Because new restorations fracture easily, use extreme care when removing the matrix band. To remove the matrix band and retainer, the dentist, first gently manipulates the point of an explorer around the inside edge of the band. This contours the marginal ridge of the restoration and removes the excess amalgam around the matrix band. The assistant will pass the dentist cotton forceps or hemostats to remove the wedge if one was placed. With the thumb or finger over the occlusal surface of the restoration and matrix band, the outer and inner nuts are turned counterclockwise to loosen the retainer from the band. After the retainer is removed, the remaining band is carefully removed. A loose end of the band is grasped with the hemostats or cotton forceps and gently rocked back and forth until the band comes out of the interproximal space. Remove the band from the other interproximal space in the same manner.

FOUR-HANDED DENTISTRY

LEARNING OBJECTIVE:

Describe proper methods for handling and passing instruments.

The goal of four-handed dentistry is to allow the dentist and assistant to function as a team in a seated position with maximal efficiency and minimal strain. Four-handed dentistry, increases productivity, and reduces stress and fatigue on the provider and assistant. Four-handed dentistry can be used in all of the specialty areas and operative dentistry. It is crucial that it be mastered by the HM.

To be an effective dental assistant in four-handed dentistry, the HM must know the correct zones and positions and where the HM is in relation to the patient and dentist. Correct passing and receiving of instruments and materials to the dentist is another task that must be practiced to work efficiently with the dentist.

ZONES AND POSITIONS

The position of the patient is determined by the procedure to be performed. Most dental treatment is provided with the patient in the supine position. Once the patient has been seated, the dentist and the assistant should place themselves in the proper positions for treatment. These positions are best understood by relating them to a clock. In the clock concept, an imaginary circle is placed over the dental chair, with the patient’s head at the center of the circle. The circle is numbered like a clock with the top of the circle at 12 o'clock. The clock is divided into four zones of operation:

- Static zone
- Assistant's zone
- Transfer zone
- Operator's zone

The use of these zones is the key to the efficient implementation of the principles of four-handed dentistry. For right-handed dentists, seated to the right of the patient, the operator's zone is between 8 and 11 o'clock, and the assistant's zone is between 2 and 4 o'clock. For left-handed dentists, seated to the right of the patient, the operator's zone is between 1 and 4 o'clock position and the assistant's zone between 8 and 10 o'clock. Whenever the treatment site is on the lingual surfaces of anterior teeth, the dentist (right or left-handed) generally uses the 12 o'clock position.

The transfer zone is from 4 to 8 o'clock. Instruments and materials are passed and received in this zone over the chest and at the chin of the patient. All instruments and materials are located in the assistant's zone.

The static zone, from 11 to 2 o'clock, is a non-traffic area where equipment, such as nitrous oxide, can be placed with the top extending into the assistant's zone. When an object is heavy, or material or an instrument is objectionable if held near the patient's face, the HM may pass or hold it in the static zone.
For example, anesthetic syringes are sometimes passed to the dentist in this area so that the patient will not be alarmed at the sight of the syringe. Part of this area can also be used when the provider is positioned in the 12 o'clock position as previously mentioned.

Dentists and dental assistants should sit with their back straight and head relatively erect. This helps prevent curvature of the spine. The patient should be lowered to a position that places the treatment site as close to the dentist's elbow level as possible. When the patient is properly positioned, the dentist's eyes should be 14 to 16 inches from the treatment site.

As the assistant, the HM should sit as close as possible to the back of the patient's chair with the feet directed toward the head of the chair. This position lets the HM reach the treatment site, hose-attached instruments and materials from the mobile cart or instrument tray without leaning, twisting, or overextending the arms. This position allows the HM to observe the patient’s responses throughout the procedure.

Adjust the stool so that it is at eye level 4 to 6 inches above the dentist's eye level. Like the dentist, the assistant should sit in an erect position. The assistant's chair may have a curved, movable armrest. This armrest may be adjusted in front to support the body just below the rib cage. Using this armrest as a brace, allows the HM to be able to lean slightly forward from the hips only. Place feet firmly on the foot-support ring at the base of the assistant chair so that the HM’s feet are parallel to the floor. The mobile cart or instrument tray should be placed toward the head of the patient's chair, and positioned to allow the HM easy access to the needed instruments and materials.

PASSING AND RECEIVING INSTRUMENTS AND MATERIALS

To increase production while reducing stress and fatigue, the HM and the dentist will need to work together as a team. The HM must be able to anticipate the dentist’s needs and fulfill those needs without unnecessary delay. To accomplish this, the HM must know the sequence of the treatment procedure and have the required instruments and materials ready at the proper time. When assisting in four-handed dentistry, the HM must also irrigate with air and water as well as aspirate with the high-volume evacuator throughout the procedure. To familiarize the HM with passing and receiving items efficiently during the procedure, this section will begin with instrument transfers.

Instrument Exchange

Instrument exchange between the dentist and assistant takes place in the transfer zone near the patient's chin. As the assistant, the HM must anticipate the dentist's needs, and be ready when signaled by the dentist to pass the next instrument and receive the used one in a smooth motion. An alert assistant does not need a verbal command to make the exchange, but should be constantly ready when the exchange signal occurs. Ideally, the instrument transfer is accomplished with a minimum of motion involving movement only of the fingers, wrist, and elbow. During the transfer, the dentist should not move his/her finger rest or eyes from the treatment site. When the exchange is completed, the dentist pivots the working hand back to the working position.

The HM should arrange the instrument setup in an orderly fashion. Usually the instruments are set up from left to right, in the sequence in which they are to be used. The HM should return them to their original position following use in case they need to be reused.

If the HM is assisting a right-handed dentist, the assistant must be seated on the left side of a patient. Since the HM’s right hand is busy aspirating, the HM must learn to transfer instruments with the left hand.
One Hand Instrument Exchange

The actual instrument transfer is divided into four stages—working, signal, pre-transfer, and mid-transfer (Fig. 16-32). In the working stage, pick up the next instrument to be used from the instrument tray with the left hand. Grasp the instrument between the thumb and first two fingers by the end opposite from the working end as shown in Figure 16-32A. Hold the working instrument close to the treatment area and parallel to the instrument being used. Extend the little finger to receive the instrument being used by the dentist as shown in Figure 16-32B.

The signal stage takes place when the dentist signals for the next instrument by slightly raising the instrument from the tooth. During this stage, the dentist maintains the fulcrum (finger rest) and, with a pivotal action, rotates the working hand away from the patient's oral cavity. This positions the used instrument so that the HM can grasp it with the little finger.

In the pre-transfer stage, grasp the used instrument firmly using the little finger as shown in Figure 16-32C. The HM may prefer to use the last two or even three finger to receive the used instruments. Immediately following this action, the HM carries out the mid-transfer stage.

In this stage, place the next instrument into the dentist's hand with the working end positioned toward the treatment site, as shown in Figure 16-32D. When the treatment site is located on the maxillary arch, point the working end of the instrument up. When the treatment site is on the mandibular arch position the working end down and do not release the grip of the new instrument until the dentist has firmly grasped the instrument.

If the instruments become tangled during the exchange, this is usually caused by failure to parallel the handles before the exchange. The exchange of all instruments is done with firm, deliberate movements to give both the dentist and the assistant the feeling of confidence and to eliminate lost time and motion. Return the used instrument to its original position on the instrument tray and prepare to repeat the procedure with the next instrument required.

Refer to Figure 16-33 for an overhead view (left-handed) of an instrument exchange during patient treatment. When the HM assists from the right side of the patient, use right hand in the same manner described for the left hand.
Figure 16-32.—Instrument Exchange (Steps A Through D)

**A**
Hold instrument opposite the working end.

**B**
Hold instrument with thumb, index and ring fingers ready to pass. Prepare to receive used instrument with little finger extended.

**C**
Passing position

**D**
New instrument placed in dentist's hand with working end pointed towards working site. Used instrument pulled toward assistant's hand.
Align new instrument parallel with used instrument near patient's chin.

Fulcrum of dentist's hand maintained. Used instrument grasped with assistant's ring and little fingers.

New instrument placed in dentist's hand while used instrument palmed in assistant's hand. Fulcrum of dentist's hand maintained.
Preparing and Passing Materials

Dental materials are exchanged under the patient’s chin and over the patient’s chest in the transfer zone. This prevents materials from being dropped on the patient’s face. Small amounts of dental materials may be mixed and passed on a glass slab, paper pad, or dappen dish.

As a HM, it is necessary to prepare dental materials at the proper time during the procedure. A material mixed too soon does not allow sufficient handling time. Knowing when to mix is equally as important as knowing how to mix. As with instruments, knowing the routine of the procedure lets the HM anticipate when the dentist will need the specific material. The HM should have the mixing equipment ready and the material in position and in place slightly before the time it is needed following manufacturer’s instructions. Begin mixing only when the dentist is ready.

When the HM is assisting during an amalgam restoration, load the amalgam into the carrier and pass the loaded carrier to the dentist. Occasionally, there will be use of two or more amalgam carriers, which allows filling the barrel of one while the dentist is using the other. The HM must also add into this sequence; the filling and refilling the amalgam carriers and the passing of condensing instruments to the dentist during the amalgam restoration process.

During the use of cements, most dentists prefer that the HM leaves the mixed cement on the glass slab or mixing pad while holding the pad or slab in the hand near the treatment site. The dentist can select the amount desired. Another option has the HM holding the air syringe to dry the area for application and placement of the material. With the use of some materials, the HM may need to hold a gauze sponge in one hand (rather than the air syringe) to wipe excess material from the application instrument.

The overall idea in passing and receiving dental instruments and materials is to have the necessary item at the right place, in the right position, at the right time. This leaves the dentist free to concentrate more on the area of treatment.

BASIC DENTAL PROCEDURES

LEARNING OBJECTIVES:

Identify anesthetics used in dental procedures.

Describe irrigation and aspiration procedures.

Some basic dental procedures, such as administration of local anesthetic, irrigation, aspiration, and retracting of tissues, are performed in nearly all aspects of all clinical dentistry. Others such as rubber dam application and assembling of matrices are performed in operative procedures. Except for the administration of local anesthetic, the HM must be able to perform these procedures. When administration of local anesthetic is required, the HM needs to prepare all the items used for this procedure.

PRE-INJECTION ITEMS (LOCAL ANESTHETIC)

Before giving a local anesthetic, the dentist may use the following pre-injection items to prepare the injection site:

- Antiseptic solution
- 2 x 2 inch gauze sponges
- Cotton tip applicators
- Topical anesthetic

The dentist may have the patient use an antiseptic mouthwash to rinse the oral cavity before applying a topical anesthetic. The gauze sponges are used to dry the injection site mucosa before applying the topical anesthetic. The topical anesthetic, usually supplied in an ointment, is applied with a cotton tip applicator to reduce the pain associated with the injection of the needle.
INJECTION ITEMS

The items used to give local anesthetics are an aspirating syringe, a needle, and a carpule. It is important to know the different types of anesthetic and how to assemble and disassemble the aspirating syringe properly for the dentist's use.

The HM will find many types of anesthetic carpules in Navy dentistry. The two most common local anesthetics used in dentistry are 2% lidocaine hydrochloride and 2% mepivacaine. Each type of anesthetic is sealed in a 1.8-cc glass carpule. The needle end of each carpule is sealed with a rubber membrane and held in place by a metal band. The other end has a different colored rubber stopper. Each type of anesthetic has a different colored rubber stopper.

Assembling an Aspirating Syringe

Based on the patient's health history and the procedure to be performed, the dentist will inform the HM which type of anesthetic (including vasoconstrictor content), needle length, and needle gauge to use to prepare the syringe. The HM will become familiar with each dentist's preference and various procedures for needle length and gauge. However, always verify the type of anesthetic solution. Assemble the syringe out of the patient's view to reduce unnecessary patient apprehension. Assembly can be done while the dentist administers the topical anesthetic.

First, always check the carpule for cracks or suspended articles floating in the solution. If the HM finds any, discard the carpule and notify the dental and dental supply to ensure other batches of anesthetic are usable. Disinfect the rubber diaphragm on the carpule with a 2x2 alcohol pad before loading it in the syringe. Do not touch the rubber diaphragm after disinfecting it.

Placing the carpule end in the aspirating syringe is fairly easy. Use the following steps:

1. Use the thumb ring to pull the plunger back against the syringe body.
2. Place the cartridge into the barrel of the syringe with the rubber stopper end in first, positioned toward the plunger.
3. Break the seal on the needle container and remove only a small portion of the plastic needle cover.
4. Insert the needle into the syringe and screw the hub onto the syringe.
5. Engage the harpoon into the rubber stopper of the cartridge by holding the body portion of the syringe with one hand while lightly tapping the end of the thumb ring with the other hand.

CAUTION:
Do not tap the thumb ring with too much force; this might cause the glass carpule to shatter.

Make a quarter turn with the thumb ring to ensure that the harpoon is firmly engaged in the rubber stopper. If it is, the thumb ring will rotate back to its original position.

Force a small, but visible amount of anesthesia through the needle to expel air.

Loosen the needle cap, but keep the plastic needle covering in place until passing the syringe to the dentist to guard against possible contamination.

The plastic needle cover must be removed to check the syringe's operation and during the injection.
Passing and Receiving the Syringe

The dentist will be ready to administer the local anesthetic after the topical anesthetic is applied. The assistant passes the syringe with the needle cover in place. Hold the barrel of the syringe in the hand. Place the thumb ring of the syringe over the dentist's thumb and the finger grip between the dentist's index and middle fingers. While still holding the syringe by the barrel, use the other hand to remove the needle cap.

After the dentist gives the injection, carefully remove the syringe by grasping the barrel and lifting the syringe out of the dentist's hand. Remember to exercise extreme caution when grasping the barrel of the syringe because the needle is exposed and contaminated. DO NOT attempt to recap the needle while the syringe is in the dentist's hand. If it is necessary to recap the needle, it must be done using some type of mechanical device or the one-handed scoop technique discussed in Chapter 12, "Preventive Medicine and Infection Control."

Disassembling the Aspirating Syringe

Before the patient is dismissed, the syringe must be disassembled safely. It is vitally important to prevent needle sticks from the contaminated needle. It is advisable to first remove the carpule with the needle remaining in place. This provides an air vent to prevent the glass carpule from shattering. To unload the carpule, pull the piston rod back as far as possible to disengage the harpoon from the rubber stopper without pulling the stopper from the carpule. The carpule can then be easily removed from the syringe. After removing the used needle and carpule they should be disposed into the sharps container.

IRRIGATION AND ASPIRATION

Immediately after the dentist administers the local anesthesia, the HM will irrigate and aspirate the injection site. This is necessary because the anesthetic solution produces a bitter taste in the patient's mouth.

Additionally, the HM is required to irrigate and aspirate (drawn by suction) often throughout the treatment procedure to maintain a clean treatment site.

Irrigation

The dentist expects the HM, to irrigate the oral cavity when necessary. By applying water or saline solutions to the treatment site in the oral cavity, small tooth particles, dried blood, and other debris are flushed from the area and removed by aspiration. Handpieces with water spray systems provide some irrigation, but additional irrigation is always necessary. At times, the dentist may decide not to use the water spray system on the handpiece for a particular procedure.

During routine operative procedures, the HM will use the three-way syringe on the dental unit to irrigate the treatment site with water or water spray. The tip of the three-way syringe rotates easily to direct the water, spray, or air at the specific treatment sites. The tip disconnects to allow for sterilization.

When the HM irrigates treatment sites during surgical procedures, sterile saline solution or sterile water will be used as the irrigation solution. Sterile saline or sterile water is applied by using a bulb-type or Luer (piston-barrel) syringe. The main purpose for irrigation during surgical procedures is to keep a clean treatment site. The cleansing is not complete until the irrigating solution is aspirated from the mouth.
Aspiration

Aspiration is necessary to remove blood, pus, saliva, and debris from the treatment site and oral cavity. This is done by using the high-volume evacuator (HVE) or saliva ejector. Figure 16-34 illustrates the reverse palm grasp and modified pen grasp that should be used when using the HVE. The HM must assure that a sterile or disposable tip is in place for each patient.

When using either of these, always place the tip in the upright position before turning the aspiration off. This helps prevent materials from dripping out or clogging the hoses. The HM must also clean and maintain the evacuation system as instructed in the manufacturer's operation and maintenance instructions.

![Reverse palm grasp.](image1)

![Modified pen grasp.](image2)

Figure 16-34.—Reverse Palm Grasp and Modified Pen Grasp Using an HVE

OPERATIVE PROCEDURES

LEARNING OBJECTIVES:

- Describe the preparation for restorations.
- Describe the methods to treating cavities.
- Describe fluoride application.

Operative dentistry strives to restore decayed or fractured teeth to their original functional ability and esthetic quality of healthy dentition. In general, procedures include the following:

- Determining the procedure to be done
- Administering anesthesia
- Placing a rubber dam
- Preparing the cavity or cavities to be filled
- Placing filling material into prepared cavity preparations
- Carving and finishing restorations
- Smoothing and polishing restorations

As an assistant in operative dentistry, the HM will perform many of the basic clinical procedures discussed earlier, such as:

- Preparing the dental treatment room (DTR)
- Performing proper infection control procedures
- Wearing appropriate personal protective equipment
- Selecting and arranging instruments and materials required for the procedure
- Receiving and preparing the patient
- Preparing local anesthetic
- Irrigating and aspirating throughout procedure
- Retracting tissue to maintain clear field of vision
- Preparing and assisting with the placement of the rubber dam
- Preparing, passing, and receiving instruments and materials
Figure 16-35 illustrates a typical selection and arrangement of instruments for a routine operative procedure. Items should be arranged in sequential order of the procedure to proceed smoothly without delay.

**TERMINOLOGY AND CLASSIFICATION OF CAVITIES**

For the necessary treatment procedures to proceed smoothly and without delay, the HM must understand basic terminology and classification of cavities.

A cavity preparation is a mechanical procedure that removes caries or existing restorative materials and a limited amount of healthy tooth structure to receive and retain restorative materials in the cavity preparation. A cavity wall is a side or surface of the cavity preparation that aids in enclosing the restorative material.
The HM should already be familiar with the terms used to describe the various tooth surfaces, such as mesial, distal, lingual, facial, incisal, and occlusal. A bevel is a slanting of the enamel margins of the tooth preparation cut at an angle with the cavity wall.

Cavities can occur on one or more surfaces, and can be of various sizes, ranging from very small to those that include all five surfaces of the tooth. Simply, cavities are those which occur on one surface of the tooth. When two surfaces of the tooth are involved, the cavity is called a compound cavity. A cavity is considered a complex cavity when three or more surfaces are involved. Compound and complex cavities may include one or both of the proximal surfaces as well as portions of the facial and lingual surfaces. When caries attack the proximal surfaces of posterior teeth, the cavity preparation must also include preparation of the occlusal surfaces.

Cavities may be classified according to the location where the carious lesion begins. Caries frequently start in the developmental pits and fissures of the teeth. These areas are deeper than the surrounding tooth substance and are nearly impossible to clean thoroughly, creating ideal conditions for bacterial plaque formation. Pit and fissure caries can be located in any of the following areas:

- Lingual pits of maxillary incisors
- Lingual grooves and pits of maxillary molars
- Occlusal surfaces of posterior teeth
- Facial grooves and pits of mandibular molars
- Pits occurring in areas because of irregularities in the formation of enamel

Smooth surface cavities can be found on all teeth on the proximal surfaces and the gingival one-third of the facial and lingual surfaces.

**STEPS IN CAVALTY PREPARATION**

After the dentist decides which tooth or teeth to restore, the anesthesia is administered and the rubber dam is placed. If the HM is well prepared, the steps in the cavity preparation should proceed smoothly without delay and the patient will be more at ease. Watch closely during the procedure and be ready to irrigate and aspirate as needed. Pass the instruments and material to the dentist when needed. The initial cavity preparation is generally done using the high-speed handpiece and a variety of rotary instruments.

**Cavity Design**

The design of the cavity preparation for either a tooth with initial caries or replacement restoration is based on several factors including the location of the caries, the amount and extent of the caries, the amount of lost tooth structure, and the restorative material to be used. Some basic principles should be considered when preparing a cavity preparation. The dentist must determine the overall shape of the preparation along the cavity margins of the restoration and the tooth surfaces. The outline form is determined by the size and shape of the carious lesion and by the need for a suitable design that will hold a restoration firmly in place.

Normally, the dentist is able to visualize the shape of the completed cavity before cutting the preparation by viewing the extent of the caries on the radiograph and examining the tooth and soft tissues.

**Removal of Remaining Caries**

Carious dentin not removed during the design of the cavity preparation is removed by using either round burs or spoon excavators. When the dentin has a firm feel with the explorer, removal of the tooth structure should cease, even if stained dentin remains.
Finishing the Enamel Walls and Margins

The last cutting step in the preparation of the cavity is finishing the enamel walls. This is a process of angling, beveling, and smoothing the walls of the cavity preparation to achieve the best marginal seal possible between the restorative material and tooth structure. The dentist may use burs, diamond stones, or hand-cutting instruments (chisels, hoes, hatchets, and gingival margin trimmers) to complete the walls by removing loose or unsupported enamel to create the strongest possible enamel wall.

Cleansing the Cavity

The final step in cavity preparation is cleansing the cavity. This includes the removal of accumulated debris, drying the cavity, and final inspection before placing restorative materials. All debris must be removed from the cavity, especially on the margins, because deposits left on them subsequently dissolve, resulting in a leak that invites recurrent caries.

Irrigating the cavity preparation with warm water usually removes all debris. Stubborn particles of debris may be removed with a small cotton pellet dampened with water or hydrogen peroxide. Following irrigation and aspiration to remove the debris, the cavity must be dried thoroughly with pressurized air from the 3-way syringe or dry cotton pellets.

Placement of Restorative Materials

After the cavity preparation is completed, the HM’s attention as the assistant is especially critical. The HM must rapidly anticipate each step in the procedure to have the necessary material ready at the proper time. The HM must prepare and pass restorative materials, mix them at the right time, and follow the manufacturer’s instructions.

More instruments are needed to place the restoration than to prepare the tooth; therefore, more instrument transfers are necessary and occur more rapidly than in cavity preparation. Once the restorative materials have been placed in the oral cavity, the dentist begins to finish the restoration.

Cavity Liners and Bases

Most dentists use some type of cavity liner or base in almost all cavity preparations. They are used primarily to protect the pulp and to aid the pulp in recovering from irritation resulting from cavity preparation. Liners and bases are placed when the cavity preparation is completed, just before insertion of the restorative material.

Glass ionomer cements and dentin bonding agents are used primarily to seal the dentin and protect the pulp from bacterial invasion. Calcium hydroxide can be used in extremely deep areas as an antibacterial agent and/or as a pulp capping material.

Most bases are applied best when the assistant wipes the instrument clean between each small application. The HM will hold a gauze sponge in the transfer zone and quickly wipe the end of the instrument as the dentist moves toward the base mix. If the dentist inadvertently gets the base on the enamel walls of the cavity preparation, the HM will pass an instrument for removal of the material.

Cavity varnish is a liner used to seal the dentinal tubules to help prevent micro-leakage and is placed in a cavity to receive amalgam alloy after any bases have been placed. Cavity varnish is being used less and less with amalgam restorations, and dentin bonding agents are replacing cavity varnish as the liner of choice. Cavity varnish has an organic solvent of ether or chloroform that quickly evaporates, leaving the resin as a thin film over the preparation. This varnish should be slightly thicker than water. If it becomes very thick, discard it. Cavity varnish is not used with composites since the varnish retards the set of composites and interferes with the bonding of composites.
A small cotton pellet held by cotton forceps is dipped into the varnish just enough to wet the pellet. The cavity varnish is applied to the pulpal area, walls of the cavity preparation, and onto the edge of the margins of the preparation. Any excess varnish can be removed from the enamel with a fresh cotton pellet. A second application of cavity varnish is placed over the first to thoroughly coat the surfaces of the dentin and fill any voids from bubbles created when the first application dries. After liners and bases are placed into the cavity preparation, the tooth may be restored with materials, such as amalgam, composite resin, or glass ionomer.

Amalgam

AMALGAM RESTORATIONS.—Amalgam is used as a restorative material on the surfaces of both permanent and primary teeth. Amalgam is aesthetically acceptable for distal restorations of the cuspid when the restoration is not readily visible. Amalgam can also be used to prepare a sound base for a tooth before the preparation of a full artificial crown. This is commonly referred to as an amalgam buildup. When multiple surfaces of the tooth are removed during the cavity preparation, a matrix is required to approximate the original wall and hold the restorative material in proper form and position until it sets. During the final stages of the cavity preparation, if not sooner, the HM should acknowledge the need for the matrix band and assemble it. While the liner and base materials set, the dentist places the assembled matrix band and retainer around the tooth, along with wedges if needed. Figure 16-36 illustrates a properly contoured and wedged matrix band.

While the dentist makes the final adjustments to the matrix, the HM will need to ensure the precapsulated amalgam is placed securely in the amalgamator and ready to triturate (mix). Wait for a signal from the dentist to begin mixing the amalgam. When the amalgamator stops, remove the amalgam capsule from the amalgamator, open the capsule, and empty the mixed amalgam into the amalgam well. Use caution with the amalgam mix because any moisture contamination causes the finished restoration to expand. Load the amalgam into...
the amalgam carrier (Fig. 16-37).

Some dentists permit the assistant to dispense the amalgam into the cavity preparation. Other dentists prefer to pass the loaded amalgam carrier and dispense the amalgam themselves. In either case, once the amalgam is placed the HM must pass the amalgam condenser to the dentist. The dentist uses the condenser to pack the amalgam firmly into all the areas of the prepared cavity. During the condensing procedure, the dentist indicates when a change of condensers is needed. Through experience, the HM will know when a change is needed by observing the stage of completion. The exchange of amalgam carrier and condensers continues until the cavity preparation is slightly overfilled. When the condenser is used for the last time, the dentist may use a burnisher and or an explorer on the restoration before removing the matrix band.

The dentist uses a burnisher to bring any excess mercury from the amalgam placed to the top of the restoration. Next the explorer is used to slightly contour the restoration between the tooth and the band before removal of the matrix and retainer. For dentists who choose to initially carve the occlusal anatomy into the restoration before removal of the matrix, have an amalgam carver ready to pass after receiving the explorer. The HM will need to have the cotton forceps or hemostat ready to pass when the dentist is ready to remove the wedge, retainer, and matrix band.

The dentist uses an interproximal carver to smooth the gingival margin of the amalgam restoration at the interproximal area. Only the excess amalgam is removed near the gingival margin to allow the proximal contact to be retained. The dentist continues carving the proximal surfaces to conform to the contour of the inter-proximal area of the tooth. The dentist uses another carver, such as the discoid-cleoid, to carve the primary grooves on the occlusal surface and remove excess amalgam. The HM may need to have another carver ready to pass to the dentist to carve the facial and lingual margins of the amalgam, if applicable.

In addition to passing and receiving a variety of carvers to the dentist, the HM will need the high-volume evacuator (HVE) tip in the other hand to aspirate the shavings from the carving procedure at various times. When the amalgam restoration has been carved, remove the rubber dam. Irrigate and aspirate the patient’s mouth and check the occlusion of the new restoration for any necessary adjustments.

Have the articulating paper ready for use by placing it into a hemostat or articulating paper holder. Pass this to the dentist to check the occlusion of the restoration. The articulating paper is placed in the teeth of the opposing quadrant and the patient is instructed to gently close the teeth together. If the patient closes the teeth together too suddenly or with too much pressure, the new amalgam restoration will fracture if it is too high. Have an amalgam carver ready to pass to the dentist to reduce any high spots on the amalgam restorations.

The restoration is checked with the articulating paper and carved until the proper occlusion is obtained. Have a burnisher, such as a ball or ovoid, ready to pass to the dentist to burnish the amalgam restoration. When the restoration is completed, the oral cavity is irrigated and aspirated using the water syringe. Use the HVE to remove amalgam shavings resulting from the occlusal adjustment. Before dismissal, ensure the patient is given the postoperative instructions and understands them.

**MERCURY CONTROL PROGRAM FOR DENTAL TREATMENT FACILITIES.**—
All dental personnel will follow BUMEDINST 6260.30 series, *Mercury Control Program for Dental Treatment Facilities* because of the health hazard potential of mercury. This instruction discusses control procedures for the handling and disposal of amalgam or mercury-contaminated items.
FINISHING AND POLISHING AMALGAM RESTORATIONS.—When amalgam restorations are placed in the tooth, finishing and polishing of the restorations generally take place at another appointment. The appointment should be at least 24 hours after the placement of the amalgam. Polishing the amalgam smoothes the surface so that plaque does not adhere to it readily and makes the restoration look more attractive. The dentist checks the margins and proximal contacts of the restoration initially. A metal filing strip can be used to remove any roughness or overhang of the restoration in the proximal area.

The dentist may use finishing burs or stones in the handpiece, followed by discs and abrasive points. Before use, discs may be coated with a lubricant, or in some cases, wet with water. The abrasive points progresses from a more-abrasive to a less-abrasive point until a smooth mirror-like surface is obtained on the amalgam restoration. Extra-fine pumice and dry tin oxide, or commercial silicone-mounted polishing cups, may be used for a final polishing.

COMPOSITE RESIN RESTORATIONS.—
The restoration of tooth surfaces that are normally easily visible are restored with tooth-colored restorative materials for an esthetic appearance. One of the most commonly used tooth-colored restorative materials is the composite resin. The three types of composite resins available are:

- Macrofilled
- Microfilled
- Hybrid

The classification of each composite resin depends on the particle size of its inorganic filler. The macrofilled and hybrid resins have higher amounts of inorganic fillers and lower amounts of organic resin than the microfilled resins. This provides the strength needed for proximal-incisal restorations. On the other hand, because microfilled resins have a smaller particle size, they are easier to polish than macrofilled resins.

Many of the recently developed hybrids achieve good polishability and esthetics—one reason for increased popularity.

Composite resin materials are available in self-curing two-paste systems and light-curing single-paste systems. Some brands offer several color selections; whereas, others are supplied in a universal shade. The shade must always be selected before the teeth are allowed to dry because dehydration results in lighter shades.

The restorative material is retained in the cavity preparation by mechanical retention. Chipped or fractured teeth rely mostly on acid-etch enamel for retention of the restorative material. Acid-etching the enamel portion of cavity preparations with a 35 to 50 percent solution of phosphoric acid results in improved retention for resin restorations. A celluloid matrix may be placed before the acid-etching procedure to protect the adjacent teeth. The phosphoric acid is applied to the enamel surface of the cavity preparation and is allowed to be in contact with the enamel for 1 minute. Then the area is rinsed thoroughly with water and dried. The etched enamel surface, when dried, appears chalky white because of a slight dissolving of the surface enamel that leaves microscopic undercuts (retention). After etching the tooth, a bonding agent is applied.

The dentist may need an instrument to pack the composite resin material into the cavity preparation and to avoid formation of air bubbles. When the composite resin material is applied to the etched and bonded surface, the resin invades the surface void, undercuts, and irregularities. When surfaces in the proximal area are restored, the dentist will place a celluloid matrix that will assist in preventing the composite material from adhering to adjacent teeth and also acts as a form to properly place the material (Fig. 16-38). If using a light-cured system of composite resin, the light source is positioned near the restoration and exposed according to the manufacturer's instructions. The dentist, assistant, and patient should wear protective glasses during the light exposure.
The surface of the restoration is smoothed further with a fine and an extra-fine disc of silicon carbide and zirconium silicate. These smooth surfaces prevent retention of food debris or plaque. If a higher gloss of the facial surface is desired, a coating of sealant material is placed over the finished restoration. After completion of the restoration, the rubber dam is removed and oral cavity irrigated and aspirated. If necessary, the dentist checks the occlusion and makes adjustments.

**GLASS Ionomer Restorations.**— Usually, the gingival areas on the facial aspect of the maxillary anterior teeth are restored with one of the tooth-colored restorative materials for an esthetic appearance. Restorations located on the gingival third of the tooth may be necessary because the tooth is carious or because it has been worn away or abraded by incorrect brushing habits. Since glass ionomer cements bond directly with enamel, dentin, and cementum, they may be used for such restorations where minimal preparation of the tooth is desired, or where the fluoride release from the cement is desired to resist recurrence of caries. During placement of the glass ionomer cement restoration, the cavity area must be kept totally dry because moisture will cause a failure of the restoration.

**FLUORIDE APPLICATION**

Topical fluoride can be administered by three different methods. The first method involves the application of fluoride solution. This type of fluoride must be painted on the teeth with a cotton tip applicator. The second method of fluoride application is the use of a concentrated fluoride rinse. The third method is the tray technique, which is used to apply fluoride gels. Gel application is generally regarded as the most effective means of topical fluoride treatment. This section will focus its attention on fluoride gel application.
A variety of trays are available for fluoride gel application. The use of disposable trays reduces the chance of cross contamination and eliminates the need to clean and sterilize reusable ones. Trays come in several arch sizes to ensure optimal fit for each patient. The tray should provide complete coverage of all erupted teeth without going beyond the most distal tooth surface in the arch. Custom-fitted trays can be made that require less gel and promote contact of the gel with the teeth. The extra time and expense of custom fluoride tray fabrication will limit the use to specific patients who require daily application of fluoride gel.

Reexamine the mouth to estimate the size of the dental arches and identify any features such as malposed teeth or bony tori that will influence tray selection. Select a maxillary tray and try it in the patient's mouth. Make sure all teeth will be contacted by the gel. Remove it and do the same for the mandibular arch. Refer to the manufacturer's instructions for the amount of gel required for each tray. A narrow strip of material along the bottom of the tray is normally adequate. This technique will minimize the amount of gel required and will reduce the chance that excess gel will be swallowed by the patient. The patient's teeth must be dried and kept as dry as possible until trays are inserted. Dry each arch separately before placing the tray into the patient's mouth.

First place the mandibular tray. Retract a corner of the mouth with the finger. Insert one end of the tray in the mouth at an angle and then rotate the other end of the tray into the mouth. Insert the saliva ejector before placing the maxillary tray. Place the maxillary tray in a similar fashion and ask the patient to close the teeth together gently.

Refer to the manufacturer's instructions for the amount of time the gel remains in the mouth. Generally, application is no longer than 4 minutes. After the trays have been removed, allow the patient to expectorate (spit) any remaining fluoride from the mouth. Instruct the patient not to rinse, drink, eat, or smoke for at least 30 minutes.

SUMMARY

This chapter has introduced the HM to the basics in Operative Dentistry, such as Operative Procedures, Dental Specialties, Instruments, Materials, Cavity Preparation and Four Handed Dentistry. Having a strong working knowledge in these areas of patient care will give a good base from which the HM can grow as a Hospital Corpsman and chair side assistant.
INTRODUCTION

Radiology technologists (X-Ray Technician) are Hospital Corpsmen (HM) performing diagnostic imaging. Technologists may specialize in a number of areas with the ultimate goal to provide quality radiographic images of patients for interpretation by a Radiologist.

Based on the American Society of Radiologic Technologists website, “Radiologic technologists often specialize in a particular diagnostic imaging area:"

- General “Diagnostic” Radiographers “use radiation (x-rays) to produce black-and-white images of anatomy. The images are captured on film, computer or videotape. X-ray may be used to detect bone fractures, find foreign objects in the body, and demonstrate the relationship between bone and soft tissue. The most common type of x-ray exam is chest radiograph.”

- Computed Tomography (CT) Technologists “use a rotating x-ray unit to obtain "slices" of anatomy at different levels within the body. A computer then stacks and assembles the individual slices, creating a diagnostic image. With CT technology, physicians can view the inside of organs - a feat not possible with general radiography.”

- Magnetic Resonance (MR) Technologists “are specially trained to operate MR equipment. During a Magnetic Resonance Imaging (MRI) scan, atoms in the patient's body are exposed to a strong magnetic field. The technologist applies a radiofrequency pulse to the field, which knocks the atoms out of alignment. When the technologist turns the pulse off, the atoms return to their original position. In the process, they give off signals that are measured by a computer and processed to create detailed images of the patient's anatomy.”

- Cardiovascular-Interventional Technologists “use sophisticated imaging techniques such as biplane fluoroscopy to help guide catheters, vena cava filters, stents or other tools through the body. Using these techniques, disease can be treated without open surgery.”

- Nuclear Medicine Technologists “administer trace amounts of radiopharmaceuticals to a patient to obtain functional information about organs, tissues and bone. The technologist then uses a special camera to detect gamma rays emitted by the radiopharmaceuticals and create an image of the body part under study. The information is recorded on a computer screen or on film.”

- Sonographers “use sound waves to obtain images of organs and tissues in the body. During an ultrasound examination, the sonographer places a transducer in contact with the patient's body. It emits high-frequency sound waves that pass through the body, sending back "echoes" as they bounce off organs and tissues. Special computer equipment converts those echoes into visual data.”

- Mammographers “produce diagnostic images of breast tissue using special x-ray equipment. Under a federal law known as the Mammography Quality Standards Act, mammographers must meet stringent educational and experience criteria in order to perform mammographic procedures.”

- Oral radiography is the art of recording images of a patient’s oral structures on film by using X-rays. As the X-ray films are processed, the resulting radiographs provide the Dental Officer with a valuable diagnostic aid. In the case of death, radiographs can be used to aid in identification.
HISTORY OF X-RAY

LEARNING OBJECTIVE:

Explain the history of x-ray.

The rays were discovered in 1895 by a scientist, Wilhelm Conrad Roentgen. While experimenting with a device called a Crooke’s tube, which generated cathode rays, he noted that a photographic plate completely wrapped in black paper and lying near the tube was fogged when developed.

He knew that the cathode rays could travel only short distances outside the cathode tube and realized he was observing a new, unknown ray, which he called an X-ray because the symbol "X" is used for the unknown in mathematics.

The first dental radiograph was taken during the same year by Dr. Otto Walkoff. Within 10 years of the first discovery of x-ray, radiographs were being used for diagnosis of medical and dental conditions, for X-ray therapy, and for scientific studies. Although technology over the years has made tremendous improvements in X-ray equipment, the basic concepts are the same.

X-radiation can be harmful and HMs must observe safety precautions when using an X-ray machine or working areas using them. The major portion of this chapter is devoted to the operation of x-ray equipment, the process for taking radiographs, and safety precautions for x-radiation.

MEDICAL X-RAY EQUIPMENT

There are a number of medical imaging equipment pieces HMs might see. This chapter outlines the most common that are utilized. Figures 17-1 and 17-2 are medical and dental X-ray machines.
Film Viewers

The film viewer is a metal case with a back-lit screen. The viewer is used to mount and examine radiographs. Figure 17-3 shows a wall mount film viewer. Never light the film viewer in the darkroom when working with unwrapped or unprocessed film. Keep the viewer screen clean at all times (Fig. 17-3).

FUNDAMENTALS

LEARNING OBJECTIVES:

Identify the aspects of radiation safety.

Identify the aspects of patient protection.

MEDICAL X-RAY

Like visible light rays, X-rays are electromagnetic rays that traveling in a wave motion. The measurement of this wave motion is called a wavelength. The difference between X-rays and other electromagnetic rays is their wavelength. The wavelength for X-rays is extremely short in comparison to electromagnetic rays which are longer. The shorter wavelength enables them to penetrate matter that usually absorbs or reflects light. X-rays and other electromagnetic rays have actions that are considerably different.

Some of the characteristics and properties of X-rays are:

- They travel in straight lines at the speed of light
- They affect photographic film by producing a hidden image made visible by processing
- They cause certain substances to fluoresce (glow)
- They cause irritation of living cells. In large amounts can cause necrosis (death) of the cells, a fact that necessitates caution in using X-rays

X-rays are produced in the x-ray tube head when a metal (tungsten) target is bombarded by a stream of electrons. The X-rays are sent from the x-ray machine the cone head, through the patient, and then reach the x-ray cassette (holds the film) to produce an image on the film.

The density of the X-ray image is controlled by four factors: kilo-voltage (kVp), exposure time, milli-amperage (mA), and target-film distance (TFD). All of these factors are interrelated and may be varied by the operator.

RADIATION SAFETY

Radiation safety and radiation protection are everyone’s responsibility. Proper warning signs are required in areas utilizing radiation.

Several groups and national committees were created to monitor the use of ionizing radiation after many occupational workers were killed or developed a medical condition due to excessive radiation exposure. One of these national groups is the Nuclear Regulatory Commission (NRC). During the early years of radiation use, there were no monitoring or governing bodies which resulted in improper use of radiation such as x-rays of shoes for foot size and heads for hats sizes.
Radiation protection is sub-divided into occupational radiation protection (protection of workers); medical radiation protection (protection of patients); and public radiation protection (protection of individual members of the public population). The types of exposure, as well as government regulations and legal exposure limits are different for each of these groups, so they must be considered separately.

There are several factors that affect the amount of exposure (dose) a patient receives from the source. Radiation exposure is managed by a combination of these factors.14

- **Time:** Reducing the time of an exposure reduces the effective dose proportionally. An example of reducing radiation doses by reducing the time of exposures can be accomplished through operator training to reduce the amount of repeated x-rays. The MAS (milliampere per second) controls the exposure time to the patient.14

- **Distance:** Increasing distance (x-ray source to patient) reduces dose due to the “Inverse Square” law. Another distance example includes having non essential personnel standing further away from the radiation exposure area.14

- **Shielding:** Adding shielding will reduce radiation dose to the patient. The radiation getting through decreases with the thickness of the shield. The walls of X-ray rooms are lead lined providing an element of shielding to people outside the room. The X-ray machine operator is shielded when standing behind a leaded glass window and can wear a lead apron. Almost any material can act as a shield from X-rays if used in sufficient amounts. Lead aprons and vests are the best methods of shielding.14

A good rule is the acronym, ALARA, "As Low As Reasonably Achievable." The aim is to minimize the risk of radioactive exposure or other hazards. The rule of ALARA is based on the principle that any amount of radiation exposure, no matter how small, can increase the chance of negative biological effects such as cancer.

It is based on the principle that the probability of the occurrence of negative effects of radiation exposure increases with the total lifetime dose. X-ray and other practices involving the use of radiation bring great benefit to the patient population and limiting radiation exposure will reduce negative effects when utilized safely.

Attention to shielding and the rule of ALARA protects the patient and workers. There are four major ways to reduce radiation exposure to patient and workers:

- **Shielding:** Use proper barriers to block or reduce ionizing radiation

- **Time:** Spend less time in radiation fields

- **Distance:** Increase distance between radioactive sources and workers or population. As a good rule during radiation exposures, the radiation worker should be a minimum distance of 6 feet from the source

- **Amount:** Limit the number of x-ray exposure taken to the lowest number possible

The facility will have Standard Operating Procedures (SOP) for the operation of radiographic (X-ray) units and equipment. The HM will be required to read these procedures before operating equipment in the Radiology Department.

**RADIATION PROTECTION STANDARDS**

**Patient Protection**

Safety precautions will be observed by all persons working in or near an area where X-rays are generated. A number of precautions are taken to prevent the patient from being overexposed to radiation.

When taking radiographs, the HM should always have patients wear lead aprons and thyroid collars to shield reproductive organs and thyroid glands. The only exception is when obtaining a panorex radiograph as the thyroid collar blocks part of the X-ray beam.
Before taking radiographs on a female, always ask whether or not she is pregnant or if pregnancy is questionable. If there is belief of a pregnancy, consult a provider.

Other radiation safety measures include X-ray machines that have built-in safeguards that filter out harmful radiation and restrict the central X-ray to the smallest possible area.

**Occupational Worker Protection**

When working near a source of radiation, personnel assigned to the Radiology department will be issued an environmental dosimetry radiation film badge (Fig. 17-4). Film badges are used to monitor scatter (stray) radiation that occurs in the Radiology department. The badges are placed in the X-ray room behind the technician’s protective lead-lined barrier or at least 6 feet from the tube head and never in the direct line of radiation during exposure.

The film badges contain X-ray sensitive film in a light-tight packet. They are collected by radiation health technician every 6 to 7 weeks. After collection, the film is sent to the radiation detection laboratory for processing and evaluation. In an ideal environment, zero REM [Radiological Equivalent Man or mammal] exposure is expected for all workers. On occasion there might be an exposure (i.e., greater than 0.010 REM) and will be referred to the Radiation Health Office for investigation.

Radioactive material shall not be used in such a manner to cause any non-radiation worker to exceed a total effective dose equivalent of 500 mRem (5 mSv) per year considering occupancy factors and source usage. When taking radiographs on a patient, observe the following precautions to avoid unnecessary exposure to radiation:

- **NEVER** stand in the path of the central X-ray beam during exposure
- **NEVER** hold the X-ray film packet in the patient's mouth during a dental exposure
- **NEVER** hold the tube head or the tube head cylinder of the X-ray machine during exposure
- **ALWAYS** stand behind a lead-lined window during an exposure

**X-Ray Film Log**

Another aspect of radiation safety is accounting for all radiographs that are taken. An X-ray film log is maintained in all X-ray rooms and will contain the following information: Patient's name, rank, SSN, unit assigned, reason for x-ray retake (if applicable), number of exposures taken, and the settings (if possible).

<table>
<thead>
<tr>
<th>NOTE:</th>
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<tbody>
<tr>
<td>When stating the reason for an x-ray retake, be specific on the nature of the retake.</td>
</tr>
<tr>
<td>For example: cone-cut, elongated, foreshortened, dark image, etc.</td>
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**Radiation Levels**

The NRC has established total whole body doses for radiation workers which is found in *Title 10, Part 20, of the Code of Federal Regulations (10 CFR Part 20)*, "Standards for Protection Against Radiation." It sets the annual total effective dose limit at 5,000 mRem (5 Rem) for the entire body.
The Navy has trained Radiation Health professionals to monitor medical and non-medical radiation doses. Refer to the local Radiation Health department or the P-5055, Radiation Health Protection Manual, for further guidance.

**Bio Effects**

Prolonged exposure to radiation may result in loss of hair, redness and inflammation of the skin, blood count change, cell atrophy (wasting away), ulcerations, sterility, genetic damage, cancer, leukemia, and death. Adherence to radiation safety will reduce the possibility of these conditions.

**Precious Metals Recovery Program**

The precious metals recovery program is designated to save Department of Defense (DOD) money by recycling precious metals and using those funds to offset the cost of supplies for DOD activities. Both lead and silver are precious metals found in all x-ray departments. Lead is found in X-ray tube packets, floor coverings, wall shielding, patient shields, and x-ray packets. Silver is found in used fixer solutions and medical/dental films. Precious metals will be saved and turned into the Supply Department following the guidelines in **BUMEDINST 4010.3, Precious Metals Recovery Program**.

**Infection Control**

Both radiographic equipment and film can become contaminated resulting in the transmission of infectious agents. To protect workers and the patients, HMs will ensure that infection control standards are used in the radiology area. Information and procedures on the Infection Control Program can be found in **BUMEDINST 6220.9 Series, Nosocomial Infection Control Program** and **BUMEDINST 6600.10 series, Dental Infection Control Program**.

**Handwashing**

Follow proper hand washing procedures when treating radiology patients. Refer to Chapter 9 of this manual for handwashing technique.

**Darkroom**

The darkroom might be a location that is overlooked as an area being contaminated. Disinfect all surfaces that the HM comes in contact with on daily basis which includes doorknobs, light switches, and other surfaces. Good infection control measures include disinfecting all area that HMs and patients touch.

**Oral Film Positioning Devices**

Film positioning devices should be disposable (single use) or steam sterilized between patients. The treatment facility should have an adequate supply of film positioning devices for the daily patient load. If supplies are short, the HM may disinfect film positioning devices between patients by immersion in an EPA-registered chemical disinfection such as a 2 percent glutaraldehyde solution. Rinse thoroughly after disinfection. Follow manufacturer's instructions for high-level disinfection. Wear gloves when placing intra-oral films and handling contaminated film packets.

**Panoramic Unit Bite-Blocks**

Use a disposable panoramic unit bite block cover for each patient. When disposable covers are not available, disinfect bite blocks in the same manner as a film holding device.

**Intraoral Film Packets**

Intraoral film packets become contaminated when placed in a patient's mouth during exposure. The following section explains procedures to handle and process contaminated intraoral film packets from the X-ray room to the dark room to avoid cross contamination.
PATIENT PREPARATION PROCEDURES

LEARNING OBJECTIVE:

Identify steps for preparing a patient for an x-ray.

To prepare a patient for an X-ray procedure, employ the following techniques:

1. Ensure a provider’s order for the examination.
   a. Only a Medical Officer, Dental Officer, Nurse Practitioner, Physician Assistant (PA) and Independent Duty Corpsmen (IDC) can order a radiographic examination.
   b. The order may be in the Composite Health Computer System (CHCS) or a written order on a SF-519, RADIOLOGIC CONSULTATION REQUEST/REPORT.

2. If the patient is a woman, ask if she is pregnant.
3. If she is or the HM suspects that she might be, consult the ordering physician.
4. Ask the patient to remove eyeglasses, jewelry (affected area), or any other object in the area of examination.
5. Drape the patient with a lead apron ensuring the reproductive organs are covered, unless area of examination will preclude covering.
6. Position the affected anatomy securely against the film screen. Positioning the patient varies according to the type of radiographic examination and the film placement technique to be used.
7. Give appropriate instructions (breathing, remain still, etc.) to the patient.
8. Set KVp and Mas based on current facility charts.
9. Make the exposure.

After the X-ray procedure is completed, return the lead apron and/or thyroid collar back to the storage device(s) to avoid damage.

NOTE:
If working in an operational environment or area not within close proximity of a Radiologist, seek the ordering provider’s impression of findings prior to forwarding the films to the Radiologist.
MEDICAL X-RAY PROCEDURES

LEARNING OBJECTIVES:

Identify the proper patient positioning techniques.

Identify the proper film size for an x-ray exam.

Identify structures shown in an x-ray.

POSITIONING OF THE HAND

Posterior anterior (PA) Projection (Fig. 17-5)

1. Film Size 8 X 10 or 10 X 12
2. Source to image distance (SID)- 40 inches (x-ray tube 40 inches from film)
3. Part position
   a. Rest the patient’s forearm on the table:
   b. Place the hand with the palm down
   c. Slightly spread the fingers
4. Central ray
   a. Perpendicular to the film
   b. Direct the central ray to the third metacarpophalangeal (MCP) joint
   c. Adjust the long axis of the cassette parallel with the long axis of the hand and forearm
5. Structures shown
   a. PA projection of the:
      i. Carpals
      ii. Metacarpals
      iii. Phalanges
      iv. Thumb will be oblique to 45°
      v. Interarticulations of the hand
      vi. Distal radius and ulna
6. Indications
   a. Discomfort due to mechanism of injury

Figure 17-5.—Posterior Anterior (PA) Projection of the Hand

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
Oblique Projection (Fig. 17-6)

1. Film size 8 X 10 or 10 X 12
2. SID - 40 inches
3. Part Position
   a. Rest the patient’s forearm on the table with the hand pronated and the palm resting on the cassette. If possible use an angled sponge as it will allow the fingers to remain straight and provide increased visualization of the joint spaces.
   b. Adjust the obliquity of the hand so that the MCP joints form an angle of approximately 45 degrees with the cassette.
   c. Fingers are flexed with fingertips resting on the cassette.
4. Central ray
   a. Perpendicular to the film
   b. Direct central ray to the third metacarpophalangeal joint
   c. Adjust the midline to be parallel with the long axis of the hand and forearm.
5. Structure shown:
   a. PA oblique projection of the bones and soft tissues of the hand.
6. Indication
   a. Determine possibility of fracture.

Figure 17-6.—Oblique Projection of the Hand

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
Lateral Projection (Fig. 17-7)

1. Film size 8 X 10 or 10 X 12
2. SID - 40 inches
3. Part position
   a. Extend the patient’s digits and adjust the first digit at a right angle to the palm
   b. Place the palm surface perpendicular to the cassette
   c. Evenly fan the fingers apart
4. Central ray
   a. Perpendicular to the film
   b. Direct the central ray through the second metacarpophalangeal joint
   c. Adjust the midline to be parallel with the long axis of the hand and forearm
5. Structures shown
   a. Lateral projection of the structures of the hand
   b. An extended lateral hand will demonstrate the second through fifth digits superimposed

NOTE:
X-rays of the wrist use the same positions as hand x-rays. Finger extension is not required.

6. Indication
   a. Phalangeal fracture
POSITIONING OF THE CHEST
Posterior anterior (PA) projection\textsuperscript{15}
(Fig. 17-8)

1. Film size - 14 x 17
2. SID - 72 inches
3. Part position
   a. Patient is in the upright position
   b. The upper border of the film is positioned approximately 1 ½ inches above the relaxed shoulders
   c. The median sagittal plane of the body is centered to the midline of the grid device
   d. Body weight is evenly distributed over both feet
   e. The head is adjusted so that the median sagittal plane of the skull is vertical and the chin is resting over the edge of the grid device
   f. Place the back of the hands on the hips
   g. Adjust the shoulders to lie in the same transverse plane
   h. If a woman’s breasts are large enough to superimpose over the lower part of the lung field, have the patient pull them upward and laterally
4. Central ray (Cross-hairs)
   a. Perpendicular to the film
   b. Directed to the level of T-7 (Inferior Scapula Angle)
5. Respirations
   a. Exposure is made following full inhalation on the second breath
   b. For certain conditions, an additional exposure is taken following exhalation
6. Indications
   a. Routine physical
   b. Chronic cough
   c. Respiratory disease
   d. Asbestos
   e. Fractured ribs
   f. Pain with respirations

Figure 17-8.—Posterior Anterior (PA) Projection of the Chest

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
Lateral Projection\textsuperscript{15} (Fig. 17-9)

1. Film size - 14 x 17
2. SID - 72 inches
3. Part position
   a. Patient is in the upright position
   b. Place the appropriate shoulder (Left Lateral preferred) against the grid device
   c. The median sagittal plane of the body is parallel to the cassette with the adjacent shoulder in contact with the grid device
   d. The upper border of the film is 1 to 2 inches above the shoulders
   e. Center the thorax to the grid device
   f. Extend the arms over the head
4. Central ray
   a. Perpendicular to the film
   b. Directed to the level of T7
5. Respirations
   a. Exposure is made following full inspiration on the second breath
6. Structures shown
   a. Lateral projection of the heart and aorta
   b. Pulmonary lesions of the side closest to the film
   c. Interlobular fissures
   d. The lobes are differentiated
7. Indications
   a. Routine physical
   b. Chronic cough
   c. Respiratory disease
   d. Asbestos
   e. Fractured ribs
   f. Pain with respirations

Figure 17-9.—Lateral Projection of the Chest

*Photograph provided by HMI James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.*
POSITIONING OF THE ABDOMEN

KUB (Kidneys, Ureter, Bladder) AP projection (Supine/standing position) (Fig. 17-10)

1. Film size - 14 X 17 lengthwise
2. SID – 40 inches
3. Part Position
   a. Patient is supine or standing
   b. The median sagittal plane is perpendicular and centered to the grid device
   c. Adjust the shoulders to lie in the same transverse plane and place arms where they will not cast shadows on the film
4. Central ray (cross-hairs)
   a. Perpendicular to the cassette
   b. Centered to the level of the iliac crest for supine
   c. 2” above iliac crest for standing position.
5. Respirations
   a. Suspended at the end of exhalation
6. Structures shown:
   a. Bilaterally Kidney
   b. Ureter
   c. Bladder

NOTE:
For standing, must include inferior aspect of lungs (Costophrenic angles).

7. Indications
   a. Quadrant pain
   b. Abnormal bowel movement
   c. Bladder trauma
   d. Abdominal trauma
   e. Impaled object
   f. Lower spine (defects, trauma related, impaled, injuries.)
Positioning of the Cervical Spine
AP axial projection (Fig. 17-11)

1. Film size - 8 x 10 or 10x 12
2. SID – 40 inches
3. Part position
   a. Patient is supine or upright
   b. Adjust the shoulders to lie in the same transverse plane
   c. Center the median sagittal plane of the patient’s body to the midline of the grid device
   d. Extend the chin so that a line from the upper occlusal plane to the mastoid tips is perpendicular to the grid device
   e. Center the cassette at C4 (1/2” above Adam’s apple)
4. Central ray
   a. Angled 15 - 20 degrees cephalic (towards head)
   b. Directed to C4 (1/2” above Adam’s apple)
5. Respirations
   a. Suspended
6. Structures shown
   a. C3 to T1 in entirety
7. Indications
   a. Tracheal deviation
   b. Foreign body
   c. Trauma

Figure 17-11.—AP Axial Projection of the Cervical Spine

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
Lateral projection (Fig. 17-12)

1. Film size - 8 x 10 or 10 x 12
2. SID - 72 inches
3. Part position
   a. Patient is upright and in the true lateral position
   b. Adjust cassette so that it is centered at C4 (1/2” above Adam’s Apple)
   c. Center the coronal plane that passed through the mastoid tips to the midline of the film
   d. Place adjacent shoulder in contact with the grid device
   e. Adjust the shoulders to lie in the same transverse plane, depress them as much as possible and immobilize them by using sandbags of equal weight distributed in both hands
   f. Elevate the chin slightly to prevent superimposition of the mandibular rami over the cervical spine
   g. Ensure the long axis of the cervical spine is parallel to the film
4. Central ray
   a. Horizontal
   b. Perpendicular to the film
   c. Directed to the level of C4
5. Respiration
   a. Suspended at the end of full exhalation
6. Structures shown
   a. Lateral view of the c-spine vertebrae from C1-T1.
7. Indications
   a. Musculoskeletal injuries

Figure 17-12.—Lateral Projection of the Cervical Spine

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
Positioning of the Thoracic Spine

AP projection (Fig. 17-13)

1. Film size: 14 x 17
2. SID – 40 inches
3. Part position
   a. Patient is in the supine or upright position
   b. Center the median sagittal plane of the body to the midline of the grid
   c. Place arms along the sides of the body
   d. If the patient is supine, flex the hips and knees to place back in contact with the table
   e. If the patient is erect, distribute body weight equally between both feet
   f. Center film at the level of the T-7 approximately three to four inches below the manubrial notch (Normally this will place the upper edge of the cassette 1 1/2 to 2 inches above the shoulder)
4. Central ray
   a. Directed perpendicularly to T7
   b. Utilize the anode heel effect by positioning the cathode end of the tube towards the feet
5. Respirations
   a. Breathing technique
      i. Slow, shallow breaths
   b. Non-breathing technique
      i. Suspend following full exhalation
6. Structures shown
   a. AP projection of the thoracic bodies, interpediculate spaces and surrounding structures
7. Indications
   a. Chronic pain
   b. Trauma
   c. Cervical spine
   d. Musculoskeletal injuries/abnormalities

Figure 17-13.—AP Projection of the Thoracic Spine

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
Lateral projection (Fig. 17-14)

1. Film size: 14 X 17
2. SID – 40 inches
3. Part position
   a. Patient is in a true lateral position, either recumbent or upright
   b. Place a firm pillow under the patient’s head
   c. Flex the hips and knees to a comfortable position
   d. Center the median coronal plane of the body to the midline of the grid at the level of T7
   e. Adjust the arms at right angles to the long axis of the body
   f. Use a radiolucent support under the lower thoracic region to place the vertebral column horizontal with the film
4. Central ray
   a. Directed perpendicularly to the median coronal plane at the level of T7
   b. Utilize an angulation of 10 degrees for women and 15 degrees for men, due to the differing shoulder widths, if necessary
5. Respirations
   a. Long exposure
      i. Quiet breathing
   b. Short Exposure
      i. Suspend respirations at the end of exhalation
6. Structures shown
   a. A lateral image of the thoracic bodies, their interspaces, the intervertebral foramina and the lower spinous processes
   b. The upper three or four segments are usually not demonstrated in this position
7. Indications
   a. Chronic pain
   b. Trauma
   c. Cervical Spine
   d. Musculoskeletal injuries/abnormalities

Figure 17-14.—Lateral Projection of the Thoracic Spine

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
Positioning of the Lumbar Spine
AP Projection (Fig. 17-15)

1. Film size: 11 x 14
2. SID – 40 inches
3. Part position
   a. Patient may be either supine or upright
   b. Center the median sagittal plane to the midline of the grid
   c. Adjust the shoulders to lie in the same transverse plane
   d. Flex the knees to help flatten the natural lordotic curve of the spine
   e. Flex the patient’s elbows and place the hands on the upper chest
   f. Center the film at the level of L-3
4. Central ray
   a. Perpendicular to the film
   b. Directed to the level of L-3
5. Respirations
   a. Suspended on expiration
6. Structures shown
   a. Lumbar bodies
   b. Intervertebral disk space
   c. Interpediculate spaces
   d. Laminae
   e. Spinous and transverse processes
7. Indications
   a. Chronic pain
   b. Trauma
   c. Cervical Spine
   d. Musculoskeletal injuries/abnormalities

Figure 17-15.—AP Projection of the Lumbar Spine

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
Lateral Projection (Fig. 17-16)

1. Film size: 11 X 14 lengthwise
2. SID – 40 inches
3. Part position
   a. Use the same body position (*recumbent* or upright) as used for the AP
   b. Place patient on the indicated side and flex the hips and knees for stability and comfort
   c. Align the median coronal plane of the body to the midline of the grid
   d. Place the arms at right angles to the body
   e. If needed, place a support under the lower thorax to position the long axis of the spine in a horizontal plane
   f. Place a sheet of leaded rubber on the table behind the patient
4. Central ray
   a. Perpendicular to the film
   b. Directed to the level of L3
5. Respiration
   a. Suspended on exhalation
6. Structures shown
   a. Lumbar bodies and their interspaces
   b. Spinous processes
   c. Lumbosacral junction
   d. The first four lumbar intervertebral foramina
7. Indications
   a. Chronic pain
   b. Trauma
   c. Cervical spine
   d. Musculoskeletal injuries/abnormalities

![Lateral Projection of the Lumbar Spine](image)

*Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.*
Positioning of the Pelvis
AP Projection (Fig. 17-17)

1. Film size 14 x 17 crosswise
2. SID – 40 inches
3. Position of patient
   a. Place the patient on the table in the supine position
4. Position of part
   a. Center the mid-sagittal plane of the body to the mid-line of the grid
   b. Adjust the patient in a true supine position
   c. Have the patient rest their hands across their chest
   d. Unless contraindicated, medially rotate the feet and lower limbs about 15-20 degrees to place the femoral neck parallel with the plane of the cassette
   e. The heels should be 8-10 inches apart
   f. Immobilize the legs with a sandbag across the ankles, if needed
   g. Position upper border of the film 1 ½ inches above the iliac crest
5. Respirations
   a. Suspend respiration prior to exposure
6. Central ray
   a. Perpendicular to the midpoint of the cassette
7. Shield reproductive organs
8. Structures shown
   a. AP projection of
      i. The pelvis
      ii. Femoral head
      iii. Femoral neck
      iv. Trochanters
      v. Proximal 1/3 or 1/4 of the shaft of the femur
9. Indications
   a. Pelvic fracture
   b. Genitourinary system complications
   c. Discoloration
   d. Deformity
   e. Hip pain

Figure 17-17.—AP Projection of the Pelvis

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
POSITIONING OF THE FOOT
AP Projection (Fig. 17-18)

1. Film size 8 x 10 or 10 x 12
2. SID - 40 inches
3. Position of patient
   a. Place the patient on seated or supine position on the table
   b. Flex the knee of the affected side
   c. Rest the sole of the foot firmly on the radiographic table
4. Position of part
   a. Position the cassette under the patient’s foot
   b. Center the cassette to the base of the third metatarsal
   c. Adjust cassette so that its long axis is parallel with the long axis of the foot
   d. Ensure that no rotation of the foot occurs
5. Central ray
   a. 10 degrees towards the heel
   b. Direct central ray to the base of the third metatarsal
6. Shield reproductive organs
7. Structure shown:
   a. AP projection (Dorsoplantar) of the:
      i. Tarsal bones anterior to the talus
      ii. Metatarsals
      iii. Phalanges
8. Indications
   a. Chronic pain
   b. Trauma
   c. Abnormalities

Figure 17-18.—AP Projection of the Foot

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
Oblique Projection (Fig. 17-19)

1. Film size 8 x 10 or 10 x 12
2. SID – 40 inches
3. Position of patient
   a. Place the patient on a seated or supine position
   b. Flex the knee of the affected side
   c. Rest plantar surface of the foot firmly on the radiographic table
4. Position of part
   a. Place the cassette under the patient’s foot
   b. Place film parallel to the foot and with its long axis
   c. Center film to the midline of the foot at the level of the base of the third metatarsal
   d. Rotate the foot medially until the plantar surface forms an angle of 30 degrees to the plane of the cassette
5. Central ray
   a. Perpendicular to the film
   b. Direct central ray to the base of third metatarsal
6. Shield reproductive organs
7. Structures shown
   a. Interspaces between the following:
      i. The Cuboid and the Calcaneus
      ii. The Cuboid and the fourth and fifth Metatarsals
      iii. The Cuboid and the lateral Cuneiform
      iv. The Talus and the Navicular bone
      v. The Cuboid is shown in profile
   b. The Sinus Tarsi is also well demonstrated
8. Indications
   a. Chronic pain
   b. Trauma
   c. Abnormalities
**Lateral Projection** (Fig. 17-20)

1. Film size 8 x 10 or 10 x 12
2. SID – 40 inches
3. Position of patient
   a. Have the patient lie on the radiographic table and turn toward the affected side
   b. Place the opposite leg behind the patient
4. Position of part
   a. Elevate the patient’s knee enough to place the patella perpendicular to the horizontal plane
   b. Adjust a sandbag support under the knee
   c. Center the cassette to the mid-area of the foot
   d. Adjust the cassette so that its long axis is parallel to the long axis of the foot
   e. Dorisflex the foot to form a 90-degree angle with the lower leg
5. Central ray
   a. Perpendicular to the film
   b. Direct central ray to the base of the third metatarsal
6. Shield reproductive organs
7. Structures shown
   a. The entire foot in profile
   b. The ankle joint
   c. The distal ends of the tibia and fibula
8. Indications
   a. Chronic pain
   b. Trauma
   c. Abnormalities

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*Figure 17-20.—Lateral Projection of the Foot*

*Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.*
Positioning of the Ankle
AP Projection (Fig. 17-21)

1. Film size 8 x 10 or 10 x 12
2. SID – 40 inches
3. Position of patient
   a. Place the patient in the supine or seated position with the affected limb fully extended
4. Part position
   a. Adjust the ankle joint in the anatomic position to obtain a true AP projection
   b. Flex the ankle and foot enough to place the long axis of the foot in the vertical position
   c. The leg should have no rotation
5. Central ray
   a. Perpendicular to the ankle joint at a point midway between the Malleoli
6. Shield reproductive organs
7. Structures shown
   a. Ankle joint
   b. Distal ends of the Tibia and Fibula
   c. Proximal portion of the talus
8. Indications
   a. Chronic pain
   b. Trauma
   c. Abnormalities

Figure 17-21.—AP Projection of the Ankle

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
Oblique Projection (Medial Rotation)
(Fig. 17-22)

1. Film size 8 x10 or 10 x 12
2. SID – 40 inches
3. Position of patient
   a. Place the patient in the supine or seated position with the affected limb fully extended
4. Part position
   a. Center the cassette to the ankle joint midway between the Malleoli
   b. Adjust the cassette so that its long axis is parallel with the long axis of the leg
   c. Dorisflex the foot enough to place the ankle at nearly right-angle flexion
   d. Grasp the lower femur with one hand and the foot with the other. Internally rotate the entire leg and foot together until the 45-degree position is achieved
5. Central ray
   a. Perpendicular to the ankle joint
   b. Entering midway between the Malleoli
6. Shield reproductive organs
7. Structures shown
   a. Distal ends of the Tibia and Fibula
   b. Parts of Tibia and Fibula are often superimposed over the talus
   c. Tibiofibular articulation should be demonstrated
8. Indications
   a. Chronic pain
   b. Trauma
   c. Abnormalities

Figure 17-22.—Oblique Projection of the Ankle

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
Lateral Projection (Fig. 17-23)

1. Film size 8 x 10 or 10 x 12
2. SID – 40 inches
3. Position of patient
   a. Have the supine patient turn toward the affected side until the ankle is lateral
4. Part position
   a. Place the long axis of the cassette parallel with the long axis of the patient’s leg and center it to the ankle joint
   b. Have the patient turn anteriorly or posteriorly as required to place the patella perpendicular to the horizontal plane
   c. Place a support under the knees if necessary
   d. Dorisflex the foot, and adjust it in the lateral position
5. Central ray
   a. Perpendicular to the ankle joint, entering the medial Malleolus
6. Shield reproductive organs
7. Structures shown
   a. Lower third of the Tibia and Fibula
   b. Ankle joint/Tarsal Bones
8. Indications
   a. Calcaneous fracture
   b. Abnormalities
   c. Twisted ankles

Figure 17-23.—Lateral Projection of the Ankle

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
DENTAL X-RAY PROCEDURES

LEARNING OBJECTIVES:

Identify the proper patient positioning techniques.

Identify how to position the tube head.

Identify structures shown in an x-ray.

PATIENT PREPARATION

To prepare a patient for a dental X-ray procedure, employ the following techniques:

1. Only a Dental Officer is authorized to order and diagnostically interpret dental radiographs.
2. Ensure all infection control procedures are followed.
3. Position the patient. Positioning varies according to the type of radiograph needed and the film placement technique.
4. If the patient is a female, ask her if she is pregnant. If she is or the HM suspects that she might be, consult the dental officer.
5. Ask the patient to remove eyeglasses, complete dentures, removable partial dentures, earrings, or any other objects about the head and neck.
6. Drape the patient with a lead apron and thyroid collar.
7. Quickly examine the patient's mouth to determine its anatomy. Such things as a small mouth, an abnormally shallow vault, crooked teeth, and bony protrusions can affect the placement of the film packet. The patient's overall bone size and density will determine proper setting. For a patient with a normal bone size and density, use a kVp setting of 87; for a patient with a thick bone size and density, use a 90 kVp setting.
8. Position the patient's head securely against the headrest.

9. Place the film packet in the patient's mouth. Occasionally, patients may gag when the film is placed in their mouth. The gagging reflex may be caused by nervousness, remain calm and reassure the patient. The HM may recommend that patients breathe through their nose, since it is difficult to gag while doing so. Having patients rinse out their mouth with water may also help or have patients concentrate on something other than gagging. Whatever technique is used, the HM will have to be swift in placing the film and making the exposure because the chance of keeping the gag reflex from returning for an extended period is highly unlikely.

After the X-ray procedure is completed, return the lead apron and thyroid collar to the storage device to avoid damage.

EQUIPMENT PREPARATION

Periapical Examination

A periapical examination is conducted to obtain radiographs of the crowns, roots, and supporting structures of the teeth. Figure 17-24 shows a typical periapical radiograph.

![Figure 17-24.—Parlleling Technique](image)

There are two techniques available to take periapical radiographs: paralleling and bisecting-angle. Both techniques use the long axis of the tooth as a focal point. The paralleling technique is the preferred method. Film placement and techniques are discussed in the following sections.
When using the paralleling technique, center the X-ray film packet behind, and parallel with the long axis of the tooth being X-rayed. A tube head with a 16-inch X-ray source to cylinder end distance (long cone) should be used. The tube head must be positioned so that the central X-ray beam is projected perpendicular to the tooth and the film packet. To properly position the film and the tube head, use paralleling devices.

There are two different paralleling devices; one for radiographs of anterior teeth and one for radiographs of posterior teeth. Each paralleling device consists of a bite-block, indicator rod, and locator ring (Fig. 17-25). The bite-block has a slot and a film backing support to hold the X-ray film packet.

Assembling the Anterior Device

Figure 17-26 shows an assembled anterior paralleling device. Refer to this figure during the following explanation on assembling the paralleling device:

1. Grasp the periapical film packet between the thumb and first two fingers of the right hand. The printed surface of the packet should be facing the HM and the side with the raised dot should be in the film positioning slot of the paralleling device.
2. Hold the base of the anterior bite-block between the thumb and first two fingers of the left hand. Ensure that the plastic film support is pointed upward and the film positioning slot is away from the HM.
3. Holding the film packet in position, press it against the plastic support and slide the film down into the positioning slot. The printed side of the packet should be facing the plastic support, and the raised dot should be located toward the positioning slot.
4. The two prongs of the indicator rod are inserted into the openings in the bite-block. Slide the anterior locator ring onto the indicator rod. Look through the locator ring. If the bite-block and film are centered in the locator ring, the device is properly assembled and ready for positioning in the patient’s mouth.

Figure 17-25.—Bite Blocks, Locator Rings, and Indicator Arms

Figure 17-26.—Assembled Anterior Paralleling Device
Assembling the Posterior Device

Figure 17-27 shows a fully assembled posterior paralleling device. Refer to this figure during the following discussion.

1. Insert the film into the posterior bite-block as previously discussed.

![Figure 17-27.—Assembled Posterior Paralleling Device]

NOTE:
The posterior device shown in Figure 17-27 is used for film placement in the right maxillary and left mandibular quadrants.

The HM must reassemble the device, rotating the locator ring and the bite-block, before using it in the left maxillary or right mandibular quadrants.

Only the posterior device must be reassembled in this manner, the anterior device does not require reassembly.

2. Assemble the posterior paralleling device and place it in the patient's mouth. Be very careful not to injure the oral tissue. If the patient gags, use the remedies discussed earlier.

3. Guide the bite-block and the film packet into position, centering the packet behind the area being X-rayed. The film packet should be positioned far enough behind the tooth so it will be parallel to the long axis of the tooth.

4. After positioning the film packet, slide the locator ring down the indicator rod until the ring almost touches the surface of the patient's face. Then, position the tube head cylinder. The end of the cylinder should be parallel with the locator-ring, and its side should be parallel with the indicator rod.

5. Once these procedures have been accomplished, the film packet and the tube head are in proper alignment. The HM is now ready to expose the film.

Exposure Routine for Full Mouth Periapical Examination

The full mouth periapical examination consists of 14 periapical radiographs (7 maxillary and 7 mandibular).

The series includes the following films and sequence starting with the maxillary arch and proceeding to the mandibular arch:

- Incisor area
- Left Cuspid area
- Left Bicuspid area
- Left Molar area
- Right Cuspid area
- Right Bicuspid area
- Right Molar area

BISECTING-ANGLE TECHNIQUE

Use the bisecting-angle technique when paralleling devices are not available; when a patient finds it painful or impossible to close on the bite-block; or when an X-ray is needed when a rubber dam is in place. This technique incorporates the use of a tube head with an X-ray source to cylinder end distance of 8 inches (short cone). The bisecting-angle technique is not recommended for routine use.

Paralleling devices are not used with the bisecting-angle technique. The HM must pay special attention to positioning the patient, the film packet, and the tube head.
Positioning the Patient

For all maxillary periapical radiographs, position the patient's head as shown in Figure 17-28 from the ala (the outer portion of the nostril) of the nose to the tragus of the ear (a projection of the cartilage on the front center of the ear). This ala-tragus line should be parallel with the floor. The patient's head should also be positioned so that the midsagittal plane is perpendicular to the floor.

For mandibular periapical radiographs, lower the headrest so the patient's head is positioned as shown in Figure 17-29. The figure shows a line running from the corner of the patient's mouth to the tragus of the ear. This line should be parallel with the floor. The midsagittal plane is perpendicular to the floor.

Positioning the Film

After the patient is positioned, insert the film packet in the patient's mouth with a pair of hemostats or other holding device. Never slide the packet in; this might irritate the oral mucosa or cause the patient to gag. Gently direct the holding device to the desired position. In order to adapt the packet to the area being radiographed and to relieve patient discomfort, it may be necessary to shape the packet. Do this by gently flexing the corners of the packet and holding it over the end of a thumb. DO NOT CREASE THE PACKET. Center the packet behind the tooth to be radiographed. The printed side of the packet should face away from the tooth, with the printed dot toward the occlusal surface. The film is held as close to the tooth as possible. At this point, the long axis of the tooth and the plane of the film should be nearly parallel. In order to project the proper image of the tooth onto the film, the HM must visualize an imaginary line bisecting the long axis of the tooth and the plane of the dental film. The central ray is then directed perpendicular to the bisecting line. This will project the proper dimensions of the tooth onto the film without elongation or foreshortening. If the anterior curvature of the patient's arch is narrow, insert a cotton roll between the packet and the teeth. This prevents the film from bending excessively and producing a distorted image.
After the film packet is properly positioned, guide a free hand of the patient to the holding device. The patient holds the device with the hand from the opposite side of the arch being radiographed.

**WARNING:**
The assistant should never hold the film packet in position during an exposure.

Each time the HM takes radiographs, standard film positioning must be used. This ensures proper comparison of radiographs taken at different times.

**Positioning the Tube Head**

After the film is inserted in the patient's mouth, position the tube head so the end of the cylinder is near the area to be radiographed. Position the tube head for correct vertical and horizontal angulation using anatomical landmarks on the patient's face. Tell the patient to maintain the position of the placement of the dental film and not to move while the radiograph is exposed.

**VERTICAL ANGULATION.**—This is the up-and-down positioning of the tube head. A $0^\circ$ vertical angulation indicates that the tube head is positioned with the cylinder parallel with the floor (Fig. 17-30). Angling the tube head so the cylinder points upward from $0^\circ$ will give a minus (–) degree of vertical angulation. Angling the tube head so the cylinder points downward from $0^\circ$ will give a plus (+) degree of vertical angulation.

Different areas of the mouth require different degrees of vertical angulation. The correct vertical angulation can usually be obtained by using the angles shown on the chart in Figure 17-30. Notice the tube head is angled downward for maxillary radiographs, and usually angled upward for mandibular radiographs. The tube head may be horizontal ($0^\circ$) when X-raying mandibular molars.

<table>
<thead>
<tr>
<th>Maxillary</th>
<th>Mandibular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incisor</td>
<td>Incisor</td>
</tr>
<tr>
<td>$+40$ to $+45$</td>
<td>$-15$ to $-20$</td>
</tr>
<tr>
<td>Cuspid</td>
<td>Cuspid</td>
</tr>
<tr>
<td>$+45$ to $+50$</td>
<td>$-20$ to $-25$</td>
</tr>
<tr>
<td>Bicuspid</td>
<td>Bicuspid</td>
</tr>
<tr>
<td>$+30$ to $+35$</td>
<td>$-10$ to $-15$</td>
</tr>
<tr>
<td>Molar</td>
<td>Molar</td>
</tr>
<tr>
<td>$+20$ to $+25$</td>
<td>$-5$ to $0$</td>
</tr>
</tbody>
</table>

**Figure 17-30.—Average Vertical Angulation**

The wrong angulation results in a distorted radiograph. Too little vertical angulation elongates the radiographic image; too much vertical angulation foreshortens the image.

A standard vertical angulation cannot be used for all patients because of differences in their oral structures. A patient may have an unusually high maxillary vault or an unusually deep palatal vault. In either case, the HM would decrease the standard vertical angulation by about $5^\circ$. For a patient with an unusually shallow vault, the HM would increase the angulation by about $5^\circ$.

After determining the correct vertical angulation for the area to be radiographed, adjust the tube head using the angle dial on the tube head as a reference. When the tube head has been set for the proper vertical angulation, center the tube head cylinder on the area to be radiographed. The cylinder should almost touch the surface of the patient's skin. Position the tube head for correct horizontal angulation.
HORIZONTAL ANGULATION.—
This is the side-to-side positioning of the tube head. Position the tube head so the central X-ray beam is directed straight through the embrasures of the teeth being radiographed. If the horizontal angulation is faulty, the central ray will be directed at an angle to the embrasures. This will produce a faulty radiograph, with the images of the teeth overlapping one another. Figure 17-31 illustrates the correct and incorrect cylinder direction.

Figure 17-31.—Correct and Incorrect Direction for Horizontal Angulation

Guidelines for Taking Periapical Radiographs, Bisecting-Angle Technique

Take the same 14 radiographs using the same exposure sequence as that discussed for the paralleling technique. Complete the following steps:

1. Program the X-ray machine for mA and kVp settings. The exposure time varies. Refer to the film manufacturer's instructions for correct time/impulse settings. Remember to reduce the kVp by 5 when taking radiographs in edentulous (condition of being toothless to at least some degree) areas, and to 70 when taking radiographs on children. Position the patient as shown in Figure 17-28 for maxillary radiographs or Figure 17-29 for mandibular radiographs. Remember that the patient's midsagittal plane must be perpendicular to the floor.

2. Position the film packet in the patient's mouth. Have the patient hold the film packet in place with a pair of hemostats or other holding device.

3. Set the vertical angulation of the tube head according to the chart in Figure 17-30.

4. Center the tube head cylinder on the area to be radiographed. To simplify this process, the numbered anatomical landmarks are provided in Figure 17-32. Take radiographs of the area by centering the tube head cylinder on these landmarks:
   a. **Maxillary incisor area**: Landmark 1, the tip of the nose.
   b. **Maxillary cuspid area**: Landmark 2, beside the ala of the nose.
   c. **Maxillary bicuspid area**: Landmark 3, below the pupil of the eye.
   d. **Maxillary molar area**: Landmark 4, below the outer angle of the eye and below the zygomatic bone.
   e. **Mandibular incisor area**: Landmark 5, the tip of the chin.
   f. **Mandibular cuspid area**: Landmark 6, directly below landmark 2 1/4 inches above the lower border of the mandible.
   g. **Mandibular bicuspid area**: Landmark 7, directly below landmark 3 1/4 inches above the lower border of the mandible.
   h. **Mandibular molar area**: Landmark 8, directly below landmark 1/4 inches above the lower border of the mandible.

Figure 17-32.—Cylinder Positioning Landmarks for Periapical Radiographs
5. With the tube head cylinder centered on the horizontal landmark, ensure that the correct horizontal angulation has been obtained. The central X-ray beam should be projected straight through embrasures of the teeth to be examined.

6. Make the exposure.

7. Remove the film packet from the patient's mouth and place it in a clean paper cup. Place the disposable container in a lead container or behind a protective screen before making the next exposure.

INTERPROXIMAL (BITEWING) EXAMINATION

The interproximal examination reveals the presence of interproximal caries, certain pulp conditions, overhanging restorations, improperly fitting crowns, recurrent caries beneath restorations, and resorption of the alveolar bone. A typical interproximal radiograph (Fig. 17-33) records in a single exposure the coronal and cervical portions of both maxillary and mandibular teeth, along with the alveolar bone of the region.

Bitewing X-ray film packets are used for the interproximal examination. The bitewing film packet (Fig. 17-34) has a paper tab, or wing, that the patient bites on to hold the packet in place during the exposure (thus the name bitewing). Interproximal radiographs can be made using either the paralleling technique or the bisecting angle technique.

PARALLEL PLACEMENT TECHNIQUE

The following procedures describe this technique:

1. Program the X-ray machine for the discussed time, mA settings, and kVp settings.

2. Prepare the inter-proximal paralleling device (Fig. 17-35). Fold the bitewing tab against the film packet and insert the packet into the bite-block so that the printed side faces the backing support. Insert the end of the indicator rod into the holes in the bite-block. Slide the locator ring onto the indicator rod. Look through the locator ring to see if the bite-block is centered in the ring. If it is, the paralleling device is ready for positioning in the patient's mouth.
Position the paralleling device with film in the patient's mouth so the anterior edge of the film touches the distal surface of the mandibular cuspid (Fig. 17-36). Have the patient close gently but firmly on the bite-block to hold the film in position. Slide the locator ring down the indicator rod until the ring almost touches the surface of the patient's face. Align the tube head using the same technique as previously described for the paralleling device.

**Figure 17-35.—Inter-Proximal Paralleling Device**

3. Position the paralleling device with film in the patient’s mouth so the anterior edge of the film touches the distal surface of the mandibular cuspid (Fig. 17-36). Have the patient close gently but firmly on the bite-block to hold the film in position. Slide the locator ring down the indicator rod until the ring almost touches the surface of the patient's face. Align the tube head using the same technique as previously described for the paralleling device.

**Figure 17-36.—Positioning the Paralleling Device**

4. Make the exposure. After making the exposure, put the exposed film in a lead lined container or behind a protective screen. The HM is now ready to take the radiograph on the opposite side of the patient's mouth.

**Figure 17-37.—Patient Closing on Wing**

**BISECTING-ANGLE TECHNIQUE**

The following procedures describe this technique:

1. Program the X-ray machine for the discussed time, mA settings, and kVp settings.
2. Position the patient so that the ala-tragus line is parallel with the floor and the midsagittal plane is perpendicular to the floor.
3. Position the film packet in the patient's mouth. Hold the wing of the packet between the thumb and index finger. Place the lower edge of the packet between the tongue and the lingual surfaces of the mandibular teeth. Position the packet so that its anterior edge touches the distal surface of the mandibular cuspid. Rest the wing of the packet on the occlusal surfaces of the mandibular teeth. Instruct the patient to close slowly. As the patient's maxillary teeth contact the HM’s index finger, roll the finger out facially, permitting the patient's teeth to close on the wing (Fig. 17-37). The film packet is now positioned.

4. Set the vertical angulation of the tube head at +5° to +10°.
5. Center the tube head cylinder on the wing of the film packet. Be sure that the central X-ray beam passes through the embrasures as shown in Figure 17-38.

![Figure 17-38.—Centering the Tube Head Cylinder](image)

6. Make the exposure. After making the exposure, put the exposed film in a clean paper cup and place in a lead lined container or behind a protective screen. The HM is now ready to take the radiograph on the opposite side of the patient's mouth.

**OCCLUSAL EXAMINATION**

An occlusal examination is usually conducted when fractures of the jaw or gross pathological conditions are suspected. A typical occlusal radiograph (Fig. 17-39) shows a large area of the maxillary or mandibular arch. The occlusal film packet is shaped much like the periapical packet, only larger. Unlike the periapical and bitewing packets, the occlusal packet contains two X-ray films. This allows different developing times to be used for these films. The finished radiographs can then be compared for diagnostic purposes. Occlusal radiographs are exposed using the bisected angle technique.

![Figure 17-39.—Typical Occlusal Radiographs](image)

**MAXILLARY OCCLUSAL RADIOGRAPHS**

Maxillary occlusal radiographs are taken using the following procedures:

1. Set the X-ray machine at 10 mA, 90 kVp, and 60 impulses (1 second).
   a. Reduce the kilovoltage 5 kVp if the arch is edentulous.
   b. Use 70 kVp if the patient is a child.
2. Position the patient so that the ala-tragus line is parallel with the floor and the mid-sagittal plane is perpendicular to the floor.
3. Place the film in the patient's mouth. Occlusal films are normally very comfortable.
   a. Have the patient relax the muscles of the mouth and cheek as much as possible.
   b. The pebbled surface of the packet should be toward the occlusal surfaces of the maxillary teeth, and the narrow side of the packet toward the patient’s cheeks.
   c. To place the packet, retract one corner of the patient’s mouth until the packet can be inserted.
   d. Position the packet far enough in the mouth so that it covers all the teeth.
e. Special care must be taken to avoid gagging the patient. Have the patient close gently but firmly on the packet to hold it in place.

4. Position the tube head.

5. For maxillary anterior occlusal radiographs, set the vertical angulation of the tube head at +65°. Center the tube head cylinder on the bridge of the patient's nose so that the central X-ray beam will be projected as shown in Figure 17-40.

![Figure 17-40.—Projection of Central Ray (CR) for Maxillary Anterior Occlusal Radiographs](image)

6. For maxillary posterior occlusal radiographs, set the vertical angulation of the tube head at +75°. Center the tube head at the top of the patient's nose so that the central X-ray beam will be projected as shown in Figure 17-40.

7. Place the film packet in the patient's mouth with the pebbled surface toward the occlusal surfaces of the mandibular teeth, and the short sides of the packet is toward the patient's cheeks. Have the patient close gently on the packet to hold it in place.

8. Take the exposure.

9. **MANDIBULAR OCCLUSAL RADIOGRAPHS**

Mandibular occlusal radiographs are taken using the following procedures:

1. Program the X-ray machine for 10 mA, 90 kVp, and 60 impulses (1 second). (Reduce the kVp setting for edentulous patients and children as discussed earlier.)

2. Position the patient.

   a. For mandibular anterior occlusal radiographs, position the patient so the ala-tragus line is at a 45° angle with the floor, and the midsagittal plane is perpendicular to the floor (Fig. 17-41).

![Figure 17-41.—Projection of central ray (CR) for Mandibular anterior radiograph](image)

   b. For mandibular posterior occlusal radiographs, position the patient so that the ala-tragus line and mid-sagittal plane are perpendicular to the floor.

3. Place the film packet in the patient's mouth with the pebbled surface toward the occlusal surfaces of the mandibular teeth, and the short sides of the packet is toward the patient's cheeks. Have the patient close gently on the packet to hold it in place.
4. Position the tube head.
   a. For mandibular anterior occlusal radiographs, set the vertical angulation of the tube head at -10°. Center the tube head cylinder on the tip of the patient’s chin so that the central X-ray beam will be projected as shown in Figure 17-42.

![Figure 17-42.—Projection of Central Ray (CR) for Mandibular Anterior Radiograph](image)

b. For mandibular posterior occlusal radiographs, set the vertical angulation of the tube head at 0°. Center the tube head cylinder beneath the patient's chin so that the central X-ray beam will be projected as shown in Figure 17-43.

![Figure 17-43.—Projection of central ray (CR) for mandibular-Posterior occlusal radiographs](image)

5. Make the exposure.

FILM PROCESSING

LEARNING OBJECTIVES:

- Identify film processing methods.
- Identify start-up and securing procedures for x-ray processors.
- Identify aspects of good and bad quality x-rays.

FUNDAMENTALS

After the film has been exposed by X-ray, it is processed to produce the finished radiograph. The film can be processed manually, or the HM can use an automatic film processor. The process requires conversion of the latent (invisible) image to the manifest (visible) image through chemical or digital conversion. The x-ray technologist is key to film processing; always ensuring quality control measures are met to ensure proper processing.

When the dental X-ray films are processed, the resulting radiographs provide the Medical or Dental Officer with a valuable diagnostic aid. Radiographs can be used to aid in identification in the case of a death.

DIGITAL IMAGING

Digital imaging is the fastest advancing technology in healthcare imaging. The advancements have led to an increased capability at a lower cost for healthcare image processing and storage. The digital imaging process may appear in two different capabilities: Computed Radiography (CR) or Direct Digital Radiography (DR). CR is a cassette based system that utilizes digital film screen technology. CR film screens are located in a conventional cassette similar to wet processing cassettes. The film screen is exposed and then placed into a separate plate reader for digital conversion. The image is displayed on a computer screen and stored on a secure server for future retrieval.

In DR, the imaging plate is fixed to the x-ray table. DR has digital image receptors that
interrupt the x-ray exposure based on the amount of x-radiation reaching the cassette. The image is then displayed on a computer screen. The stored information is placed on a secure server for future retrieval. In Radiology departments the HM may see either CR or DR. CR is the most economical based on current technologies.

Dental digital radiography uses an electronic sensor and computerized imaging system that produces x-ray images almost instantly on a computer monitor. In dental radiography, a sensor, or small detector, is placed inside the mouth of the patient to capture the radiographic image. The sensor is used instead of the intraoral dental film. As in conventional radiography, the x-ray beam from the tube head is aimed to strike the sensor. An electronic charge is produced on the surface of the sensor; the electronic signal is digitized, or converted into “digital” form. The digital sensor in turn transmits the information to a computer.

Digital radiography systems are not limited to intraoral images; panoramic and cephalometric images may also be obtained.

WET PROCESSING

Automatic film processors are the most commonly utilized systems. Manual processing can be used for a backup method for the automatic film processor. If the command has manual processing capabilities, refer to the manufacturer's operating instructions. There are five basic steps involved in processing X-ray film: developing, rinsing, fixing, washing, and drying.

DARKROOM PROCEDURES

The darkroom has two sources of illumination: white light and safelight. A white light is a standard ceiling light. It provides regular illumination for mixing solutions and cleaning the darkroom. An unwrapped, unprocessed X-ray film package must never be exposed to white light. Exposed film is useless.

A safelight, which contains a 15 watt bulb with a special filter (usually red) is the only safe source of illumination in the darkroom when processing X-ray film. The safelight must be located no less than 4 feet from the work surface so that the HM can open film cassette and process film. Limit the length of exposure of undeveloped imaging film to the safelight for no more than 2 minutes. Films not stored in protective coverings exceeding this time might get a fogged image (discussed under faulty radiographs).

Occasionally, film is exposed (ruined) because of light leakage. White light may leak through the filter on the safelight or it may leak into the darkroom from an outside source. A simple test will enable the HM to detect leakage. To check for possible light leakage from an outside source, perform the test with all lights off, including the safelight.

1. Obtain a piece of unexposed X-ray film.
2. Lay the film on the workbench, and place a penny over it for a period of 5 minutes.
3. Process the film.
4. The processed film should show no image. If the outline of the penny can be seen, there is light leakage and the HM should inform the supervisor.

The HM should perform this test at every location in the darkroom where unwrapped film is being processed.

AUTOMATIC PROCESSING

Automatic processing is the most commonly used method of processing medical and dental radiographs in the Navy. The automatic film processor mechanically transports exposed X-ray film through the developing, fixing, washing, and drying cycles. Automatic processing is quicker than manual processing, and it produces finished radiographs of uniform quality. A variety of automatic film processors are in use in the Navy and they can be generally classified as small or large. Refer to the command SOP or manufacturer’s guide for processing instructions.

PROCEDURES FOR PROCESSING FILM
If processing a large quantity of X-ray films, the HM must avoid any mix-up. To do this, after inserting one patient’s X-ray films, wait 15 seconds before inserting the next patient’s films. After inserting the X-ray films of each patient, set the X-ray mount, envelope, and identification label aside; make sure to keep them in the order in which they were processed. This will help the HM match the processed radiographs to the patient’s unit, envelope, or identification label when the film exits the processor.

For medical films, the identification flasher machine will be utilized to stamp the films with the patient’s information prior to the film being processed. This machine can be located either inside or outside of the darkroom.

Securing the Processor

The processor should be secured at the end of the day. The securing procedures are as follows:

1. Depress the on/off switch to the off position.
2. Turn the water supply valve to the off position. (Some models will be stand alone, and will not require this step.)
3. Unplug the power supply cable.
4. Wipe the cover and housing of the processor with a damp sponge or cloth.
5. Open the lid to allow ventilation

Chemistry Change

Change the developer and fixer at a minimum of once every 3 to 4 weeks. If a large quantity of X-rays has been processed, change the developer sooner. Replenish the solutions following the manufacturer’s instructions.

Because of the alkaline and acid nature of the developer and fixer solutions, minor chemical irritation or burns can occur when they come in contact with the skin, the eyes, and the mouth. Use caution when stirring or mixing solutions. Always wear rubber gloves and protective eye wear or a protective face shield and an apron when working around these solutions. If the solutions come in contact with the skin, flush the area with large amounts of water. If the solutions accidentally splash into the eyes or mouth, flush with large amounts of water and immediately seek medical attention. Fixer solution can stain and discolor clothing.

Maintenance Schedule

The HM is responsible only for user maintenance of the processor; equipment repairs are the responsibility of the Dental equipment repair technician.

Monthly maintenance consists of cleaning the roller transports and solution tanks. Weekly maintenance consists of soaking the transport rollers, solution agitators, and other removable internal parts for 5 to 10 minutes with a processor cleaner.

NOTE: Any time the processor cover is lifted and maintenance is being performed, the HM must wear a safety face shield, apron, and protective gloves.

Faulty Radiographs

Faulty radiographs are caused by the incorrect positioning of the film packet or the tube head; incorrect kVp, mA and time setting; or by incorrect processing procedures. One common cause of faulty radiographs due to tube head and film misalignment have already been discussed (e.g., incorrect horizontal angles produce superimposed radiographic images, and incorrect vertical angles produce images that may be foreshortened or elongated).

The following are additional causes of faulty radiographs:

1. Incorrect tube-to-film distance.
2. Incorrect filtration.
3. Incorrect film speed.
4. Incorrect developer strength.
5. Incorrect fixer strength.
6. Incorrect temperature or humidity.
7. Improper drying or storing of films.
8. Improper processing chemicals.
9. Improper processing equipment.
10. Improper film development conditions.

Safety Precautions

The solutions used for automatic processing are not the same as those used for manual processing.
• **No image** (Fig. 17-44): The film was immersed in the fixer before the developer. If the film is completely clear, it was never exposed.

• **Very light image** (Fig. 17-45): The file was underexposed (kilo-voltage too low); the developer was weak; or the film was not left in the developer long enough.

• **Very dark image** (Fig. 17-46): The film was over-exposed (kilo-voltage too high); the developer was too warm; or the film was left in the developer too long.

• **Partial image** (Fig. 17-47): The film was not completely immersed in the developer; the film came into contact with other film or the side of the tank while in the developer; or the film or tube head was incorrectly positioned (cone cutting).

Figure 17-44.—No Image

*Photograph provided by the Dental Readiness Department of National Naval Medical Center, Bethesda, MD.*

Figure 17-45.—Very Light Image

Figure 17-46.—Very Dark Image

*Photograph provided by the Dental Readiness Department of National Naval Medical Center, Bethesda, MD.*

Figure 17-47.—Partial Image

*Photograph provided by the Dental Readiness Department of National Naval Medical Center, Bethesda, MD.*
- **Blurred image** (Fig. 17-48): The patient or tube head moved during the exposure

![Figure 17-48.—Blurred Image](image)

*Photograph provided by the Dental Readiness Department of National Naval Medical Center, Bethesda, MD.*

- **Fogged film** The film was outdated or contaminated; the film was overexposed by being held too close to the safelight; the film was exposed to stray radiation, excessive heat, chemical fumes, or light leaks in the darkroom; the developer was improperly mixed, contaminated, or too hot

- **Streaked or stained film**: The film was insufficiently washed or fixed; the processing solutions were dirty; or the film hanger was dirty

- **Reticulation**: There was a too rapid change in temperature during processing (e.g., the film was taken from a warm developer to a cold rinse)

- **Crescent-shaped lines** (Fig. 17-49): The film packet was creased or bent

![Figure 17-49.—Crescent-Shaped Lines](image)

- **Herringbone image** (Fig. 17-50): The wrong side of the film, packet was facing the source of the X-ray beam during exposure causing the embossing pattern from the lead backing to appear on the film

![Figure 17-50.—Herringbone Image](image)

- **Black areas**: The film was pulled too rapidly from its black paper wrapping, causing a discharge of static electricity

- **White spots**: The developer failed to work on these areas because of dirt or air bubbles

- **Foreign object image** (Fig. 17-51): Dentures or other objects were in the patient’s mouth during the exposure

![Figure 17-51.—Foreign Object Image](image)

*Photograph provided by the Dental Readiness Department of National Naval Medical Center, Bethesda, MD.*
MOUNTING DENTAL RADIOGRAPHS

After processing the dental X-ray film, the HM will mount the finished radiographs in cardboard or plastic holders. Mounting makes the radiographs easy to view, keep them in a chronological order, and protect them from damage.

Mounted radiographs may be viewed from either the front or back of the mount. If viewed from the front, the teeth appear on the film as if the HM was looking directly into the patient's mouth. If viewed from the back, the teeth appear on the film as if the HM was sitting on the patient's tongue looking out. Always mount X-rays in anatomical order. After the HM mounts the radiographs, file the mount in the patient's Dental Record. The Dental Officer may want to retain the radiographs for diagnostic purposes (e.g., endodontic). These are normally placed in a drug envelope, labeled and dated, and placed in the dental record.

Medical x-rays are not mounted. They are placed in folders. If there are multiple types of medical x-rays (diagnostic, Ultrasound, Cat Scan, etc., the x-rays are placed in sub-folders to keep them separated and easier to locate.

Interproximal (Bite-Wing) Mounting

Figure 17-52 shows a serial mount for interproximal (bite-wing) radiographs. The mount contains slots for mounting five pairs of interpromixal radiographs for a patient taken at different times/dates and mounted in chronological order. Serial mounting enables the Dental Officer to compare radiographs taken at different intervals to detect changes in the patient's oral structures.

The front of the mount contains spaces for the patient's name and social security number, mount number, and the date of each exposure. Fill in this information whenever a new mount is started. After completing the necessary information on the front side, turn the mount over and lay it face down on a table top.

Full Mouth Periapical Mounting

Figure 17-53 shows a full mouth periapical film mount. The mount contains 14 slots for periapical radiographs and 2 slots for interproximal (bite-wing) radiographs.

Photograph provided by HM2 Pablo A. Mercado of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD.
When mounting full mouth periapical radiographs, there will be multiple radiographs; take care to sort and mount them correctly. To do this, the HM must be able to recognize certain maxillary and mandibular anatomical landmarks.

ANATOMICAL LANDMARKS

During the following discussion, locate each anatomical landmark on Figure 17-54. The landmarks are indicated by arrows.

Maxillary Incisor Area

Radiographs of this area usually show a large white region caused by the bone of the nasal septum (Fig. 17-54).

Mandibular Incisor Area

Mandibular incisors are smaller than maxillary incisors. The mandibular incisor area has a network of tiny white lines around and below the roots (Fig. 17-54).

Maxillary Cuspid and Bicuspid Areas

Radiographs of these areas usually show a distinct wavy white line above or near the apices of the teeth (Fig. 17-54). The wavy white line identifies the floor of the maxillary sinus. This white line is not found in radiographs of the mandibular arch.

Mandibular Cuspid and Bicuspid Areas

Radiographs of these areas show a fine network of tiny white lines around and below the roots and a dark area in the cuspid area representing the mental foramen which is one of two holes ("foramina") located on the anterior surface of the mandible (Fig. 17-54).

Maxillary Molar Area

Radiographs of these areas show the maxillary arch and the roots of the maxillary molars curving slightly toward the rear of the mouth (Fig. 17-54). Maxillary molars have three roots; they tend to be indistinct on radiographs. In addition, the radiographs will usually show a distinct wavy white line above or near the apexes of the teeth.

Mandibular Molar Area

Mandibular molars show two roots that are distinct on radiographs. The mandibular nerve canal frequently shows as a dark, narrow band running horizontally under the apexes of the mandibular molars. The mandibular arch and the roots of the molars curve slightly toward the rear of the mouth. An impacted third molar will often be present on radiographs of the mandibular molar areas (Fig. 17-54).
Figure 17-54.—Maxillary and Mandibular Radiographic Landmarks

A. INCISOR AREA

B. CUSPID AREA

C. MOLAR AREA

D. INCISOR AREA

E. BICUSPID AREA

F. MOLAR AREA
MOUNTING PROCEDURES

Place all the radiographs in the full mouth periapical series on a dry, flat working surface with the dimple side up. On the front of the film mount, enter the patient’s name, social security number, rank/rate, the date, and the name of the dental treatment facility. Place the mount face down on the working surface. The two small arrows on the back of the mount should point toward the HM. Follow these steps to mount the radiographs:

1. Check each radiograph and make sure each surface with the raised dimple faces the HM.

2. Mount interproximal radiographs. If interproximal (bite-wing) radiographs are included in the full mouth series, insert them in the slots provided.

3. Divide the radiographs into maxillary and mandibular groups. Using the film viewer, locate the anatomical landmarks discussed earlier. The maxillary radiographs are inserted in the 7 slots across the top of the film mount and the mandibular radiographs in the 7 slots across the bottom.

4. Insert the maxillary radiographs. Identify the radiograph of the central incisor area. Keeping the side with the raised dimple facing toward the HM, rotate the radiograph until the incisal edges of the teeth point down. With the back of the mount toward the HM, slide the radiograph into the incisor slot. When the radiograph is properly mounted, the side with the raised dimple will face the HM, and the incisal edges pointing down toward the center of the mount.

5. Work outward from the central incisor slot, inserting the rest of the maxillary radiographs in the following order: cusp area, bicusp area, and molar areas.

6. Insert the mandibular radiographs. Start with the radiographs of the central incisor areas and work outward. The raised dots will be toward the HM and the incisal/occlusal surfaces of the teeth should be pointing upward toward the center of the mount.

7. After inserting all of the radiographs, hold the mounted radiographs up to the viewer. Double check to see that each radiograph is mounted correctly.

PANORAMIC RADIOGRAPHS

The panoramic X-ray machine is used to produce an extraoral radiograph that shows both dental arches and the temporomandibular joints (Fig. 17-55). The radiograph is made by rotating the tube head and film around the patient while the patient remains stationary. Because of the different manufacturers and models of panoramic X-ray machines used in the Navy, this operation and maintenance will vary. Always refer to manufacturer's instruction manual prior to use.
Operational Check

The operational check for the panoramic X-ray machine is accomplished without a patient. To perform the operational readiness check, perform the following procedures:

1. Turn on the pilot switch; the pilot light will illuminate.

2. Set the kVp selector switch to the desired voltage. Adjust the kVp meter as a reference for the desired kVp setting.

3. Select the mA settings, to be used. Adjust them according to the manufacturer’s instructions. When the mA and kVp settings that give the best results are determined, enter them on a technique values chart. Remember each manufacturer’s film is different, follow the recommendations.

WARNING:
When performing the operational check, keep the collimator (x-ray tube) covered with the lead cap.
Preparing the Film

When the X-ray machine is operational, prepare the panoramic film. Load the film into a cassette drum, and then mount it in the cassette drum assembly on the X-ray machine. To load and mount the cassette drum, follow the manufacturer's instructions.

Labeling the Cassette

The cassette is labeled for the purposes of orientation and patient identification.

There are two ways to label the cassette for patient identification. The HM can use a self-adhesive label or an X-ray film identification printer. Follow the manufacturer's instructions when using the printer. The patient information includes: the patient's name (last name, first name, and middle initial), family member prefix code, social security number, and the date of the exposure.

Requirements for a Good Panoramic Result

Follow the manufacturer's operating instructions for complete operation of the panoramic X-ray machine before attempting to use it. The following is a list of important procedures that must be followed to ensure a good quality X-ray is produced.

- Make sure patient's back and cervical spine are as straight as possible
- Check that the patient's mid-sagittal plane is centered within the unit
- Ensure the patient's Frankfurt plane (anatomical position of the human skull) is horizontal
- Ensure the anterior maxillary and mandibular teeth are located on the indents of the bite-block. If the patient's bite is abnormal, adjust mandible forward or backward to compensate
- Observe patient to ensure there is no movement during the radiographic procedure

Operating the Panoramic X-Ray Machine

With the machine operational and the film cassette drum in the cassette drum assembly, the HM is now ready to take the radiograph on the patient. Follow the manufacturer's instructions for patient positioning and operation. When the patient is being positioned, explain the exposure procedures. Make the exposure and process the film. The HM should wait 5 minutes between exposures to prevent overheating of the X-ray head.

Panoramic X-Ray Machine Maintenance

The panoramic X-ray machine requires very little user maintenance. Wipe the metal and painted parts with a soft, dry cloth daily. Report malfunctions to the supervisor. All repairs are the responsibility of the biomedical repair technician.

SUMMARY

This chapter outlined the details of radiation safety & protection applying to radiation workers, patients, and the population; patient positioning techniques; film processing techniques; and examples of finished radiographs. Ensuring that all of these details are followed will provide quality x-ray images for proper diagnosis in a setting that is destined to provide radiation exposure that follows the principles of ALARA (As Low As Reasonably Achievable). The imaging department is an integral part of the Healthcare Team that provides healthcare providers with the tools needed to combat medical and dental disease processes in any setting worldwide.
CHAPTER 18

PHARMACY

INTRODUCTION

As the Hospital Corpsman (HM) advances in rate, there will be increased involvement in the administration of medicines. Although medications and their dosages are prescribed by Medical Officers (MO) and other authorized prescribers, the HM is involved in the administration. It is necessary for the HM to learn medication sources, composition, methods of preparation and administration, and physiologic and toxicologic action. This chapter covers pharmacology, toxicology, medication calculations, pharmaceutical preparations, and prescriptions.

PHARMACOLOGY

LEARNING OBJECTIVE:

Identify the sub-sciences of pharmacology, medication standards, medication administration methods, and factors that affect dosage.

Pharmacology is the science dealing with the origin, nature, chemistry, effects, and uses of medications. The sub-sciences of pharmacology and their specific areas of concentration are:

- **Pharmacognosy** is the branch of pharmacology dealing with biological, biochemical, and economic features of natural medications and their constituents
- **Pharmacy** is the branch of pharmacology dealing with the preparation, dispensing, and proper use of medications
- **Posology** is the study of the dosages of medicines and medications
- **Pharmacodynamics** is the study of the action or effects of medications on living organisms
- **Pharmacotherapeutics** is the study of the uses of medications in the treatment of disease
- **Toxicology** is the study of poisons, their actions, their detection, and the treatment of the conditions produced by them
- **Therapeutics** is the science of treating disease by any method that will relieve pain, treat or cure diseases and infections, or prolong life
  - Therapeutics does not deal solely with giving or taking medicine
  - This field also includes many other methods, such as radiological treatment, diathermy, and hydrotherapy

MEDICATION STANDARDS

Texts dealing with pharmaceutical preparations include the United States Pharmacopeia and National Formulary (USP–NF), which sets standards for the quality, purity, strength, and consistency and provides standards for medications of therapeutic usefulness and pharmaceutical necessity. Inclusion of medications into this reference is based on therapeutic effectiveness and popularity. The USP–NF provides tests for medication identity, quality, strength, and purity. The U.S. Federal Food, Medication, and Cosmetics Act designates the USP–NF as the official reference for medications marketed in the United States. Drug Facts and Comparisons is a comprehensive medication information reference that is organized by therapeutic medication class. A comprehensive description of each pharmaceutical preparation (including indications, administration and dosage, actions, contraindications, warnings and precautions, medication interactions, adverse reactions, and dosage forms available, and the generic and trade medication names) is provided.

18-1
This publication is used as a reference for in-depth information on pharmaceutical products by healthcare providers and pharmacy personnel.

*Drug Information Handbook* is an easy to use reference for clinicians and healthcare providers seeking quick and concise medication information. The information in this is similar to that which is contained in the *Drug Facts and Comparisons*.

*Remington: The Science and Practice of Pharmacy* is the most widely used text/reference in American pharmacies. It contains all areas relevant to the art/science of pharmacy. It is a textbook of pharmacology, toxicology, and therapeutics. This work is known as the "blue bible" of pharmacology.

**MEDICATION ADMINISTRATION**

The quantity and frequency of a medication's administration to a patient depend on several factors, as does the method of that medication's administration. This section covers some factors affecting dosage calculations and methods of administration.

**Dosage**

The amount of medication to be administered is referred to as the dose. The study of dosage and the criteria that influence it is called posology. The doses given in the *United States Pharmacopeia and National Formulary (USP-NF)* are average therapeutic doses and are known as "usual adult doses." The following terms are used in connection with doses.

**DOSAGE RANGE.**—It is a term applying to the range between the minimum and maximum amounts of a given medication required to produce the desired effect. Many medications (such as penicillin) require large initial doses that are later reduced to smaller amounts.

Closely associated with "dosage range" are the terms **minimum dose** (the least amount of medication required to produce a therapeutic effect), **maximum dose** (the largest amount of medication that can be given without reaching the toxic effect), and **toxic dose** (the least amount of medication that will produce symptoms of poisoning).

**THERAPEUTIC DOSE.**—is referred to as the normal adult dose, the usual dose, or average dose. It is the amount needed to produce the desired therapeutic effect. This therapeutic dose is calculated on an average adult male of 24 years who weighs approximately 150 pounds.

**MINIMUM LETHAL DOSE.**—is the least amount of medication that can produce death.

**FACTORS AFFECTING DOSAGE.**—The two primary factors that determine or influence the dosage of a medication are the age and weight of the patient.

**Age**—Age is the most common factor that influences the amount of medication to be given. An infant requires a lower dose than an adult. Elderly patients may require a higher or lower dose than the average dose, depending upon the action of the medication and the condition of the patient.

A rule governing calculation of pediatric (child's) doses, **Young's Rule**, is expressed as:

\[
\text{Age in years} \left(\frac{\text{Age in years}}{\text{Age in years} + 12}\right) \times \text{adult dose} = \text{child's dose}
\]

The age in years of the child is the numerator, and the age plus 12 is the denominator. This fraction is then multiplied by the normal adult dose.

**Example:** The adult dose of aspirin is 650 mg. What is the dose for a 3-year-old child?

\[
\frac{3}{3 + 12} \times 650 \text{ mg} = 260 \text{ mg}
\]
Weight—In the calculation of dosages, weight has a more direct bearing on the dose than any other factor. This is especially true in the calculation of pediatric doses. The doses of the majority of medications based on body weight are conveniently expressed in terms of mg/kg, since the doses of most medications are administered in milligram amounts. However, this is not always the case. Depending on the medication, dosage form or other factors, the dose of some medications may be expressed in different units of measure.

A useful equation for the calculation of doses based on body weight is:

Patient’s dose (mg) = Patient’s weight (kg) × Medication dose (mg) / 1 (kg)

If different units are given, other units may be substituted in the equation as long as the terms used are consistent.

Example: The dose of medication “A” is 22 mg/kg. How many milligrams of medication “A” are needed for a patient weighing 17 kg?

\[ x \text{ (mg)} = 17 \text{ kg} \times 22 \text{ mg} \]
\[ x \text{ (mg)} = 17 \times 22 \]
\[ x = 374 \text{ mg} \]

Another rule governing calculation of pediatric doses based on weight is Clark’s Rule, expressed as:

\[ \text{Weight in pounds} \quad x \quad \text{adult dose} = \text{child's dose} \]
\[ 150 \]

The child's weight in pounds is the numerator, and the average adult weight (150 pounds) is the denominator. This fraction is multiplied by the adult dose.

Example: The adult dose of aspirin is 650 mg. What is the dose for a child weighing 60 pounds?

\[ \frac{60}{150} \times 650 \text{ mg} = 260 \text{ mg} \]

NOTE: Young’s and Clark’s rule are not generally used because the majority of medications are now dosed based according to weight, providing a more patient specific dose.

Other Factors that Influence Dosage

- **Sex**: Females usually require smaller doses than males
- **Race**: Black individuals usually require larger doses, and Asians require smaller doses than Caucasians
- **Occupation**: Persons working in strenuous jobs may require larger doses than those who sit at a desk all day
- **Habitual use**: Some patients must take medications continuously, causing their bodies to build up tolerance to the medication. This tolerance may require larger doses than their initial doses to obtain the same therapeutic effect
- **Time of administration**: Therapeutic effect may be altered depending upon time of administration (e.g., before or after meals)
- **Frequency of administration**: Medications given frequently may need a smaller dose than if administered at longer intervals
- **Mode of administration**: Injections may require smaller doses than oral medications
Methods of Administering Medications

Medications may be introduced into the body in several ways, each method serving a specific purpose. The most common routes of administration are oral (enteral) and injection (parenteral).

**ORAL** is the most common method of administering medications. Among the advantages of administering medication orally (as opposed to other methods) are:

- Oral medications are convenient
- Oral medications are generally cheaper
- Oral medications do not have to be pure or sterile
- A wide variety of oral dosage forms are available

Oral medication administration may have disadvantages for the following reasons:

- Some patients may have difficulty swallowing tablets or capsules
- Oral medications are often absorbed too slowly
- Oral medications may be partially or completely destroyed by the digestive system

Other methods of administration closely associated with oral administration are **sublingual** and **buccal**.

Sublingual medications are administered by placing the medication under the tongue. The medication is then rapidly absorbed directly into the blood stream. An example of a sublingual medication is nitroglycerin sublingual tablets (for relief of angina pectoris).

Buccal medications are administered by placing the medication between the cheek and gum. Buccal medications, like sublingual medications, are quickly absorbed directly into the blood stream. An example of a medication that may be given buccally is the anesthetic benzocaine.

**PARENTERAL** medications are introduced by injection. All medications used by this route must be pure, sterile, pyrogen-free (pyrogens are products of the growth of microorganisms), and in a liquid state.

**EXAMINATIONS OF PARENTERAL SOLUTIONS.**— Parenteral solutions are examined at least three times at the activity at which they are ultimately used:

- Upon receiving the solution
- Periodically while in storage
- Immediately preceding use

Parenteral solutions, unless the label states otherwise, must be free of turbidity or undissolved material. All solutions should be inverted and gently swirled to bring any sediment or particulate matter into view. A well-illuminated black or white background will facilitate this examination.

Parenteral solutions may be unfit for use for the following reasons:

- Deterioration from prolonged storage
- Accidental contamination occurring upon original packaging
- Defects that may develop in containers or seals

There is no set rule that can be applicable in regards to any of these factors. To ensure suitability for use, a regimented program of inspection is necessary.
Methods of Parenteral Administration

Subcutaneous is the medication injected just below the skin's cutaneous layers. Example: Insulin.

Intradermal is the medication injected within the dermis layer of the skin. Example: Purified Protein Derivative (PPD).

Intramuscular is the medication injected into the muscle. Example: Procaine Penicillin G.

Intravenous is the medication introduced directly into the vein. Example: Intravenous fluids.

Intravenous (I.V.) administration has certain advantages over other routes:

- I.V. administration provides the most rapid onset of action
- Medication is administered directly into the bloodstream
- Patients may not be able to take oral medications
- Some medications are not suitable for oral administration

Some dangers and disadvantages associated with intravenous administration:

- Effects of an error in dose are magnified when medications are administered by I.V. Once administered, it is difficult to stop the medication from producing all of its effects, including adverse effects
- Risk of infection is always present when the skin is punctured
- Pain, real or psychological may accompany an injection
- Medication injected intravenously must be sterile. This demands special medication dosage forms and supplies; as well as the skills to prepare and administer them

Intrathecal or Intraspinal is the medication introduced into the subarachnoid space of the spinal column. Example: Procaine hydrochloride.

INHALATION is a means of introducing medications through the respiratory system in the form of a gas, vapor, or powder. Inhalation is divided into three major types: vaporization, gas inhalation, and nebulization.

- Vaporization - the process by which a medication is changed from a liquid or solid to a gas or vapor by the use of heat (such as in steam inhalation)
- Gas Inhalation - almost entirely restricted to anesthesia
- Nebulization - the process by which a medication is converted into a fine spray by the use of compressed gas

TOPICAL are applied to a surface area of the body. Topically applied medications serve two purposes:

- Local effect: intended to relieve itching, burning, or other skin conditions without being absorbed into the bloodstream.
- Systemic effect: absorbed through the skin into the bloodstream.

Examples of topical preparations are ointments, creams, lotions, and shampoos.

RECTAL.—administered rectally by inserting them into the rectum. The rectal method is preferred to the oral route when there is danger of vomiting or when the patient is unconscious, uncooperative, or mentally incapable. Examples of rectal preparations are suppositories and enemas.

VAGINAL.—inserted into the vagina to produce a local effect. Examples of vaginal preparations are suppositories, creams, and douches.
"RIGHTS" OF MEDICATION ADMINISTRATION

To prevent medication errors, there are six important steps to follow when administering medication to a patient. Many medication errors can be linked to an inconsistency in adhering to the six “right” steps of medication administration.

Right Patient

Make sure the patient is identified. This is more than asking for the patient’s name. Sometimes the patient is confused, their level of consciousness may be altered due to medication or a procedure, or they may be unable to communicate. The HM should use two forms of patient identification. Check the patient's arm band and verify it with the Medication Administration Record (MAR).

Right Medication

A medication order is required for every medication to be administered to a patient. Compare the order with the MAR when the order was initially ordered. After determining the information on the MAR is accurate, use the MAR to prepare the medications. When preparing medications from bottles or container, compare the label with the MAR three times: (1) before removing from the shelf or drawer, (2) as the amount of medication ordered is removed from the container, and (3) before returning the container to storage. If it is listed as a generic equivalent and the HM is unsure if it is the same as what is ordered on the MAR, they must consult a medication book or other reference to confirm that the medication to be given is the same as the one ordered. Certain medications are frequently confused with another with a similar name or appearance.

Right Dose

With the use of generic drugs increasing in hospitals, the HM may be confronted with the need to give more than one of a specific tablet or capsule, or to measure a liquid into a syringe or dose cup.

The HM must double-check measurements and make sure of the correct number of pills or capsules before taking the medication to the patient. Tablets may need to be split. If using the automated system, there should be a warning of the dosage difference. The HM must not exclusively rely on that for accuracy. Check the packaging against the MAR.

Right Route

If the medication is ordered PO, make sure it is given it PO. Don't give an injection as an IV infusion. If it's ordered deep IM, make sure the right length and correctly gauged needle is used for accurate administration. Do not leave the medication on the bedside table; watch the patient to make sure the medication is taken correctly. Patients have been known to ingest suppositories or make other mistakes while confused or under the influence of pain medications.

Right Time

Medication doses can be spaced at specific intervals. Levels may need to be maintained in the bloodstream, certain meds may need to be given an hour or more apart from other medications, or they may need to be taken in specific relation to meals. Absorption and efficacy may be affected if medications are incorrectly administered, **If in question, review the MAR and reference books, and refer to the patient's chart if needed in order to make sure the appropriate guidelines are being followed for the ordered medication(s).**

There are established windows for administering oral, IM, and IV medications. These windows allow for certain flexibility, but the medication should be given within the established framework unless extenuating circumstances prevent it. In that case, the HM needs to document why the medication was given outside the parameters and notifies the MO and pharmacy to adjust the future doses.
**Right Documentation**

Health care providers use accurate documentation to communicate with each other. Many medication errors result from inaccurate or incomplete documentation. Before administering medications, ensure the MAR clearly reflects the patient’s name, name of the medication ordered written out in full, and the medication’s dosage route and frequency. After administering the medication, document which medications were given on the patient’s MAR according to local policy to verify that the medication was given as ordered.

Healthcare professionals have a responsibility to make sure that patients receive the best care possible. Safe medication administration is an important part of quality care and will help minimize the occurrence of negative effects while the patient is under care.

**MEDICATION CLASSIFICATIONS**

**LEARNING OBJECTIVE:**

Identify medication groups, the generic and trade names of medications listed in each medication group, and recognize each medications use.

The definition of a medication is any chemical substance that has an effect on living tissue but is not used as a food. Medications are administered to humans or animals as an aid in the diagnosis, treatment, or prevention of disease or other abnormal condition; for the relief of pain or suffering; and to control or improve any physiologic or pathologic condition.

Medications are classified according to set criteria and fall into three specific areas: general, chemical, and therapeutic.

- **General:** Grouped according to their source whether animal, vegetable, or mineral in origin
- **Chemical:** Grouped by their chemical characteristics
- **Therapeutic (Pharmacological):** Grouped according to their action on the body

**NOTE:**

Some medications may have more than one action and fall into more than one therapeutic class.

**MEDICATION NOMENCLATURE**

Medications normally have three names: chemical, generic (nonproprietary), and brand (proprietary).

- **Chemical name** relates to the chemical and molecular structure. An example is 2,4,7-triamino-6-phenylpteridine. The chemical name is meaningful to the pharmaceutical chemist but is rarely used because of its complexity.

- **Generic name** is often derived from the chemical name. Every medication has only one generic name, regardless of which manufacturer markets the medication. The generic name is the common name of the medication. An example is triamterene. (Note the underlining of the chemical name above.)

- **Brand name (trade name)** is the proprietary name given by the manufacturer. Brand name is also referred to as the trade name. An example is Dyrenium®, a brand of triamterene made by SmithKline Beecham.
MEDICATION CLASSES

The types of medications outlined in this chapter and the correlating medications in common use described in appendix IV are grouped according to pharmacological classes. Only a brief summary is possible here, the HM desiring a more complete description of each medication should refer to the *USP-NF, Drug Facts and Comparisons, Medication Information Handbook,* or other medication reference books.

Astringents

Astringents are medications that cause shrinkage of the skin and mucous membranes. Mainly used to stop seepage, weeping, or discharge from mucous membranes.

- **Aluminum Acetate solution (Burow’s Solution, Domeboro®)** is used as a wet to dry dressing for the relief of inflammatory conditions of the skin, such as athlete’s foot, poison ivy, swelling, external otitis, bruises and insect bites.

- **Calamine, zinc oxide, glycerin, and bentonite magma in calcium hydroxide (calamine lotion)** is used to treat various skin afflictions in the same way as aluminum acetate. It is a topical astringent and protectant. It should be applied to blistered, raw, or oozing areas of the skin.

Emollients

Emollients are bland or fatty substances that may be applied to the skin to make it more pliable and soft. They may serve as vehicles for application of other medicinal substances. Emollients are available as ointments, creams, or lotions.

- **Theobroma oil (cocoa butter)** is an excellent emollient with a pleasant odor. Ideal for the treatment of chapped skin and lips, cracked nipples, or minor irritated or abraded skin areas.

- **Petrolatum (petroleum jelly)** is a good emollient that provides a highly occlusive, protective barrier. When petrolatum is used as an ointment base, it may not release some drugs.

- **Zinc Oxide** is a white petrolatum containing approximately 20% zinc oxide powder. It is used as an emollient with slightly astringent properties. Because of its opaqueness, is ideal for protecting the skin and relieving chafing.

Expectorants and Antitussives

Expectorants and Antitussives are commonly used in the symptomatic treatment of the common cold or bronchitis. (See appendix IV, page 1.) Expectorants are more accurately known as bronchomucotropic agents. These agents assist in the removal of secretions or exudates from the trachea, bronchi, or lungs. Therefore, they are used in the treatment of coughs to help expel these exudates and secretions. Antitussives are agents that inhibit or suppress the act of coughing. Other cold and allergy relief preparations are discussed later in this chapter.

- **Guaifenesin and dextromethorphan (Robitussin® DM)** In this drug combination, guaifenesin acts as an expectorant. It may be useful in symptomatic relief of dry, nonproductive cough, and in the presence of mucous in the respiratory tract. Dextromethorphan is a synthetic non-narcotic derivative of codeine that acts as an antitussive. It is used to control nonproductive coughs by soothing minor throat and bronchial irritations.

- **Guaifenesin and codeine phosphate (Robitussin® AC)** are combined to relieve the symptoms of the common cold. Guaifenesin is an expectorant, and codeine phosphate is a narcotic antitussive. Patients should be advised that this medication contains a narcotic and, if abused, could cause dependency.
Nasal Decongestants

Nasal Decongestants reduce congestion and the swelling of mucous membranes. They are used for temporary relief of nasal congestion due to the common cold, allergies, and sinusitis, and to promote nasal or sinus drainage. They are used to relieve Eustachian tube congestion. They are often combined with antihistamines, antitussives, and expectorants to relieve the symptoms of colds, allergies, and sinusitis.

- **Pseudoephedrine Hydrochloride (Sudafed®)** Pseudoephedrine hydrochloride (HCL) is indicated for the symptomatic relief of nasal congestion due to the common cold, hay fever, or other upper respiratory allergies.

- **Pseudoephedrine Hydrochloride and Triprolidine Hydrochloride (Actifed®)** are a nasal decongestant and antihistamine combination. Pseudoephedrine HCl, a nasal decongestant, reduces congestion and swelling of mucous membranes, and triprolidine HCl, an antihistamine, promotes drying of mucous membranes. This drug combination is indicated for the symptomatic relief of colds, hay fever, etc.

- **Pseudoephedrine and Guaifenesin (Mucinex D®)** Pseudoephedrine, a nasal decongestant, and guaifenesin, an expectorant, are combined for the symptomatic relief of nasal congestion and cough due to the common cold, hay fever, or other respiratory allergies.

Antihistamines

Antihistamines are used to counteract the physical symptoms that are caused by histamines. Histamine, a substance released by most cells distributed in connective tissues usually near blood vessels, promotes some of the reactions associated with inflammation and allergies, such as asthma and hay fever. Antihistamines may cause drowsiness, so patients should be warned against driving or operating machinery while taking this type of medication.

- **Diphenhydramine Hydrochloride (Benadryl®)** Diphenhydramine HCl is given for active and prophylactic treatment of motion sickness, as a nighttime sleep aid, and for the symptomatic relief of urticaria, allergic rhinitis, and other allergic conditions.

- **Chlorpheniramine Maleate (ChlorTrimeton®)** Chlorpheniramine HCl is used for the symptomatic treatment of urticaria and other allergic conditions.

- **Meclizine Hydrochloride (Antivert®, Bonine®)** Meclizine HCl is given to prevent and treat nausea, vomiting, and dizziness of motion sickness. It has a longer duration of action than diphenhydramine hydrochloride.

- **Dimenhydrinate (Dramamine®)** Similar to other antihistamines, the greatest usefulness of dimehydrinate is the prevention and treatment of motion sickness. It may also be used to control nausea and vomiting in connection with radiation sickness.

Histamine H₂ Receptor Antagonists

Histamine H₂ Receptor Antagonists block histamines that cause an increase of gastric acid secretion in the stomach. They are effective in preventing complications of peptic ulcer disease and alleviating symptoms of this disease.

- **Cimetidine (Tagamet®)** Used for the short term treatment and maintenance of active duodenal and benign gastric ulcers. It may be used for other medical conditions which cause an excess amount of gastric acid to be produced.

- **Ranitidine (Zantac®)** Like Cimetidine, ranitidine is used for short term treatment and maintenance in active duodenal and benign gastric ulcers to promote healing of duodenal ulcers. It is used to treat gastroesophageal reflux disease (GERD).
Antacids

Antacids are used to counteract hyperacidity in the stomach. Normally, there is a certain degree of acidity in the stomach. An excess of acid can irritate the mucous membranes and commonly known as indigestion, heartburn, or dyspepsia. In some disease states, the gastrointestinal tract may become excessively acidic (very low pH), causing diarrhea or leading to peptic ulcer formation. Antacids may interfere with the body’s ability to use or metabolize many medications. For this reason, oral medications normally should not be taken within 2 hours of taking an antacid.

- **Magnesium Hydroxide (Milk of Magnesia USP)** is used for the symptomatic relief of upset stomach associated with hyperacidity, treatment and maintenance of duodenal ulcers, and used to reduce phosphate absorption in patients with chronic renal failure. It should be taken on an empty stomach with lots of fluids. It should not be used in the presence of abdominal pain, nausea, or vomiting. Prolonged use may result in kidney stones. Magnesium hydroxide also has a laxative effect.

- **Aluminum Hydroxide Gel (Amphojel®)** is used to manage peptic ulcers, gastritis, and gastric hyperacidity. The major advantage of this drug is that no systemic alkalosis is produced. It may cause constipation.

- **Alumina and Magnesia Oral Suspension (Maalox®)** Alumina and magnesia oral suspension coats the stomach lining and neutralizes gastric acid. It is less constipating than aluminum hydroxide alone.

Disinfectants are agents used to disinfect inanimate objects and are primarily germicidal in their action. All of these agents are for external use only, unless otherwise indicated.

- **Phenol (carbolic acid)** Historically, one of the first antiseptic agents used. It is the standard by which all other antiseptic, disinfectant, and germicidal agents are measured in effectiveness. Because of its highly caustic nature, phenol must be handled with care. The effect of phenol is coincident with the concentration: high concentrations are germicidal and can cause tissue destruction; lower concentrations are antiseptic. Phenol is inactivated by alcohol. Because more effective and less damaging agents have been developed, phenol is no longer used extensively.

- **Povidone-iodine (Betadine®)** Numerous iodine and iodine-complex agents are available for use in disinfection. The most common of these is povidone-iodine (Betadine®). It is used externally to destroy bacteria, fungi, viruses, protozoa, and yeasts. Povidone-iodine is relatively, nontoxic, nonirritating, and non-sensitizing to the skin. When used as an antiseptic, the complex breaks down on contact with skin or mucous membranes to release free iodine, which is slowly absorbed. Most commonly used as a preoperative skin antiseptic.

**NOTE:**
Check for iodine allergies before using this antiseptic on patients.

- **Isopropyl Alcohol (Isopropanol)** is used in a 70% solution as a skin antiseptic; it is volatile and also has a drying effect on the skin.

Antiseptics, Disinfectants, and Germicides

Antiseptics, Disinfectants, and Germicides primarily intended for the prevention of infections by destroying bacteria or preventing their growth. The differences among them are based primarily on degree of activity and how they are used. **Antiseptics** suppress the growth of microorganisms. **Germicides** kill susceptible organisms.
• **Hexachlorophene (pHisoHex®)** Synthetic preparation is a bacteriostatic cleansing agent effective against gram-positive organisms. The presence of pus or serum decreases its effectiveness. It is a neurotoxin agent and must not be used on premature infants, denuded skin, burns, or mucous membranes. It is used as an antiseptic scrub by physicians, dentists, food handlers, and others. Residual amounts can be removed with alcohol.

• **Glutaraldehyde (Cidex®)** is effective against vegetative gram-positive, gram-negative, and acid-fast bacteria, bacterial spores, some fungi, and viruses. It is used in an aqueous solution for sterilization of fiber optics, plastics, rubber, and other materials that are not resistant to heat.

• **Hydrogen Peroxide** is a germicide and routinely used to cleanse pus-producing wounds and in the treatment of necrotizing ulcerative gingivitis (NUG) also known as trench mouth. It is an oxidizing agent that is destructive to certain pathogenic organisms, but it is mild enough to be used on living tissue. It is for external use only and is normally available in 3% solution.

• **Silver Nitrate** The soluble salts of silver nitrate ionize in water to produce highly concentrated astringent and antiseptic solutions. In a solid form is most commonly used to cauterize mucous membranes and to treat aphthous ulcers. The most common side effect of silver nitrate is the skin turns black where the silver nitrate comes in contact with it. The black area on the skin is not harmful and will resolve slowly. Silver nitrate in liquid form is used as eye drops to prevent gonorrheal ophthalmia in newborns. Liquid silver nitrate is also used as a wet dressing.

<table>
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<th>CAUTION:</th>
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<td>When using silver nitrate as a wet dressing, use precautions to keep the dressing from drying out.</td>
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If the wet dressing dries out, the silver nitrate will precipitate and be absorbed into the skin, which will turn a slate gray.

This condition is known as argyria.

There is no known reversal for this condition.

**Sulfonamides**

Sulfonamides were the first effective chemotherapeutic agents to be available in safe therapeutic dosage ranges. Prior to the introduction of penicillins in 1941, sulfonamides were the main therapy for bacterial infections in humans. Sulfonamides are synthetically produced and are effective against both gram-positive and gram-negative organisms.

• **Sulfisoxazole (Gantrisin®)** is a systemic sulfonamide that is a bacteriostatic and is indicated to treat urinary tract infections and acute otitis media.

• **Trimethoprim and Sulfamethoxazole (Bactrim®, Septra®)** The combination of trimethoprim and sulfanethoxazole is an anti-infective used to treat urinary tract infection and otitis media.

• **Sulfacetamide Sodium (Sodium Sulamyd®, Bleph®-10)** Sulfacetamide sodium is an ophthalmic bacteriostatic for the treatment of conjunctivitis, corneal ulcer, and other superficial ocular infections. It is available in solutions of various strengths and in ointment form.

• **Silver Sulfadiazine (Silvadene® Cream)** is a topical antimicrobial agent used to treat second and third degree burns to prevent wound sepsis. It is water soluble and easily washed off the skin.
Penicillins

Penicillin is one of the most important antibiotics. It is derived from a number of Penicillium molds commonly found on breads and fruits. The mechanism of action is the inhibition of cell wall synthesis during the reproductive phase of bacterial growth. It is one of the most effective and least toxic of the antimicrobial agents.

- **Penicillin G, Aqueous** is indicated for susceptible infection such as meningococcal meningitis, anthrax, and gonorrhea. Penicillin G is for parenteral (IV) use only.

- **Penicillin G, Benazathine (Bicillin® LA)** is indicated for conditions such as syphilis and upper respiratory tract infections caused by streptococcal (Group A) bacteria. This drug is injected into a large muscle.

- **Penicillin G Procaine, Aqueous (Wycillin®)** is indicated for conditions such as uncomplicated pneumonia, middle ear and sinus infections, NUG and pharyngitis, and scarlet fever. Penicillin G procaine is for parenteral use only, and it has longer duration of action than most of the other penicillins.

- **Penicillin V Potassium (Pen-Vee K®, Betapen-VK®, V-Cillin K®)** is used to treat conditions such as upper respiratory tract infection, otitis media, sinusitis, bacterial endocarditis, and mild staphylococcal infection of skin and soft tissue. Penicillin V has the same spectra of activity of penicillin G and is usually the drug of choice for uncomplicated group-A beta-hemolytic streptococcal infections. It is available as oral tablets or powder for reconstitution for oral suspension.

- **Dicloxacillin Sodium (Dynapen®)** is used to treat infections caused by penicillin G-resistant staphylococci. It may be used to initiate therapy in any patient in whom a staphylococcal infection is suspected.

- **Ampicillin (Polycillin®)** is used to treat conditions such as shigella, salmonella, escherichia coli, and gonorrhea.

- **Amoxicillin (Amoxil®)** The spectrum of amoxicillin is essentially identical to ampicillin, except that amoxicillin is more effective against shigella. Amoxicillin also has the advantage of more complete absorption than ampicillin.

- **Amoxicillin and Clavulanate potassium (Augmentin®)** is used to treat many different infections caused by bacteria, such as sinusitis, pneumonia, ear infections, bronchitis, urinary tract infections, and infections of the skin.

Cephalosporins

Cephalosporins are a group of semi-synthetic derivatives of cephalosporin C, an antimicrobial agent of fungal origin. They are structurally and pharmacologically related to the penicillins. Because cephalosporins are similar to penicillins, some patients allergic to penicillin may also be allergic to cephalosporin medications. The incidence of cross-sensitivity is estimated to be 5 to 16 percent.

This family of antibiotics is generally divided into three generations: first, second, and third generation. The main differences among the groups are the change in the antibacterial spectrum. The third generation agents have a much broader gram-negative spectrum than the earlier generations.

- **Cefazolin Sodium (Ancef®, Kefzol®)** is used to treat a wide range of medical conditions, such as lower respiratory tract infections (pneumonia and lung abscess), septicemia, and bone and joint infections. It is used preoperatively to reduce the chance of certain infections following surgical procedures (such as vaginal hysterectomy, gastrointestinal surgery, and transurethral prostatectomy).

- **Cephalexin (Keflex®)** is indicated for the treatment of infection of the respiratory tract, otitis media, skin and skin structures, and genitourinary system.
Cefprozil (Cefzil®) is used to treat pharyngitis, tonsillitis, otitis media, bronchitis, and mixed infections of the skin and skin structure. Mixed infections are infections that include both aerobic and anaerobic pathogenic organisms. This medication is used preoperatively to prevent the incidence of certain postoperative infections.

Tetracyclines

Tetracyclines introduced in 1948, were the first truly broad-spectrum antibiotics. They include a large group of medications with a common basic structure and chemical activity. The most important mechanism of action of the tetracyclines is the blocking of the formation of polypeptides used in protein synthesis. Because of their broad spectrum of activity, are most valuable to treat mixed infection, such as chronic bronchitis and peritonitis; however, they are medications of choice for only a few bacterial infections. Tetracycline is also used as a topical preparation to treat acne.

The tetracyclines are relatively nontoxic, the most common side effects being mild gastrointestinal disturbances. Allergic reactions and anaphylaxis are rare. Administration to children and pregnant women is not indicated because it may produce discoloration of the teeth and depress bone marrow growth. The major hazard of tetracycline therapy is the overgrowth of resistant organisms, especially Candida and staphylococci. Tetracyclines should not be administered with milk, milk products, antacids or iron preparations; they combine with metal ions to form non-absorbable compounds.

Tetracycline hydrochloride (Achromycin®, Sumycin®) is used to treat infections caused by rickettsiae (such as Rocky Mountain spotted fever and typhus fever), agents of lymphogranulomas venereum and granuloma inguinale, and the spirochetal agent of relapsing fever. Tetracycline hydrochloride is indicated for severe acne as an adjunctive therapy. Food and some dairy products may interfere with absorption; antacids containing aluminum, calcium, or magnesium impair absorption of the antibiotic as well. This medication should be given 1 hour before or 2 hours after meals.

Doxycycline Hyclate (Vibramycin®) is active against a wide range of gram-positive and gram-negative microorganisms and has a low affinity for binding with calcium. In addition to the conditions listed under tetracycline, doxycycline is indicated for the treatment of uncomplicated chlamydial infections and uncomplicated gonococcal infections. Doxycycline can be used for malaria prophylaxis.

Minocycline Hydrochloride (Minocin®) is indicated for the same conditions as tetracycline hydrochloride and doxycycline hyclate.

Aminoglycoside

Aminoglycosides are a group of medications that share chemical, antimicrobial, pharmacologic, and toxic characteristics, and that are effective against most gram-positive and gram-negative organisms. Their method of action is by inhibiting protein synthesis. Aminoglycosides can cause varying degrees of ototoxicity and nephrotoxicity, depending on the particular agent and the dose. Toxicity is more prevalent in the very young or old, in the presence of renal impairment or dehydration, or with the use of diuretics.
Because of their high toxicity, aminoglycosides are not recommended when the infective organism is susceptible to less toxic preparations.

- **Gentamicin sulfate** (*Garamycin®*) is used to treat serious systemic infections of susceptible gram-negative organisms. While the patient is on gentamicin sulfate, it is necessary to monitor renal and hepatic function to determine if toxic levels have been reached. It is available as a topical preparation for the treatment of burns and infected wounds, and as an ophthalmic preparation for eye infections.

- **Tobramycin sulfate** (*Nebcin®*) is used to treat serious infections such as septicemia, meningitis, and infections of the eye.

- **Neomycin sulfate** (*Mycifradin®*) is used as a topical preparation to treat skin infections, burn wounds, ulcers, and dermatoses. It is given orally to reduce intestinal flora prior to surgery involving the bowel or anus.

**Macrolides**

Antibiotics constituting a large group of bacteriostatic agents that inhibit protein synthesis. They are effective against gram-positive cocci, *Neisseria*, *Hemophilus*, and mycobacteria. All are similar to penicillin in their antibacterial spectra and are often used in patients who are sensitive to penicillin.

- **Erythromycin** (*E-Mycin®, Ilotycin®*) is one of the drugs of choice when penicillin is contraindicated. This medication is indicated to treat medical conditions such as gonorrhea; uncomplicated urethral, endocervical, and anal infections; early syphilis; and cases of severe or prolonged diarrhea associated with campylobacter enteritis and enterocolitis. It is prescribed, as a prophylactic agent, prior to colorectal surgery. Erythromycin is available in enteric-coated tablets, as an ophthalmic ointment, and as a topical preparation for the adjunctive treatment of acne. Erythromycin can make the skin more sensitive to sunlight and sunburn may result.

- **Clindamycin hydrochlorids** (*Cleocin®*) is used to treat susceptible anaerobic organisms. The use of clindamycin hydrochloride has often been associated with severe colitis and profuse diarrhea; if this condition occurs, the drug should be discontinued. A topical preparation is available for the treatment of acne.

- **Vancomycin hydrochloride** (*Vancocin®*) is indicated in potentially life-threatening infections not treatable with other effective, less toxic antimicrobials, including the penicillins and cephalosporins. Potentially life-threatening infections that vancomycin may be used for include endocarditis, osteomyelitis, pneumonia, and septicemia.

- **Azithromycin** (*Zithromax®*) is used for the treatment of community-acquired pneumonia, otitis media, infections of the skin structure, sexually transmitted diseases, chancroid, and bacterial sinusitis. It can be given as a one dose treatment, oral or parenteral, or over several days.

**Antifungals**

Agents that inhibit or suppress the growth systems of fungi, dermatophytes, or *Candida*. Antifungals have not been developed to the same degree as antibacterial agents. Most fungi are completely resistant to the action of chemicals at concentrations that can be tolerated by the human cell. There are only a few available for internal use, most antifungal agents are topical. The antifungal agents that are available for systemic use generally produce hepatic or renal dysfunction or other serious side effects. Because of these side effects, systemic antifungals should be limited to serious or potentially fatal conditions. Therapy that includes topical preparations may be provided in conjunction with oral or parenteral antifungal agents.
Nystatin (Mycostatin®) is primarily used to treat candidal infections. It is fungicidal and fungistatic against a wide variety of yeasts and yeast-like fungi, and is most often used to treat candidiasis. It can be used concurrently with tetracycline to suppress the overgrowth of Candida in the bowel.

Griseofulvin (Gris-PEG®, Fulvicin®) is a fungistatic agent given orally to treat fungal infections of the nails, hair, and skin. It is generally reserved for chronic infections that have not responded to topical therapy alone. Because treatment may last for several months, the patient should be instructed to follow the treatment regimen even though symptoms may abate. Inclusion of topical therapy is a must for effective elimination of the infection.

Miconazole nitrate (Monistat®, Micatin®) is a synthetic antifungal that inhibits the growth of common dermatophytes. It is indicated to treat cutaneous fungal infections and vulvovaginal candidiasis.

Undecylenic acid (Desenex®) is used primarily to treat and prevent tinea pedis and is often compounded with zinc to act as an astringent. It is available in ointment, dusting powder, solution, and spray.

Tolnaftate (Tinactin®, Aftate®) was the first fungicide synthesized. It is indicated for the topical treatment of tinea pedis, tinea corporis, tinea capitis, and tinea versicolor.

Clotrimazole (Lotrimin®, Mycelex®) is a broad-spectrum antifungal that inhibits the growth of pathogenic dermatophytes, yeast, and other types of fungus growth, including Candida albicans. It is indicated for the treatment of tinea pedis, tinea cruris, tinea corporis, and candidiasis.

**Antiparasitics**

Antiparasitics are agents that are destructive to parasites. Parasitic infections or infestations account for the largest number of chronic disabling diseases known. They are especially prevalent in the tropics or subtropics and in lesser-developed countries where overcrowding and poor sanitation exist. Parasitic infections include protozoal infections (malaria, amebiasis, and to a lesser extent, trichomoniasis), helminthic infections (intestinal worms), and ectoparasites. Ectoparasites, such as head lice and crab lice, although not disabling, are considered a nuisance and can transmit disease.

Permethrin (Elimite®/Nix) is a pediculicide used to treat Pediculus capitis (head lice) and Phthirus pubis (crab lice). It is indicated for scabies. Use with caution, especially in infants, children, and pregnant women, since it penetrates human skin and has the potential for systemic poisoning. This drug is irritating to the eyes and should be discontinued immediately if local irritation occurs. It is applied only once per treatment, and must be removed by water after the appropriate contact time has elapsed.

Metronidazole (Flagyl®) is effective in treating amebiasis. It is also used as a trichomonacide. Patients should be warned about combining Flagyl and alcohol, as it can produce violent side effects.

Mebendazole (Vermox®) is regarded as the drug of choice for pinworm and roundworm infestations.

Pyrantel pamoate (Antiminth®) is effective in treating infestations of hookworm, roundworm, pinworm, and whipworm.

Thiabendazole (Mintezol®) is a vermicide used to destroy pinworms, roundworms, threadworms, hookworms, and whipworms. It is not indicated as a prophylactic agent.

**Antimalarial Preparations**

Antimalarial preparations are medications that are used to treat or prevent malaria. Malaria is a mosquito-borne disease caused by a parasite. People with malaria often experience fever, chills, and flu-like illness. Left untreated, they may develop severe complications and die.
• **Chloroquine phosphate (Aralen®)** is the drug of choice in treating acute malarial attacks. It is used in the prevention and suppression of malaria in endemic areas.

• **Primaquine phosphate** is the drug of choice for the prevention or relapse of malaria caused by *P.vivax* and *P.ovale*. It is contraindicated in G-6-PD-deficient personnel, as it may result in hemolytic anemia.

**Laxatives**

Laxatives are medications that facilitate the passage and elimination of feces from the colon and rectum. They are indicated to treat simple constipation and to clean the intestine of any irritant or toxic substances (catharsis). They may be used to soften painfully hard stools and to lessen straining of certain cardiac patients when defecating. They are contraindicated in certain inflammatory conditions of the bowel, bowel obstruction, and abdominal pain of unknown origin, and should not be used in the presence of nausea and vomiting. They are classified as irritant, bulk, emollient, or stool softeners. Frequent or prolonged use of any laxative may result in dependence.

• **Mineral oil** is an emollient laxative used to lubricate the fecal mass. It is often used in combination with an irritant agent such as phenolphthalein (Ex-Lax). It can also be used for bowel irrigation.

• **Lactulose (Enulose®)** is used for the treatment of chronic constipation. Diarrhea may be a sign of overuse or overdosing. It may be mixed with fruit juice, milk, or citrus flavored beverages.

• **Bisacodyl (Dulcolax®)** is a relatively nontoxic irritant cathartic that reflexively stimulates the colon on contact. It usually produces softly formed stools in 6 to 12 hours and is normally taken at bedtime. It is often used as a preparatory agent prior to some surgeries and radiological examinations.

• **Magnesium citrate (Citrate of magnesia)** is a saline irritant laxative that also inhibits the absorption of water from the intestine. It is preferred by radiology departments for use prior to special x-rays.

• **Psyllium hydrophilic mucilloid (Metamucil®)** is a bulk laxative that works by absorbing water. The effect occurs within 12 to 72 hours. It is provided as a dry powder that is stirred into water or fruit juice. This laxative should be drunk immediately after mixing, while the material is in suspension.

• **Ducosate calcium (Surfak®)** is a stool softener that promotes water retention in the fecal mass.

**Diuretics**

Diuretics are agents that increase the rate of urine formation. These agents are useful in treating hypertension and edematous conditions, such as congestive heart failure and acute pulmonary edema. However, loss of body fluids due to use of diuretics can seriously deplete electrolytes from the system, and care should be taken to monitor and replenish lost sodium and potassium through diet and supplement therapy.

• **Hydrochlorothiazide (Esidrix®, Oretic®)** is used for edema associated with congestive heart failure and other edematous conditions. It is also used to manage hypertension as the sole agent or in combination with other antihypertensive agents.

• **Chlorthalidone (Hygroton®)** is used in the same manner as hydrochlorothiazide.

• **Furosemide (Lasix®)** a potent diuretic is used to treat edema associated with congestive heart failure, cirrhosis of the liver and renal disease. It is particularly useful when greater diuretic potential is desired, and may be used alone or in combination with other antihypertensive agents to treat hypertension.
• Acetazolamide (Diamox®) is used for the treatment of various forms of glaucoma. It can also be used to treat edema in patients with congestive heart failure and acute mountain sickness.

• Triamterene and hydrochlorothiazide (Dyazide®, Maxzide®) This combination of a potassium-sparing (triamterene) and potassium-depleting diuretic is often more effective than either drug alone. It is used for edema associated with congestive heart failure and other edematous conditions. It is also used in the management of hypertension.

Non-Narcotic Analgesics, Anti-pyretics, and Anti-Inflammatory Agents

Non-narcotic analgesics are medications that relieve pain without producing unconsciousness or impairing mental capacities. Antipyretics relieve or reduce fevers. Anti-inflammatory agents counteract or suppress inflammation or the inflammatory process. Many of the medications discussed were developed with two or more of these properties.

• Aspirin (ASA, Ecotrin®) is still the most economical analgesic, antipyretic, and anti-inflammatory agent available. Some preparations have an antacid-type buffer to assist in the reduction of gastric irritation. It is an analgesic for mild to moderate pain and an effective antipyretic. It is indicated for various inflammatory conditions, such as rheumatoid arthritis and bursitis.

• Acetaminophen (Tylenol®) is an analgesic and antipyretic used to relieve pain and fever accompanying diseases (such as the common cold and influenza). It is also used to relieve pain and discomfort of upper GI disease (ulcer and gastritis), gouty arthritis, a variety of arthritic and rheumatic conditions involving musculoskeletal pain, as well as other painful disorders. It is indicated for patients who are allergic to aspirin.

• Ibuprofen (Motrin®) is indicated for the relief of mild to moderate pain, including headaches and menstrual cramps. It is also used as an anti-inflammatory agent to treat arthritis, tendonitis, bursitis, etc. It is not recommended for use in cases of gastrointestinal bleeding or renal impairment, or during the third trimester of pregnancy.

• Indomethacin (Indocin®) is a potent anti-inflammatory agent with antipyretic and analgesic properties. With the potential for adverse reactions, indomethacin should be reserved for cases of chronic rheumatoid arthritis, osteoarthritis, and acute gout.

• Naproxen (Naprosyn®, Anaprox®) an analgesic indicated for the relief of mild to moderate pain and for the treatment of primary dysmenorrheal, rheumatoid arthritis, osteoarthritis, tendinitis, bursitis, and acute gout. The effects are similar to those of aspirin and indomethacin, but with fewer and less toxic gastrointestinal side effects; however, it is not indicated for patients with a history of gastrointestinal disease, especially those with a propensity for peptic ulcer disease.

• Meloxicam (Mobic®) is an anti-inflammatory agent used for treatment osteoarthritis, rheumatoid arthritis and juvenile rheumatoid arthritis. It is contraindicated in the 3rd trimester of pregnancy.

• Piroxicam (Feldene®) is an anti-inflammatory agent used to relieve the signs and symptoms of acute and chronic osteoarthritis and rheumatoid arthritis.

Central Nervous System Stimulants

Certain medications stimulate the activity of various portions of the central nervous system (CNS). The Manual of the Medical Department (MANMED) Chapter 21 is explicit as to the usage of these medications in the Navy. Primary indications for this class of medications are narcolepsy, hyperkinesis, and attention deficit disorders in children.
Central nervous system stimulants are generally contraindicated in patients with hypertension, arteriosclerosis, symptomatic cardiovascular disorders, agitated states, glaucoma, or history of medication abuse.

- **Methylphenidate hydrochloride (Ritalin®)** is indicated for use in hyperkinetic children and children with attention deficit disorders. In children, this drug is used as a central nervous system depressant. Methylphenidate HCl is also indicated for narcolepsy in adults.

- **Dextroamphetamine sulfate (Dexadrine®)** is primarily indicated for narcolepsy. However, because of dextroamphetamine’s anorexia effect (it diminishes appetite); it is occasionally used as an adjunct to diet therapy for obesity caused by overeating.

Central Nervous System Depressants

Central nervous system (CNS) depressants range in depressive action from mild sedation to deep coma, differing mainly in rapidity, degree, and duration of action. Any of these CNS depressants may, in sufficient doses, cause respiratory depression. Alcohol use while taking CNS depressants should be avoided. Many of the central nervous system depressants are controlled medications. Refer to Chapter 21 of the MANMED for control, custody, and accountability guidelines for controlled substances.

Barbiturates comprise a widely used group of CNS depressants. They are used mainly as sedative-hypnotics, anticonvulsants, anesthetics for short anesthesia, and may be used in combination with analgesics to enhance their analgesic effect. NOTE: Barbiturates may be habit forming.

- **Phenobarbital (Luminal®)** is a long-lasting barbiturate frequently used to treat convulsive disorders. This is the drug of choice in petit mal epilepsy, and it is used as a hypnotic or sedative.

- **Dextroamphetamine sulfate (Dexadrine®)** is primarily indicated for narcolepsy. However, because of dextroamphetamine’s anorexia effect (it diminishes appetite); it is occasionally used as an adjunct to diet therapy for obesity caused by overeating.

- **Pentobarbital (Nembutal®)** is indicated for short-term treatment of insomnia. It is used as a preanesthetic medication.

- **Phenytoin sodium (Dilantin®)** is a nonbarbiturate anticonvulsant that is the drug of choice for the treatment and management of grand mal epilepsy. Because phenytoin sodium possesses no hypnotic properties, it is preferred to Phenobarbital in treating seizure disorders. However, Phenytoin sodium and Phenobarbital are frequently used in combination to more effectively manage certain types of epilepsies.

Opium and Opium Alkaloids

The activity of opium is primarily due to its morphine content. The major medical use of opium has been for its antiperistaltic activity, particularly in diarrhea. Opium alkaloids, e.g., morphine and codeine, have replaced opium in medical use. Members of this medication group are used as analgesics, cough sedatives, and for certain types of diarrhea.

**NOTE:**

Warn patients taking opium or opium alkaloids that drowsiness, dizziness, and blurring of vision may occur.

For this reason, they should not drive or perform other tasks that require alertness.

Also, caution patients against consuming alcohol and other CNS depressants.

Patients should notify their physician immediately if shortness of breath or difficulty in breathing occurs.

- **Morphine Sulfate (Roxanol®, MS Contin®)** is an opium alkaloid indicated for the relief of severe pain. It is used to preoperatively sedate patients and to treat severe pain associated with myocardial infarction. Morphine is contraindicated for patients with head injuries, acute alcoholism, and convulsive disorders.
- **Codeine Sulfate** is an opium alkaloid is like morphine. However, it has only one-sixth of the analgesic power and one-fourth of the respiratory depressant effect of morphine. Codeine is used for moderate to severe pain and as an antitussive.

- **Meperidine hydrochloride** (Demerol®) is a synthetic analgesic similar to morphine. It is used for moderate to severe pain and as a preoperative medication. Meperidine HCl is not as effective as morphine in its analgesic properties.

**Psychotherapeutic Agents**

Tranquilizers and mood modifiers are the two primary groups of psychotherapeutic agents. Psychotherapeutic agents are classified as **major tranquilizers**, **minor tranquilizers**, and **mood modifiers**. The mood modifiers have replaced amphetamines as treatment of choice for depressive states.

- **Chlorpromazine hydrochloride** (Thorazine®) is indicated for alleviating manifestations of psychosis, tension, and agitation. Dosage is highly individualized depending on the severity of symptoms and degree of response. It may be used as an antiemetic.

- **Thioridazine** (Mellaril®) is used for antipsychotic purposes and is considered to be a good all around tranquilizer.

- **Prochlorperizine** (Compazine®) is most often used in the symptomatic treatment of nausea and vomiting, but it shares all the antipsychotic effects of chlorpromazine.

- **Haloperidol** (Haldol®) is indicated in treating schizophrenia with manifestations of acute manic symptoms, social withdrawal, paranoid behavior, and the manic stage of manic-depressive patients.

- **Lithium** (Eskalith®, Lithonate®) is used to treat manic episodes of manic-depressive illness. It is the drug of choice to prevent or diminish the intensity of manic episodes.

- **Amitriptiline hydrochloride** (Elavil®) is an antidepressive mood elevator with mild tranquilizing effects. It is indicated for the long-term treatment of depressive disorders.

- **Chlordiazepoxide hydrochloride** (Librium®) is an antianxiety agent for the treatment of anxiety disorders. It is not indicated for anxiety or tension associated with the stress of everyday activities. It is indicated in the abatement of acute withdrawal symptoms of alcoholism.

- **Hydroxyzine pamoate** (Vistaril®, Atarax®) is a rapid-acting antianxiety and antiemetic with antispasmodic and muscle relaxant effects. It is most often used in pre- and postoperative sedation and in conjunction with meperidine hydrochloride to enhance its effects and reduce nausea.

- **Diazepam** (Valium®) is useful in treating mild to moderate depression with anxiety and tension. Because of its muscle relaxant properties, it is used to treat spastic muscle conditions and convulsive seizure episodes. It is the drug of choice in status epilepticus. In the United States Military diazepam is also known as CANA (Convulsive Antidote, Nerve Agent). One CANA kit is typically issued to service members, along with three Mark I NAAK kits when operating in circumstances where chemical weapons in the form of nerve agents are considered a potential hazard.

- **Fluoxetine hydrochloride** (Prozac®) is an oral antidepressant used to treat depression. It may be useful in treating bulimia nervosa and obsessive compulsive disorders.

- **Zolpidem** (Ambien®) is a non-benzodiazepine and hypnotic indicated for the short term treatment of insomnia (difficult with sleep onset).

**Skeletal Muscle Relaxants**

Skeletal muscle relaxants are used in connection with the treatment of muscle spasm due to various conditions. They may also be used to produce muscular relaxation during surgical anesthesia.
Skeletal muscle relaxants may cause drowsiness and impair performance of tasks that require alertness.

- **Methocarbamol (Robaxin®)** is used as an adjunct therapy for the relief of discomfort associated with acute, painful musculoskeletal conditions. It may have a beneficial effect in the control of neuromuscular manifestations of tetanus.

- **Cyclobenzaprine (Flexeril®)** is indicated as an adjunct to rest and physical therapy for relief of muscle spasm with acute painful musculoskeletal conditions.

### Cardiovascular Agents

Cardiovascular agents affect the action of the circulatory system.

- **Digoxin (Lanoxin®)** is indicated for all degrees of congestive heart failure and for various arrhythmias. It has a direct effect on the myocardium, causing and increase in the force of contractions.

- **Quinidine Sulfate** is indicated for premature atrial and ventricular contractions and other arrhythmias. NOTE: Do NOT confuse this medication with quinine sulfate, an antimalarial.

- **Amyl Nitrite** is employed medically to treat heart diseases such as angina and is used for the prevention of erection in adult males following circumcision.

- **Nitroglycerin (Nitrostat®, Nitro-Bid®)** is indicated for the treatment and management of acute and chronic angina pectoris.

- **Isosorbide dinitrate (Isordil®, Sorbitrate®)** is similar to nitroglycerin in its antianginal action.

- **Dipyridamole (Pershantine®)** is indicated as an adjunct to warfarin sodium (an anticoagulant) in the prevention of postoperative thromboembolic complications of cardiac valve replacement.

- **Procainamide hydrochloride (Pronstyl®, Procan® SR)** is indicated for the treatment of premature ventricular contractions, ventricular tachycardia, and atrial fibrillation. It may be used for cardiac arrhythmias associated with anesthesia and surgery.

- **Verapamil (Isoptin®)** is indicated for the treatment of angina pectoris and for the management of essential hypertension.

- **Diltiazem (Cardizem®)** is indicated for the treatment of angina pectoris and for the management of essential hypertension.

### Vasoconstrictors

Vasoconstrictors produce constriction of the blood vessels with consequent rise in blood pressure.

- **Epinephrine (Adrenaline, Chloride, Susprine)** When inhaled, is used to relieve acute bronchial asthma. When injected, relieves respiratory distress in bronchial asthma attacks and relieves bronchospasms in patients with chronic bronchitis, emphysema, and other obstructive pulmonary diseases. It may be used to treat hypersensitivity reactions to drugs, serums, insect stings or other allergens. (Symptoms of these reactions may include bronchospasms; urticaria; pruritus; and swelling of the skin, lips, eyelids, tongue, and nasal mucosa; and anaphylactic shock.

- **Tetrahydrozaline hydrochloride (Visine® Eye Drops)** is an ophthalmic preparation for symptomatic relief of irritated eyes.

- **Phenylephrine hydrochloride (Neo-Synephrine®)** is used to shrink mucous membranes of the nose and to relieve local congestion.

- **Oxymetazoline hydrochloride (Afrin®)** is a topical vasoconstrictor used to relieve nasal congestion.
Anticoagulants

Anticoagulants delay or prevent blood coagulation. Before an anticoagulant agent is prescribed and its dosage determined, laboratory testing of the patient's blood-clotting capabilities should be performed.

- **Heparin sodium** is used in prophylaxis and treatment of venous thrombosis (and its expansion) and of pulmonary embolism.
- **Warfarin sodium (Coumadin®)** is used extensively to treat embolism in the prevention of occlusions.

Vitamins

Vitamins are unrelated organic substances that occur in many foods and are necessary for the normal metabolic functioning of the body. Vitamins may be **water-soluble** or **fat-soluble**. The majority of vitamins are water-soluble. Water-soluble vitamins are excreted in the urine and are not stored in the body in appreciable quantities. The fat-soluble vitamins (A, D, E, and K) are soluble in fat solvents and absorbed along with dietary fats. Fat-soluble vitamins are not normally excreted in the urine and tend to be stored in the body in moderate amounts.

- **Vitamin A (Retinol)** is a fat-soluble vitamin necessary for visual adaptation to darkness. Deficiencies rarely occur in well-nourished individuals, and an excess of vitamin A can be toxic. Conditions which may cause vitamin A deficiency include biliary tract or pancreatic disease, colitis, hepatic cirrhosis, and extreme dietary inadequacy (such as anorexia). Retinoic acid, a degradation product of retinol, is useful to treat acne and pseudofolliculitis barbae.
- **Vitamin B₁ (Thiamine hydrochloride)** is a water-soluble vitamin necessary for carbohydrate metabolism. This vitamin is used to treat patients with appetite loss resulting from dietary disturbances. The deficiency disease is beriberi.
- **Vitamin B₂ (Riboflavin)** is a water-soluble vitamin functioning in the body as a coenzyme necessary in tissue respiratory processes, e.g., oxidation reduction reactions. Deficiency is associated with cheilosis, glossitis, visual disturbances, or visual fatigue.
- **Vitamin B₃ (Niacin)** is a water-soluble vitamin indicated for the correction of niacin deficiency and in the prevention and treatment of pellagra.
- **Vitamin B₆ (Pyridoxine hydrochloride)** is a water-soluble vitamin and a coenzyme in the metabolism of protein, carbohydrate, and fat. It is most often used during isoniazid (INH) therapy to prevent the development of peripheral neuritis.
- **Vitamin B₁₂ (Cyanocobalamin)** is a water-soluble vitamin that is essential to growth, cell reproduction, and blood cell formation. When vitamin B₁₂ therapy is used to treat pernicious anemia, the treatment is continued indefinitely, and folic acid is normally included in the therapy protocol.
- **Vitamin C (Ascorbic acid)** is a water-soluble vitamin necessary for the prevention and cure of scurvy. Vitamin C in high doses is believed to prevent the common cold, and to treat asthma, atherosclerosis, wounds, schizophrenia, and cancer.
- **Vitamin D** is a fat-soluble vitamin involved in the regulation of calcium and phosphorous metabolism. Vitamin D deficiency leads to rickets in children and osteomalacia in adults.
- **Vitamin E (Tocopherol)** is a fat-soluble vitamin and an antioxidant that prevents the destruction of red blood cells by preventing fatty acids in the red blood cells from taking on too much oxygen. It stimulates the production of an enzyme necessary to cell respiration and protects the cell membrane.
• **Vitamin K** The naturally occurring form of vitamin K is fat-soluble. However, many synthetic forms of vitamin K are water-soluble. Vitamin K is involved in the formation of prothrombin and other blood clotting factors. Deficiency results in an increase in blood clotting time.

General and Local Anesthetics

Generally speaking, anesthesia means “without feeling” and application of the word anesthetic to medication leads to the insensibility to pain.

- **General anesthetics** are usually gaseous or vaporized and are administered by inhalation. Anesthesiology is a highly specialized field and the administration of a general anesthetic should never be undertaken without the supervision of a MO. HMs may be called upon to assist in administering general anesthesia. HMs should become familiar with the most commonly used general anesthetics and their respective properties.

- **Local anesthetics** produce loss of sensation to pain in a specific area or locality of the body, without loss of consciousness or mental capacity. The majority of these medications are administered parenterally or topically.

- **Nitrous Oxide** commonly called laughing gas and is used with oxygen in general anesthesia. It may produce a condition during which the patient may laugh and become quite talkative. It is commonly used in dentistry or as a preinduction agent to other general anesthesia.

  CAUTION: High concentrations of nitrous oxide may cause cyanosis and asphyxia.

- **Halothane (Fluothane®)** is used for inhalation anesthesia in most operative procedures with patients of all ages. It is nonflammable and non-explosive. It is contraindicated in obstetrics or in patients with hepatic dysfunction.

- **Ketamine Hydrochloride (Ketalar®)** is a fast acting general anesthetic agent used as a preinduction agent or for procedures that do not require skeletal muscle relaxation. One significant effect of this agent is that when the patient begins to recover from the drug, they might experience psychological manifestations ranging from pleasant dream-like states to hallucinations to delirium accompanied by confusion and irrational behavior. The effects of these manifestations may be minimized by keeping aural and tactile stimuli to a minimum. It is contraindicated for patients with hypertensive disease.

- **Fentanyl and droperidol (Innovar®)** Fentanyl and droperidol are a combination of a narcotic (fentanyl) and a tranquilizer (droperidol). Because of the self-potentiating combination, the combination must be used with extreme caution in patients with any respiratory problems.

- **Procaine hydrochloride (Novocain®)** Administered only by injection, it may be used for many types of anesthesia, including spinal anesthesia. It is available in various solutions for injection.

- **Lidocaine hydrochloride (Xylocaine®)** is the standard to which all other anesthetics are compared. It may be combined with epinephrine for vasoconstrictive effects. Lidocaine is also used to treat myocardial infarctions to prevent or suppress preventricular contractions.

  CAUTION: Total dosage injected in 24 hours should not exceed 0.05 g per patient when used with epinephrine.

- **Dibucaine (Nupercainal®)** is used as a topical local anesthetic on mucous membranes and may also be administered parenterally.

- **Proparacaine (Ophthectic®, Ophthaine®)** is a local ophthalmic anesthetic used topically. It is suited for almost every ophthalmic procedure. Proparacaine is fairly long lasting.
Oxytocics

Oxytocics are medications that produce a rhythmic contraction of the uterus. Although their action is selective for the uterus, other smooth muscles are affected.

- **Ergonovine maleate (Ergotrate® Maleate)** is used in the treatment of postpartum and post-abortal hemorrhage.

- **Oxytocin (Pitocin®)** is indicated for the initiation or improvement of uterine contractions or to control postpartum hemorrhage.

Immunizations

The chief purpose served by these preparations in the Navy is the immunization of personnel against infectious disease. They may, however, be used in the treatment of disease or act in a diagnostic capacity. Dosage and routes of administration are described in the package insert. Refer to BUMEDINST 6230.15 series, Immunizations and Chemoprophylaxis for more information.

Immunizing and chemoprophylaxis agents are stored, shipped, and handled in accordance with the pharmaceutical manufacturers’ instructions as outlined in the product’s package insert or other guidance.

The following is a descriptive list of the most common immunizing agents used by the U.S. armed forces to inoculate military personnel against disease.

- **Anthrax** immunization is administered to prevent anthrax infection by any route of exposure due to spores or the bacteria *Bacillus anthracis*. Inhalational anthrax is almost uniformly fatal once symptoms develop.

- **Hepatitis A** vaccine is given to prevent hepatitis A, an acute infection of the liver, acquired by consuming food or water contaminated with hepatitis A virus during deployment or travel to areas with poor food, water, and sewage sanitation. Hepatitis A is endemic worldwide.

- **Hepatitis B** vaccine is given to prevent hepatitis B, an acute or potentially chronic infection of the liver that is acquired through percutaneous, sexual, and other permucosal exposure to blood and body fluids from people infected with hepatitis B virus. Hepatitis B infections occur worldwide, and some infected people maintain a chronic carrier state.

- **Influenza A and B** vaccine is used to prevent influenza A and B, which are acute febrile respiratory viral infections that can cause epidemics within military populations, especially under conditions of crowding, such as initial entry training, aboard ship, extended air transport, or deployment settings.

- **Measles, mumps, and rubella (MMR)** vaccine is indicated to prevent Measles, mumps, and rubella, primarily by boosting immunity acquired from childhood immunization. These 3 acute viral infections are spread by the respiratory route or person–to–person contact. In military trainee populations, each can cause disease outbreaks. Rubella usually causes a mild infection, but infection during the first trimester of pregnancy puts the fetus at high risk of congenital rubella syndrome and birth defects. Young adults may experience more severe complications from mumps infection. All 3 diseases occur worldwide, primarily among children.

- **Smallpox vaccine** In 1980, the World Health Organization (WHO) declared the global eradication of naturally occurring smallpox. Stocks of variola virus, the causative agent of smallpox, could be used as a biological warfare agent. Designated military personnel are vaccinated according to DOD policy and Service–specific implementation plans.
Tetanus, diphtheria, and pertussis is indicated to prevent tetanus, diphtheria, and pertussis, primarily by boosting immunity acquired from childhood immunization. Tetanus is an acute illness caused by an exotoxin of *Clostridium tetani*, bacteria that grows at the site of wounds contaminated with its spores. The *C. tetani* spores are ubiquitous in the environment worldwide. Diphtheria is an acute disease caused by a cytotoxin of the bacteria *Corynebacterium diphtheriae*. Diphtheria occurs worldwide. Pertussis is an acute illness caused by the bacteria *Bordetella pertussis*. Available vaccines include bivalent tetanus–diphtheria (Td) toxoids and Td combined with acellular pertussis (Tdap) antigens. The Tdap is preferred so that people vaccinated sustain immunity to pertussis.

Yellow fever is administered to prevent yellow fever, a mosquito-borne viral disease, and to meet international health requirements during deployment or travel to yellow–fever–endemic areas.

NOTE:
Always refer to the most recent BUMED instruction for current immunization requirements.

PHARMACY CALCULATIONS

LEARNING OBJECTIVES:

*Identify the various pharmaceutical weight and measurement system.*

*Recognize medication dosage by using the conversion process or the percentage and ratio calculations.*

This section will provide the HM with a basic introduction to the field of pharmacy and help in preparing for these responsibilities.

METROLOGY AND CALCULATION

Metrology, called the arithmetic of pharmacy, is the study and science of weights and measures. The use of metrology in pharmacy applies to medications, their dosage, preparation, compounding, and dispensing. It is absolutely vital for HMs to thoroughly understand the principles and applications of metrology in pharmacy. Errors in this area may endanger the health and even the life of the patient.

THE METRIC SYSTEM OR INTERNATIONAL SYSTEM OF UNITS (SI)

The Metric System, also called the International System of Units (SI), is the official system of weights and measures used by Navy Pharmacy Departments for weighing and calculating pharmaceutical preparations. The Metric System is becoming the accepted system throughout the world. HMs need to be concerned primarily with the divisions of weight, volume, and linear measurement of the metric system. Each of these divisions has a primary or basic unit and is listed below:

- Basic unit of weight is the *gram*, abbreviated "g"
- Basic unit of volume is the *liter*, abbreviated "l"
- Basic linear unit is the *meter*, abbreviated "m"

By using the prefixes *deka*, *hecto*, and *kilo* for multiples of, ten, one hundred, and one thousand, respectively, and the prefixes *micro*, *milli*, *centi*, and *deci* for one-tenth thousandth, one- thousandth, one-hundredth, and one-tenth, respectively, makes up the basic structure of the Metric System.
By applying the appropriate basic unit to the scale of Figure 18-1, the HM can readily determine its proper terms. For example, using the gram as the basic unit of weight, the HM can readily see that 10 g equals 1 dekagram; 100 g equals 1 hectogram; and 1000 g is referred to as a kilogram. Conversely, going down the scale, 0.1 g is referred to as a decigram, 0.01 g is called a centigram, and 0.001 g is a milligram.

The following are select guidelines for the correct use of the metric system from the U.S. Metric Association, with additional considerations relevant to the practice of pharmacy.19

- Unit names and symbols are generally not capitalized except when used at the beginning of a sentence or in headings. However, the symbol for liter (L) may be capitalized or not. Examples: 4 L or 4 l, 4 mg and 4 g.
- Periods are not used following metric symbols except at the end of a sentence. Examples: 4 mL and 4 g, not 4 mL. and 4 g.
- Symbols should not be combined with spelled-out terms in the same expression. Example: 3 mg/mL, not 3 mg/milliliter.
- A zero should be placed in front of a leading decimal point to prevent medication errors caused by uncertain decimal points. Example: 0.5 g, not .5 g.

NOTE:
It is critically important to recognize that a misplaced or misread decimal point can lead to an error in calculation or dispensing of a minimum of one tenth or ten times the desired quantity.

- To prevent misreading and medication errors, “trailing” zeros should not be placed following a whole number on prescriptions or medication orders. Example: 5 mg, not 5.0 mg. Exceptions: A “trailing zero” may be used only where required to demonstrate the level of precision of the value being reported, such as for laboratory results, imaging studies that report size of lesions, or catheter/tube sizes. It may not be used in medication orders or other medication-related documentation.

OTHER SYSTEMS OF MEASUREMENT

In addition to the metric system, the HM should be aware of two other systems of measurement: the avoirdupois and apothecaries’ systems.

The Apothecaries’ System

Although fast becoming obsolete, is a system for weighing and calculating pharmaceutical preparations. It is still used and must be taken into consideration. It has two divisions of measurement: weight and volume. In the Apothecaries’ system, the basic unit of weight is the grain ("gr"), and the basic unit of volume is the minim ("m").
The Avoirdupois System

A system used in the United States for ordinary commodities. The basic units of the avoirdupois system are dram (27.344 grains), ounce (16 drams), and pound (16 ounces).

<table>
<thead>
<tr>
<th>Systems of Weights</th>
<th>Systems of Volume Measures</th>
<th>Linear Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AVOIRDUPOIS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary unit of weight is the grain.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>437.5 grains      = 1 ounce (av. oz.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.0 ounces       = 1 pound (av. lb.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>APOTHECARY</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary unit of weight is the grain.</td>
<td>Smallest unit of volume is the minim.</td>
<td></td>
</tr>
<tr>
<td>20 grains (gr)    = 1 scruple (ʒ)</td>
<td>60 minims (m) = 1 fluid dram (ʒ)</td>
<td></td>
</tr>
<tr>
<td>3 scruples        = 1 dram (j)</td>
<td>8 fluid drams = 1 fluid ounce (j)</td>
<td></td>
</tr>
<tr>
<td>8 drams           = 1 ounce (ʒ)</td>
<td>16 fluid ounces = 1 pint (j)</td>
<td></td>
</tr>
<tr>
<td>(480 gr)          = 1 ounce (ʒ)</td>
<td>2 pints = 1 quart (qt.)</td>
<td></td>
</tr>
<tr>
<td>12 ounces         = 1 pound (lb)</td>
<td>4 quarts = 1 gallon (Cong. or gal.)</td>
<td></td>
</tr>
<tr>
<td><strong>METRIC</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary unit of weight is the gram.</td>
<td>Primary unit of volume is the liter.</td>
<td>Primary unit of linear measure is the meter.</td>
</tr>
<tr>
<td>1000.000 grams = 1 kilogram (kg)</td>
<td>1000.000 liters = 1 kiloliter (kl)</td>
<td>1000.000 meters = 1 kilometer (km)</td>
</tr>
<tr>
<td>100.000 grams = 1 hectogram (hg)</td>
<td>100.000 liters = 1 hectoliter (hl)</td>
<td>100.000 meters = 1 hectometer (hm)</td>
</tr>
<tr>
<td>10.000 grams = 1 dekagram (dkg)</td>
<td>10.000 liters = 1 dekaliter (dl)</td>
<td>10.000 meters = 1 dekameter (dkm)</td>
</tr>
<tr>
<td>1.000 gram = 1 gram (gm)</td>
<td>1.000 liter = 1 liter (l)</td>
<td>1.000 meter = 1 meter (m)</td>
</tr>
<tr>
<td>0.1 gram = 1 decigram (dg)</td>
<td>0.1 liter = 1 deciliter (dcl)</td>
<td>0.1 meter = 1 decimeter (dm)</td>
</tr>
<tr>
<td>0.01 gram = 1 centigram (cg)</td>
<td>0.01 liter = 1 centiliter (ccl)</td>
<td>0.01 meter = 1 centimeter (cm)</td>
</tr>
<tr>
<td>0.001 gram = 1 milligram (mg)</td>
<td>0.001 liter = 1 milliliter (mcl)</td>
<td>0.001 meter = 1 millimeter (mm)</td>
</tr>
</tbody>
</table>

NOTE: The relationship of the basic units in the Metric System should be noted. The meter, which is 1/40,000,000 of the earth’s polar circumference, is the natural standard. The volume contained in 1/10 of a meter cubed is 1 liter. The weight of 1 cubic centimeter of distilled water is 1 gram. Grams of water are approximately equivalent at all temperature ranges. Current usage prefers that ml rather than cc be used since it has been found that 1000 cc do not equal exactly 1 liter.

Table 18-1.—Table of Metric Doses with Approximate Equivalents
CONVERTING WEIGHTS AND MEASURES

There are times when it will be necessary to convert weights and measures from one system to another, either metric to apothecary or vice versa. Patients are not expected to be familiar with either system. Therefore, the HM must always translate the dosage directions on the prescription into terms the patient can easily understand. Household measurements are standardized on the assumption that the utensils are common enough to be found in any home. Table 18-2 is a table of household measures, with their metric and apothecary equivalents.

CAUTION:
Exact equivalents must be used when converting specific quantities in a prescription and when converting a pharmaceutical formula from one system to another.

When quantities in units of the apothecaries or avoirdupois systems are encountered they should be converted to equivalent quantities in metric units.

The required calculation should then be solved in the usual manner.

Conversion

In the practice of pharmacy, it may be necessary to convert from one system to another in order to dispense the proper amounts of medications that have been ordered. Although the denominations of the metric system are not the same as the other systems, the Bureau of International Standards has established conversion standards that will satisfy the degree of accuracy required in almost any practical situation. Ordinary pharmaceutical procedures generally require something between two- and three-figure accuracy, and the following tables of conversion (Tables 18-2 and 18-3) are more than sufficient for practical use. Table 18-4 provides examples of conversions. If potent agents are involved, the HM must use a more precise conversion factor for purposes of calculation.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Apothecary</th>
<th>Household</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 ml</td>
<td>1 fl dr</td>
<td>1 teaspoonful*</td>
</tr>
<tr>
<td>10 ml</td>
<td>2 fl dr</td>
<td>1 dessertspoonful</td>
</tr>
<tr>
<td>15 ml</td>
<td>4 fl dr</td>
<td>1 tablespoonful (½ fl oz)</td>
</tr>
<tr>
<td>30 ml</td>
<td>8 fl dr</td>
<td>2 tablespoons (1 fl oz)</td>
</tr>
<tr>
<td>60 ml</td>
<td>2 fl oz</td>
<td>1 wineglassful</td>
</tr>
<tr>
<td>120 ml</td>
<td>4 fl oz</td>
<td>1 teacupful</td>
</tr>
<tr>
<td>240 ml</td>
<td>8 fl oz</td>
<td>1 tumblerful</td>
</tr>
<tr>
<td>480 ml</td>
<td>16 fl oz</td>
<td>1 pint</td>
</tr>
<tr>
<td>960 ml</td>
<td>32 fl oz</td>
<td>1 quart</td>
</tr>
</tbody>
</table>

*Official U.S.P. teaspoonful is 5 ml.

Table 18-2.—Household Measurements with Metric and Apothecary Equivalents.

Conversion Table for Weights and Liquid Measures

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 grain = 0.065 gram or 65 milligrams</td>
<td></td>
</tr>
<tr>
<td>1 gram = 15.432 grains</td>
<td></td>
</tr>
<tr>
<td>1 milliliter = 16.23 minims</td>
<td></td>
</tr>
<tr>
<td>1 fluid ounce = 29.57 milliliters</td>
<td></td>
</tr>
</tbody>
</table>

Table 18-3.—Conversion Table for Weights and Liquid Measurements
PERCENTAGE CALCULATIONS

Percentage means "parts per hundred" or the expression of fractions with denominators of 100. Thus, a 10 percent solution may be expressed as 10%, 10/100, 0.10, or 10 parts per 100 parts.

It is necessary for the Pharmacist to compound solutions of desired percentage strength. Percentage in that respect means parts of active ingredient per 100 parts of total preparation.

<table>
<thead>
<tr>
<th>Examples of Weight and Liquid Conversions</th>
</tr>
</thead>
<tbody>
<tr>
<td>gr to g</td>
</tr>
<tr>
<td>ml to fl oz</td>
</tr>
<tr>
<td>minim to ml</td>
</tr>
<tr>
<td>mg to gr</td>
</tr>
<tr>
<td>g to gr</td>
</tr>
<tr>
<td>fl oz to ml</td>
</tr>
<tr>
<td>ml to minim</td>
</tr>
<tr>
<td>gr to mg</td>
</tr>
</tbody>
</table>

Table 18-4.—Examples of Weight and Liquid Conversions

SOLVING PERCENTAGE PROBLEMS

A popular method for solving percentage problems is illustrated below. This method is often preferred since it eliminates errors that may result from misinterpreting the values given in the problem.

\[
\% \text{ strength} = \frac{\text{Amount of active ingredient} \times 100(\%)}{\text{Total amount of preparation}}
\]

Example #1: Calculate the percent of A in a solution if 120 g of that solution contains 6 g of A.

Solution: Substitute the known values in the equation and use X for the percent (the unknown factor).

\[
X = \frac{6}{120} \times 100(\%) = 5 \ (%)
\]

Therefore, X = 5, which is the percent strength of the solution.

A variation of the alternate percentage equation, illustrated below, uses "parts per hundred " instead of percent, with X used as the unknown.

\[
\frac{\text{Amt of active ingredient}}{\text{Amt of total preparation mixture}} = \frac{\text{Parts of active ingredient}}{100 \text{ parts (total mixture)}}
\]

RATIO AND PROPORTION CALCULATIONS

Ratio is the relationship of one quantity to another quantity of like value. Example ratios are 5:2, 4:1. These ratios are expressed as "5 to 2" and "4 to 1" respectively. Ratios can also be written as a fraction with the first term as the numerator and the second term as the denominator. A ratio can exist only between values of the same kind, as the ratio of percent to percent, grams to grams, dollars to dollars. In other words, the denominator must be constant.
**Proportion** is the expression of equality of two ratios. It may be written in any one of the following three standard forms:

- \( a:b = c:d \)
- \( a:b :: c:d \)
- \( \frac{a}{b} = \frac{c}{d} \)

Each of these expressions is read: \( a \) is to \( b \) as \( c \) is to \( d \), and \( a \) and \( d \) are called the *extremes* (meaning “outer members”) and \( b \) and \( c \) the *means* (“middle members”).

**Application of Proportion**

In any proportion, *the product of the extremes is equal to the product of the means*. This principle assists the HM to find the missing term in any proportion when the other three terms are known. If the missing term is a *mean*, it will be *the product of the extremes divided by the given mean*, and if it is an *extreme*, it will be *the product of the means divided by the given extreme*.

The important factor when working proportions is to put the right values in the right places within the proportion. If the proportion is set up properly, the position of the unknown term does not matter. By following a few basic rules, the HM can accomplish this without difficulty and solve the problem correctly.

When solving calculations that relate to medication products, assess the information provided and write out the first fraction using the “given” information, usually the strength or dosage provided on the stock bottle. This is usually the dose in milligrams over the volume needed to represent one dose. For example, if the HM has a product that is 10 mg/ml, this means that there are 10 mg of active ingredient in each milliliter. This is the same as 10 mg / 1 ml.

The second fraction contains the unknown, represented by \( x \), and the other element provided in the problem.

To find out how many milligrams are in 10 mL, set up the following ratio and proportion.

\[
\frac{10 \text{ mg}}{1 \text{ ml}} = \frac{x \text{ mg}}{10 \text{ ml}}
\]

The key to setting up ratio and proportions is to keep like units consistent. If the first fraction is stated as mg/ml, the second fraction should be stated the same way. Doing this will enable the HM to solve the equation and identify the answer using the correct units. The HM must be aware of which units are needed for the final answer, such as milligrams, milliliters, and liters.

**Example:** Medication B is supplied as 15 mg / ml. How many milliliters of medication B are required to provide a patient with a 20 milligram dose?

Set up the first fraction with the given information, 15 mg / ml. The second fraction is set up in the same manner, mg / ml.

\[
\frac{15 \text{ mg}}{1 \text{ ml}} = \frac{20 \text{ mg}}{x \text{ ml}}
\]

Multiply the means \((20 \times 1)\) and divide by the extremes \((15)\).

\[
(20 \times 1) / 15 = 1.33 \text{ ml}
\]

**PHARMACEUTICAL PREPARATIONS**

**LEARNING OBJECTIVE:**

*Identify the composition and physical characteristics of commonly used pharmaceutical preparations.*

While assigned to a pharmacy in a treatment facility, the HM may be required to make pharmaceutical preparations. The following sections provide information with the composition and physical characteristics of some of these preparations.
ELIXIRS

Elixirs are aromatic, sweetened hydroalcoholic solutions containing medicinal substances. The color of elixirs varies according to the nature of the ingredients; some are artificially colored.

SUSPENSIONS

Suspensions are coarse dispersions comprised of finely divided insoluble material suspended in a liquid medium. To keep the insoluble material suspended, a third agent, called a suspending agent, is required. The process of mixing or combining the ingredients to form a suspension is called reconstitution.

OINTMENTS

Ointments are semisolid, fatty, or oily preparations of medicinal substances. These preparations are of a consistency to be easily applied to the skin and gradually liquefy or melt at body temperature. Ointments vary in color according to their ingredients. The base of an ointment is generally greasy in texture, and the medicinal substances combined with it are always intended to be very fine particles, uniformly distributed.

SUPPOSITORY

Suppositories are solid bodies intended to introduce medicinal substances into the various orifices of the body (rectum, vagina, and urethra). The ingredients are incorporated into a base that melts at body temperature.

CAPSULES

Capsules are gelatin shells containing solid or liquid medicinal substances to be taken orally. A common type of capsule contains medicine in the form of a dry powder that is enclosed in transparent cases made of gelatin.

PHARMACEUTICAL INSTRUMENTS

LEARNING OBJECTIVE:

Identify commonly used pharmaceutical instruments and describe the purpose of each.

In the process of preparing some pharmaceutical preparations, the HM may need to use specialized instruments. The following sections provide commonly used pharmaceutical instruments, a description of each instrument, and an explanation of their purpose. See Figure 18-2 for an illustration of each instrument discussed.
PHARMACEUTICAL BALANCES

Pharmaceutical balances are used for weighing substances. Two types of pharmaceutical balances are in common use in the Navy: torsion balances and electronic balances. Torsion balances, also called Class A prescription balances, are used for weighing loads from 120 mg to 120 g. All dispensing pharmacies are required to have at least one Class A balance on hand at all times. Most pharmacies now use electronic balances because they provide greater accuracy and are easier to use (Fig. 18-3).

ERLENMEYER FLASK

An Erlenmeyer flask is a glass container with metric measurements inscribed on it. It is used for mixing and measuring various medicinal ingredients.

MORTAR AND PESTLE

A mortar and pestle are used to reduce substances to fine powders. These two items always go together, one being useless without the other. The mortar is a heavy bowl, with one distinct property: the inside concavity is geometrically hemispheric. The accompanying pestle is a hand tool that has a tip made of identical material as the mortar, and its convexity forms a perfect hemisphere. The reason for the two opposing hemispheres is to provide an even grinding surface. Mortars and pestles are made of glass, metal, or unglazed pottery called Wedgwood. Glass is used when triturating (reducing substances to fine particles or powder by rubbing or grinding) very pure products (such as eye ointments), and when the preparations contain stains.

NOTE:

Metal mortars and pestles should never be used when the medications are likely to react with the metals.

SPATULA

A spatula is a knifelike utensil with a rounded, flexible, smoothly ground blade, available in various sizes. The spatula is used to work powders, ointments, and creams in the process of levigation (the rubbing, grinding, or reduction to a fine powder with or without the addition of a liquid) and trituration. It is also used to transfer quantities of medications from their containers to the prescription balance. Spatulas should not be used to pry open cans or as knives for opening boxes. Once the surface is scratched or the edges bent, the spatula is ruined, and it becomes useless for pharmacy work.
GRADUATES

Graduates are conical or cylindrical clear glass containers graduated in specified quantities and used to measure liquids volumetrically. Measuring should always be done at eye level. It is best to select the graduate with a capacity equal to or just exceeding the volume to be measured to ensure the most accurate measurement (Fig. 18-4).

Figure 18-4.—Graduate Conversion
Occasionally, the medications used to improve a patient’s condition may not work in the manner intended. The outcome may be contrary to that which was expected, and, indeed, could even cause harm to the patient. It is important to be aware of symptoms that may indicate a medication is not doing its job properly.

**INCOMPATIBILITIES**

There are instances when a medication used simultaneously with another medication or substance does not perform as intended. These medications or substances may be incompatible together and should not be administered at the same time. A medication incompatibility can also occur when medications are compounded together in the pharmacy. There are three classes of medication incompatibilities: therapeutic, physical, and chemical.

**Therapeutic Incompatibilities**

Therapeutic incompatibilities occur when agents antagonistic to one another are prescribed together. Such circumstances seldom occur, but when they do, the HM should bring the perceived incompatibility to the attention of the physician. The pharmaceutical agents may have been used together for one agent to modify the activity of the other. The physician will verify the prescription as necessary.

**Physical Incompatibilities**

Physical incompatibilities are often called pharmaceutical incompatibilities and are evidenced by the failure of the medications to combine properly. It is virtually impossible for uniform dosages of medicine to be given from such solutions or mixtures. Ingredients such as oil and water (which are physically repellant to each other) and substances that are insoluble in the prescribed vehicle are primary examples of physical incompatibilities.

**Chemical Incompatibilities**

Chemical incompatibilities occur when prescribed agents react chemically upon combination to alter the composition of one or more of the ingredients (constituents).

**Manifestations of Incompatibility**

The following list outlines the various ways incompatibility between or among medication agents may be manifested. The respective type of incompatibility is also noted.

- Insolubility of prescribed agent in vehicle (physical)
- Immiscibility (incapable of being mixed) of two or more liquids (physical)
- Precipitation due to change in a solution that results in decreased solubility (called salting out) (physical)
- Liquification of solids mixed in a dry state, called eutexia (physical)
- Cementation (hardening) of insoluble ingredients in liquid mixtures (physical)
- Evolution or changes in color (chemical)
- Reduction or explosive reaction (called oxidation) (chemical)
- Precipitation due to chemical reaction (chemical)
- Inactivation of sulfa medications by procaine HCl (therapeutic)
It is impossible to eliminate all medication-agent incompatibilities, some combinations may respond to one of the following corrective measures.

- Addition of an ingredient that does not alter the therapeutic value (such as the addition of an ingredient to alter solubility of an agent)
- Omission of an agent that has no therapeutic value or that may be dispensed separately
- Change of an ingredient (e.g., substitution of a soluble form of an ingredient for an equivalent insoluble form)
- Utilization of special techniques in compounding

**CONTRAINDICATION**

Contraindication is any condition which makes a particular treatment or procedure inadvisable. These conditions include, but are not limited to, the disease process and other administered medications.

**ADVERSE MEDICATION REACTIONS**

Adverse medication reactions may occur when a medication, administered in a dose appropriate for human prophylaxis, diagnosis, or therapy, has an unintended and harmful effect on the patient receiving it. HMs must be aware of the possibility of adverse effects of medications so that they can be prevented or at least minimize the impact on the patient.

**MEDICATION INTERACTIONS**

Patients may receive more than one medication at a time (as happens frequently in the case of hospitalized patients). Combining medications may cause the individual medications to have a positive or negative outcome that would not usually occur if the medications were administered separately. Such interactions may affect the intensity of a medication’s response, the duration of its effect, and side effects that may occur. As stated above, medication interactions can be positive as well as negative, and two or more medications are often administered to achieve a greater therapeutic effect.

**INFORMATION CONCERNING MEDICATION CONTRAINDICATIONS, ADVERSE REACTIONS, AND INTERACTIONS**

Descriptions of medication contraindications, adverse reactions, and interactions may be found in several publications, most notably the *Drug Facts and Comparisons*. However, the most important location for finding this information is the manufacturer's package insert and associated literature that accompanies each medication.

**PRESCRIPTIONS**

**LEARNING OBJECTIVES:**

*Identify the parts of a prescription and authorized prescribers.*

*Identify how prescriptions are written, filled, verified, labeled, and filed.*

The most important tool used by the pharmacy is the prescription. A prescription is a written or computerized order from a Healthcare Provider (prescriber) directing the pharmacy to compound and dispense a medication for a patient to use.
Of special importance is understanding and conformance to the following protocols:

- All information pertaining to a prescription is confidential and should not be divulged to any persons not specifically involved in the treatment.
- No prescription or any of its parts may be applied to or transferred to any person other than the patient specified.

To fill a prescription correctly, the HM must thoroughly understand the prescription writing and filling process. Because regulations and policies governing pharmacies sometimes change, it is important for to be familiar with pharmacy policies in the Manual of the Medical Department (MANMED), NAVMED P-117. Chapter 21 of the MANMED is the basic guide to pharmacy operations.

### Parts of the Prescription

Currently, there are two standardized forms used for prescriptions: the DoD Prescription, DD Form 1289 (Fig. 18-5) and the Polyprescription, NAVMED 6710/6 (Fig. 18-6). Information placed on these forms must be either typewritten or legibly handwritten in ink or indelible pencil. In addition to these two forms, many of today’s treatment facilities now have automated pharmacy systems that allow healthcare providers to enter prescription orders into computers in their offices instead of handwriting prescriptions. Prescriptions, written or computerized, have, for the most part, the same information requirements. The only major difference is that automated prescriptions do not require the prescriber’s signature (they are completed electronically).

The DD 1289 is used extensively for outpatient prescriptions. The DD 1289 will contain only one medication order. All controlled medications should be written on the DD 1289. The Polyprescription is available for up to four prescriptions for one patient to be written together. If a controlled medication must be written on a polyprescription due to unavailability of a DD 1289, it must be the only medication prescribed on that form. See Figure 18-5 for examples of specific block entries.
Figure 18-5.—DOD Prescription Form

Figure 18-6.—Polyprescription Form

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Patient Information Block

In the patient information block, located at the top of the DD 1289, the patient’s full name and date of birth are required. At most treatment facilities additional patient information is added to this block. This additional information may include the patient’s duty station; social security number with family member prefix; rate; and branch of service.

Medical Facility and Date Block

The treatment facility block, located below the patient information block, should contain the name of the treatment facility where the prescription was written. Completion of this block is important if the source of the prescription needs to be traced.

The date block, located to the right of the treatment facility block, should contain the date in which the prescription was written.

Prescription Block

The large block in the center of the DD 1289 is the prescription block. It contains four parts: the superscription, the inscription, the subscription, and the signa.

SUPERSRIPTION.—The superscription "Rx" means "take" or "take thou" or, in effect, "I want this patient to have the following medication."

INSCRIPTION.— The inscription is that part of the prescription that lists the name and quantity of the medication to be used. This part of the prescription is of greatest importance, since the spelling of many unrelated medications is similar. Whenever there is doubt as to the medication or the amount listed in the inscription, the individual filling the prescription should always verify the inscription with the prescriber.

NOTE:
The medication should be written generically, and the dosage size or strength written metrically.

SUBSCRIPTION.—The subscription follows the inscription and is that part of the prescription that gives directions to the compounder.

SIGNA.—The signa, not to be confused with the prescriber’s signature, is the part of the prescription that gives the directions for the patient. This portion is preceded by the abbreviation “Sig.”

Prescriber Signature Block

Finally, the prescriber signature block, located at the bottom of the form, must contain a legible signature of the prescriber, as well as the prescriber's full name, rank, corps, and service, stamped, typed, or hand-printed. Mimeographed, preprinted, or rubber-stamped prescriptions may be used, but signatures must be original and in the handwriting of the prescriber. Facsimiles are not acceptable.

AUTHORIZED PRESCRIBERS

Prescriptions from treatment facilities and DoD authorized providers for formulary drugs will be honored. Authorized prescribers may include: Medical and Dental Corps Officers, Optometrists, Physician Assistants, Pharmacists, Physical Therapists, Podiatrists, Nurse Practitioners (Certified Nurse Anesthetists, Nurse Midwives, Women’s Health Nurse Practitioners, Family and Pediatric Nurse Practitioners), Veterinarians (when prescribing medications for military working animals), or civilian Physicians employed by the Navy or the Military Health System.
Authorized prescribers also include Navy Independent Duty Hospital Corpsmen (IDC) personnel authorized in Section IV of MANMED Chapter 21, and others authorized in writing by the Commanding Officer (CO) (or delegated representative) to prescribe in their official capacities and defined by the treatment facilities’ Professional Affairs office.

Prescriptions written by civilian prescribers, other than those employed by the Navy, may be filled for authorized beneficiaries, at treatment facilities with a licensed Pharmacist assigned, provided the prescribed item is on the treatment facility’s formulary (a published listing of medications) and the prescribed quantity is within limitations established by the command.

With the exception of the polyprescription, prescriptions are limited to one item per prescription. The quantity of the medication prescribed should be a reasonable amount needed by the patient. Excessive or unrealistic quantities should not be prescribed. Erasures on prescriptions are prohibited, and interlineations (information inserted between lines of writing) must be initialed.

Persons authorized to prescribe cannot write prescriptions for themselves or members of their immediate families.

FILLING PRESCRIPTIONS

When receiving a prescription for filling, certain basic steps must be followed to make sure that the correct patient receives the correct medicine in the correct amount in the correct way.

Prescription Verification

Verify that the prescription received is a bonafide one and the patient providing the prescription is entitled to have it filled by the pharmacy. Be thorough with the verification process due to high abuse and fraud potential. The simplest and best way is to ask for an ID card to verify the name and expiration date on the ID card.

Review the prescription carefully and make sure that the medication prescribed is reasonable; that its amount or dosage is realistic in consideration of the patient's age and that the quantity of the medication is practical. A prescription calling for 1,000 tetracycline tablets or a pint of Ipecac®, for example, warrants further inquiry.

If, in the process of verification, it is believed that there is a discrepancy, an ambiguity, an incompatibility, or for any reason; the HM must consult the prescriber. Be careful to never allow the patient to suspect that anything is amiss. Never fill a prescription that is not completely understood or appears incorrect. What appears to be an overdose may be the desired dose for a specific patient; the prescriber will appreciate being called for verification.

When the HM understands the prescription and is satisfied that it is correct, it is filled. Most mistakes are made when the person filling the prescription is either interrupted while doing so or is trying to accomplish more than one task at a time.

During the process of filling a prescription, the label on the containers used in filling the prescription should be verified at least three times. Initially, the label should be read when the container is taken from the shelf. Then it should be read again when the contents are removed from the container. The container’s label should be read before it is returned to the shelf. By following these three verification steps for each prescription filled, there is a reduction in the possibility of making a prescription error.
Prescription Labeling

Proper labeling of a prescription is as important as filling it correctly. It is reasonable to assume that if a great deal of accuracy is necessary to properly compound a prescription, it is just as important that the patient take the correct amount of medication in the right manner to receive its maximum benefits. Improperly written or misunderstood directions on a prescription label can be disastrous. Make sure all labels are typed clearly and their directions translated into simple layman’s language. Keep in mind that the prescription label serves two purposes. First, it gives the patient directions pertaining to the medication. Second, in case of misuse or error, it is the quickest means by which the contents of the prescription container, the person who wrote the prescription, and the person who filled it can be traced. The following information, illustrated in Figure 18-7, should always be on the label:

- The name and phone number of the dispensing facility
- A serialized number that corresponds with the number on the prescription form.
- The date the prescription is filled
- The patient’s name
- The directions to the patient, transcribed accurately from the prescription, in clear, concise layman’s language
- The prescriber’s name and rate or rank
- The initials of the compounder
- Authorized refills, if any
- The expiration date, if applicable
- Name, strength, and quantity of medication dispensed

**NOTE:**
Pharmaceutical preparations should be identified and labeled with the generic name. However, trade or brand names may be used if the trade or brand name is actually on the container.

**Figure 18-7.—Prescription Label**

Other information that may need to be attached to the prescription container are labels that read "Shake Well Before Using" or "For External Use Only." "Poison" labels should be omitted when a preparation is intended for external use, as many physicians prefer the "For External Use Only" labels.

After the prescription is labeled, check the ingredients again by some systematic method to ensure accuracy.

As an added precaution and to aid expeditious identification of medications in case of undesirable effects, note the manufacturer and the lot number of the proprietary medication dispensed on the prescription form (see Figs. 18-5 and 18-6). This procedure, however, does not apply to medications consisting of a mixture of several ingredients. The initials or the code of the person filling the prescription must also be written on the prescription form (see Fig. 18-5 and 18-6).
Filling Prescriptions

Prescriptions that have been filled must be maintained in one of three separate files:

- **Schedule II (narcotics):** Prescriptions containing narcotics are numbered consecutively, preceded by the letter "N", and filed separately
- **Schedule III, IV, and V (controlled medications):** These prescriptions are numbered consecutively, preceded by the letter “C” and filed separately
- **General files:** All other prescriptions are numbered consecutively and filed together

Currently, prescriptions are required to be kept on file for at least 2 years after the date of issue.

REGULATIONS AND RESPONSIBILITIES PERTAINING TO CONTROLLED SUBSTANCES, ALCOHOL, AND DANGEROUS MEDICATIONS

**LEARNING OBJECTIVES:**

- Identify HM responsibilities and accountability pertaining to controlled substances.
- Identify controlled substance schedules.
- Identify controlled substance security, custody, inventory, and survey procedures.

HMs who handle controlled substances and other medications are held responsible for the proper distribution and custody of those substances and medications. Nowhere is the demand for strict integrity more important. Misuse, abuse, loss, and theft of these substances have always, sooner or later, ended in tragedy and severe consequences. No one has ever profited by their misappropriation.

Every HM must understand the responsibility concerning the custody and handling of controlled substances and other medications and to be familiar with the regulations and laws.

**RESPONSIBILITY**

The MANMED specifically assigns custodial responsibility for controlled substances to a Commissioned Officer. The HM has the responsibilities of administering and securing them properly. All controlled substances and other medications are to be kept under lock and key. Neither keys nor medications should ever be entrusted to a patient.

**ACCOUNTABILITY**

HMs are held accountable for medications entrusted to them. Great care should be exercised to prevent the loss or unauthorized use of medications. No medication should be administered without proper authority. In addition, U.S. Navy Regulations forbid the introduction, possession, use, sale, or other transfer of marijuana, narcotic substances, or other controlled substances.

**CONTROLLED SUBSTANCE SCHEDULES**

Controlled substances and medications require special handling and security measures. The Controlled Substance Act of 1970 established five schedules (categories) related to a medication's potential for abuse, medical usefulness, and degree of dependency, if abused.

Controlled substances may migrate between schedules, and new products may be added. In addition, local commands may designate certain drugs having abuse potential and require security measures similar to those for controlled substances. The CO will establish special security and accounting procedures for these command-sensitive items designated as “Locally Controlled Substances.”
Schedule I

Substances that have high abuse potential and no accepted medical use. Examples include heroin, marijuana, and LSD.

Schedule II

Substances that have high abuse potential and severe psychological and/or physical dependence liability. Examples include narcotics, amphetamines, and barbiturates. Prescriptions for schedule II substances can never be ordered with refills and in most cases must be filled within 7 days of the date originally written. See MANMED Chapter 21 for further information.

Schedule III

Substances that have less abuse potential than schedule II substances and moderate dependence liability. Examples include nonbarbiturate sedatives, nonamphetamine stimulants, and medications that contain a limited quantity of certain narcotics. Prescriptions must be filled within 30 days of the date written and may be refilled up to five times within 6 months.

Schedule IV

Substances that have less abuse potential than schedule III substances and limited dependence liability. Prescriptions must be filled within 30 days of the date written and may be refilled up to five times within a 6-month period.

Schedule V

Substances that have limited abuse potential. Schedule V substances are primarily antitussives or antidiarrheals. Prescriptions must be filled within 30 days of the date written and may be refilled up to five times within 6 months.

SECURITY AND CUSTODY OF CONTROLLED SUBSTANCES

Schedule I and II controlled substances require vault or safe storage and inventory by the Controlled Substance Inventory Board (discussed in more detail in the section entitled "Inventory of Controlled Substances"). Working stock may be kept in a locked area within the pharmacy. A copy of the safe combination must be kept in a sealed envelope on file with the CO or representative.

Schedule III, IV, and V controlled substances require locked cabinet security for storage of bulk medications. A minimum amount of working stock may be dispersed among other pharmacy stock, provided the pharmacy stock itself is secure. Otherwise, all stock in this category must be kept in locked cabinets.

Custodial responsibility for controlled substances at treatment facilities is entrusted to a Commissioned Officer or a civilian Pharmacist who is appointed in writing by the CO. At remote Branch Health Clinics that do not have a Commissioned Officer or a civilian Pharmacist, the CO will designate, in writing a member of the branch clinic as custodian. On board large naval vessels, the CO will appoint an officer of the Medical Department or another officer, in writing, as the bulk custodian.

This officer will be responsible for, and maintain custody of, all bulk controlled substances. On board smaller naval vessels, access to controlled substances is limited to the bulk custodian and the Senior Medical Department Representative (SMDR). Only individuals whose official duties require access to such spaces are provided the safe combinations.
INVENTORY OF CONTROLLED SUBSTANCES

Quarterly, or more frequently if necessary, the Controlled Substances Inventory Board (CSIB) takes an unannounced inventory of controlled substances.

**NOTE:**
An exception to this frequency may be made for ships with an Independent Duty Corpsman. On these ships, the inventory may be conducted on a quarterly basis if there have been no transactions of controlled substances (including filled prescriptions or receipts of items requisitioned from supply).

The CO appoints the members of the CSIB in writing. The board consists of three members, at least one of whom is a Commissioned Officer. After the board conducts the inventory, it submits a report to the CO. The officer having custodial responsibility cannot be a member of the board. On small ships and installations, the SMDR may be a board member. For further guidance on controlled substance inventory procedures, refer to MANMED Chapter 21 *Pharmacy Operation and Drug Control* and BUMEDINST 6710.70 series.

SURVEY OF CONTROLLED SUBSTANCES

Schedule I and II controlled substances and locally controlled medications that have become outdated, deteriorated to the point of not being usable, are of questionable purity or potency, or have had their identity compromised, must be reported to the CO. If destruction is indicated and directed by the CO, destruction must be accomplished in the presence of a member of the CSIB. A certification of destruction form contains the complete nomenclature and quantity of the substances to be destroyed together with the method of destruction to be used.

After certification is completed, approved by the CO, and signed by the members witnessing the destruction, the certification of destruction is retained and filed as required by current instructions. The destroyed substances should then be removed from the stock records and the controlled substance log.

**SUMMARY**

Inpatients and the majority of outpatients will receive pharmaceutical products as part of the treatment. As a healthcare provider administering these products or filling prescriptions, it is crucial to have a good foundation of knowledge in pharmacology, toxicology, and the proper handling of prescriptions and controlled substances. This chapter provided a review of these topics to assist in the duties. Always consult the recommended publications, such as the *Manual of the Medical Department, Drug Facts and Comparisons*, and the *Drug Information Handbook*, to provide the guidance and knowledge needed to provide the best possible care for patients.
CHAPTER 19

CLINICAL LABORATORY

INTRODUCTION

A basic knowledge of clinical procedures is critical for the Hospital Corpsmen (HM), particularly those working at small dispensaries and isolated duty stations without the supervision of a Medical Officer. Clinical laboratory results aid health care providers to make accurate and timely diagnoses and treatment plans for their patients.

This chapter will outline laboratory administrative responsibilities, ethics in the laboratory, the microscope, blood collection techniques, the complete blood count, and urinalysis. Additional information includes a basic understanding of bacteriology, serology, operational readiness, and the Walking Blood Bank.

THE HOSPITAL CORPSMAN AND THE CLINICAL LABORATORY

LEARNING OBJECTIVE:

Explain clinical laboratory administrative procedures and ethics policy.

The HM is not expected to make a diagnosis from test findings or to institute definitive treatment based upon them. The availability of various communication methods aids the HM in giving a clearer clinical picture to the provider. This chapter is not intended to replace laboratory manuals, test procedures, or policies, but will provide basic laboratory principles.

Accuracy and attention to detail are essential to obtain optimum test results. These tests are only aids to diagnose a patient. Many other clinical factors must be taken into consideration before treatment may be started.

ADMINISTRATIVE PROCEDURES AND RESPONSIBILITIES

The ability to understand clinical laboratory tests is a commendable attribute of the HM. The entire testing effort will be wasted if proper documentation and filing practices are ignored, or the test results are misfiled. As a member of the medical team, it is the responsibility of the HM to make sure established administrative procedures are followed with regard to accurate patient and specimen identification. This includes ensuring laboratory reports are handled and filed properly in medical records.

Test results are a part of the patient’s treatment record(s). Test results have a bearing upon the patient’s immediate and future diagnosis and medical history.

Laboratory Request Forms

The Armed Forces have gone to great lengths to produce effective forms that serve a purpose with a minimum of confusion and chance for error. These forms are Standard Forms (SF) in the 500 series. With the exception of SF-545 (Laboratory Report Display), SF laboratory forms have been replaced by printed copies of laboratory results from computerized laboratory information systems (CHCS and AHLTA), or locally developed chits that meet the needs of each operational platform. Laboratory reports are filed on top of or attached to the SF-545 (see fig 19-1) located inside the patient’s health record. For a complete listing of SF forms and their purposes, refer to the Manual of the Medical Department (MANMED), NAVMED P-117.

Laboratory request forms are not the only means by which healthcare providers can order laboratory tests. Many of today’s treatment facilities have computerized laboratory systems.
These systems enable providers to enter laboratory test requests into computers located in their spaces. After providers enter their test requests, patients may report immediately to the Laboratory Department, where specimens are obtained and tests are performed.

**Use of Laboratory Request Forms**

Write information on the laboratory request forms in black or blue-black ink. Use a separate laboratory request form for each patient. Document the patient's full name, family member prefix and sponsor's social security number, rate/rank, date of birth, status, and branch of service in the "Patient Identification" block. Additionally, identify the ward or department ordering the test in this block. Computer-generated laboratory test requests require the same patient identification data as manual laboratory requests and the required information is automatically populated on the requests. HMs are required to verify the patient information before specimen collection and labeling.

The results of laboratory test are closely associated with the patient’s health and treatment. The requesting provider’s name must be included on the request. This practice ensures that reports/results get back to the requesting provider as soon as possible.

In addition to identifying the appropriate test on the form, enter any specific instructions in the area provided for remarks (e.g., “Clean catch midstream to rule out urinary tract infection”). Because the data requested, the date reported, and the time of specimen collection are required to support the clinical picture, information should be clearly written on the request.

**Patient and Specimen Identification**

Before accepting laboratory request forms and specimens in the laboratory, check patient identification information on both the request form and the specimen container label for completeness and legibility. Ensure the specimen(s) label(s) and request form information match with the patient. Proper documentation of patient identification on these items prevents errors.

**Filing Laboratory Forms**

After providers have reviewed laboratory test reports, they will initial or sign the form to indicate the review of the test results. This acknowledgement may be electronic via AHLTA or CHCS, or via initial/signature on a hard copy lab chit. After the provider releases the laboratory report, it will be filed in the patient’s treatment record. Manual, automated, or computer-generated laboratory test reports will be placed above SF-545 (Fig. 19-1) in the health record. All forms will be filed chronologically with the each new result placed on top of the previous results.
Figure 19-1.—SF–545, Laboratory Report Display
ETHICS AND GOOD PRACTICES IN THE LABORATORY

LEARNING OBJECTIVES:

Identify the correct steps to perform blood collection by the finger puncture method and venipuncture method.

Explain Universal Precautions and other safety precautions that apply to blood collection.

The nature of laboratory tests and their results will be treated as a confidential matter between the patient, the provider, and the performing technician. Chapter 16 of the MANMED outlines the Navy’s ethics policy with regard to disclosure of the contents of a patient’s medical record, including lab reports. Other agencies that regulate medical ethics and patient confidentiality include The Joint Commission, Medical Inspector General (MED IG), and the Department of Health and Human Services (HHS). Of specific concern is the Health Insurance Portability and Accountability Act (HIPAA) enacted by Congress and enforced via HHS detailing how protected health information (PHI) may be transmitted and released. It is good practice to prevent unauthorized access to these reports, to leave interpretation of the test results to the requesting provider, and to refrain from discussing results with the patient. Always refer the patient back to their requesting provider for all laboratory results.

There are two principal methods of obtaining blood specimens: the capillary method and the venipuncture method. For most clinical laboratory tests requiring a blood specimen, venous blood obtained by venipuncture is preferred. Infection control practices, equipment requirements, and step-by-step instructions on performing both of these blood collection methods will be discussed in the following sections.

UNIVERSAL BLOODBORNE PATHOGEN PRECAUTIONS21 (See www.osha.gov and Standard 1910.1030 for complete details)

Under the concept of "Universal Bloodborne Pathogen Precautions” outlined by Occupational Safety & Health Administration (OSHA), all human blood and certain other human body fluids are treated as if known to be infectious for HIV, HBV, and other bloodborne pathogens, and therefore considered potentially infectious. Remember from Chapter 9 that Universal Precautions are a subset of Standard Precautions. The following Universal Precautions are in effect for all phlebotomy procedures:

- Gloves are required to be worn in conjunction with proper hand washing techniques
- Gloves will be disposed of after each patient
- Needles and other sharp instruments used in the blood collection process will be handled with extreme caution and disposed of in biohazard sharps containers
- Sharps containers will be conveniently located near phlebotomy work sites to reduce the distance between patient care and sharps disposal
- Absorbent materials, such as cotton 2 x 2’s used to cover blood extraction sites, normally contain only a small amount of blood and can be disposed of as general waste
- If a large amount of blood is absorbed, the absorbent material will be placed in a biohazard waste container and treated as infectious waste
- Clean phlebotomy work site equipment and furniture daily with a disinfectant, or as needed after patient care
CAPILLARY BLOOD COLLECTION

Capillary blood collection is performed when a small quantity of blood is needed for testing as in the case of some pediatric blood draws. It may also be used when access to normal venipuncture draw sites are limited on a patient such as severely burned patients or ICU patients. Most adult capillary blood collections are from the finger. Capillary blood collections for newborns may occur from the heel.

Materials Required for Capillary Finger Puncture Procedure

To perform a finger puncture, the following materials are required:

- Sterile gauze pads (2" x 2")
- 70% isopropyl alcohol or povidone-iodine solution pads
- Blood lancets
- Plastic Capillary tubes
- Bandages

Arrange the equipment in an orderly manner and have it within easy reach. The HM will wash hands before and after each procedure.

Capillary Finger Puncture Procedure

To perform a finger puncture, follow the steps given below:

1. Explain the procedure to the patient.
2. Using the middle or ring finger, warm the site to make collection easier and faster. Warming the site reduces the tendency to squeeze the site.
3. Cleanse the fingertip with an alcohol pad or povidone-iodine solution and let dry.
4. Locate the correct puncture location on the finger. Always puncture away from the midline of the finger or heel to prevent injury to the bone (Fig 19-2). Do not puncture parallel to the grooves or lines of the fingerprint. A parallel puncture will allow blood to run down the finger rather than form a well rounded drop, and make collection difficult.

Figure 19-2.—Veinpuncture; A. Finger puncture; B. Heel Puncture


5. Take a lancet and make a quick stab no greater than 2 mm deep on the side of the finger (off-center). Commercially produced single-use lancets are available for ease of use and patient safety to control the puncture depth.
6. Wipe away the first drop of blood with a sterile 2 x 2 gauze. This prevents contamination of the specimen with excess tissue fluid. Avoid squeezing the fingertip to accelerate bleeding as this tends to dilute the blood with excess tissue fluid. Position the site downward to enhance blood flow and apply gentle intermittent pressure to tissue surrounding a finger puncture site.

7. Collect blood in the correct specimen container by “scooping” blood one drop at a time.

8. When the required amount of blood has been obtained, apply a pad of sterile gauze, instruct the patient to apply pressure, and then apply a bandage.

When dealing with newborns, infants, and very small children, the heel or great toe puncture may be used to obtain a blood specimen. This method is performed in a similar fashion. Additional training is required before these methods are performed by the HM.

**VENIPUNCTURE (VACUTAINER METHOD)**

Venipuncture is defined as the puncture of a vein for drawing blood. For the convenience of technician and patient, arm veins are best for obtaining a blood sample. If arm veins cannot be used due to interference from bandage or IV therapy, thrombosed or hardened veins, post-surgical requirements, etc, consult a supervisor for instructions on the use of hand or foot veins.

**Materials Required for Venipuncture**

To perform a venipuncture, the following materials are required:

- Sterile gauze pads (2" x 2")
- 70% isopropyl alcohol or povidone-iodine solution pads
- Tourniquet
- Vacutainer needles and holder with safety device to prevent accidental needle sticks
- Vacutainer tube(s) appropriate for the test to be performed

Arrange the equipment in an orderly manner and have it within easy reach. The HM will wash hands before and after the procedure.

**Venipuncture Procedure**

The patient must be positioned so that the vein is easily accessible and the HM is able to perform the venipuncture in a comfortable position. Always have the patient either lying in bed or sitting in a chair with the arm propped up.

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**NOTE:**

Do not draw blood from an arm with IV fluid running into it or on the same side of a patient's mastectomy. Choose another site.

The IV fluid will alter test results and drawing blood from the same side of a patient's mastectomy can cause permanent damage.

If a patient has IV fluids running into both arms, consult a supervisor for instructions on the correct site for blood collection.

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**WARNING:**

Never perform a venipuncture with the patient standing up.

If the patient faints, serious injury could result.

Safeguards should be in place to prevent patients from falling forward when they are seated.
To perform venipuncture, follow the steps given below.

1. Explain the procedure to the patient.

2. Apply tourniquet around the arm approximately 3 to 4 inches above the intended venipuncture site, usually the antecubital fossa (the depression in the anterior region of the elbow (Fig. 19-3). A BP cuff (sphygmomanometer) may be used instead of a tourniquet if a patient is difficult to draw. This technique should only be performed by experienced HM.

3. Position the patient’s arm extended with little or no flexion at the elbow.

4. Locate a prominent vein by palpation (feeling). If the vein is difficult to find, it may be made more prominent by having the patient hold their arm in a downward position.

5. Cleanse the desired site with a 70% alcohol pad or povidone-iodine solution and allow it to dry.

**CAUTION:**
After cleaning the desired site, only the sterile needle should be allowed to touch it.

DO NOT TOUCH WITH UNSTERILE OBJECTS.

6. "Anchor" the vein by using the thumb of the free hand placing it a minimum of 1 to 2 inches below and slightly to the side of the intended venipuncture site, and pull the skin toward the wrist.

7. Using a smooth continuous motion, introduce the needle, bevel side up, into the vein at about a 15 to 30 degree angle with the skin (Fig. 19-4).
Figure 19-4.—Phlebotomy

8. Holding the vacutainer barrel with one hand, push the tube into the holder with the other hand and watch for the flow of blood into the tube.

9. The tourniquet should be removed as soon as blood flows freely into the tubes. In some difficult draw situations, the tourniquet is sometimes left on until the last tube is filled. Do not leave the tourniquet on for more than one minute.

10. Once all the specimens have been collected, remove the final tube, hold the vacutainer with one hand and release the tourniquet with the other.

11. Place a sterile gauze over the puncture site and remove the needle with a quick and smooth motion.

12. Apply pressure to the puncture site and instruct the patient to keep the arm in a straight position. Have the patient hold pressure while the tubes are labeled.

13. Take this time to invert any tubes that need to have anticoagulant mixed with the blood.

14. Specimens are to be labeled immediately after blood collection and never before. The label must be permanently attached to the tube(s) before leaving an inpatient's bedside or dismissing an outpatient.

15. Re-inspect the puncture site to make sure bleeding has stopped, and apply a bandage.

**Blood tubes**

It is common that one venipuncture may result in filling numerous blood tubes for more than one laboratory test. Blood tubes have standardized color-coded stopper tops to indicate which additive or anticoagulant is used in each tube. Different testing methodologies (hematology, chemistry, alcohol) are performed on different colored tubes that prepare the blood sample for testing.

It is important for every HM to understand the different tubes available at a specific command and know what each colored tube is used for. For example, a lavender-top is often used for complete blood counts (CBCs), and a red-top is often used for blood chemistry. Tubes and their uses change from one facility to the next, so it is important to understand the procedures of each facility. Refer to Table 19-1 for a list tubes and their common uses.
Table 19-1.—Tubes and Their Common Uses

THE MICROSCOPE

LEARNING OBJECTIVE:
Identify the parts of the microscope, and state their functions.

Before any attempt is made to view blood smears, urinary sediments, bacteria, or parasites, the HM must know the microscope. It is a precision instrument used extensively in clinical laboratories to observe objects too small to be seen by the unaided eye. Most laboratories are equipped with binocular (two-eyepiece) microscopes, but monocular (one-eyepiece) microscopes are also commonly used in the field settings. The type of microscope most often used in the laboratory is referred to as the compound microscope (Fig. 19-5).

![Microscope Diagram]

Figure 19-5.—Microscope

A compound microscope contains a system of lenses with sufficient magnification and resolving power (ability to show, separate, and distinguish) allowing small elements close together in a specimen to appear larger and distinctly separated. In the following sections, the compound microscope’s framework, illumination system, magnification system, and focusing system will be outlined.

FRAMEWORK

The framework of the compound microscope consists of four parts: arm, stage, mechanical (movable) stage, and base.

Arm is the structure that supports the magnification and focusing system. It is the handle by which the microscope is carried.

Stage is the platform on which a specimen is placed for examination. In the center of the stage is an aperture or hole that allows the passage of light from the condenser.

Mechanical (movable) Stage holds the specimen in place and is the means by which the specimen may be moved about on the stage to view the sample.

Base is the structure on which the microscope rests.

ILLUMINATION SYSTEM

Ideal illumination of a specimen viewed under the microscope requires even light distribution. The objectives must also be entirely filled with light from the condenser. To fulfill these requirements, the illumination system of the compound microscope consists of three parts: an internal light source, a condenser, and an iris diaphragm.

Internal Light Source is located in the base of the microscope providing a precise and steady source of light into the microscope.

Condenser is composed of a compact lens system and is located below the stage. It concentrates and focuses light from the light source on the specimen.

Iris Diaphragm is located on the condenser to control the amount of light and angle of light rays that will pass to the specimen and lens, which affects the overall resolution, or ability to observe and interpret a sample.
**MAGNIFICATION SYSTEM**

The magnification system of the compound microscope contains at least two lens systems. The two lens systems are mounted on either end of a tube called the body tube. The lens nearest the object is called the objective lens, and the lens nearest the eye is the ocular lens or eye piece.

**Objective Lens** is responsible for the magnification and resolution of detail in a specimen. On a compound microscope, there is usually a set of three objective lenses (or "objectives"). Each objective lens has a different focus distance and magnification power. A set of objectives normally consists of a low-power lens (approximate magnification 10X), a high-power lens (approximate magnification 40X), and an oil-immersion lens (approximate magnification 100X). The colors on each lens may vary by manufacturer; objective lenses are also marked for easy recognition: 10X, 40X, and 100X.

**Revolving Nosepiece** contains openings into which objective lenses are fitted, and revolves objectives into desired position.

**Body Tube** is a tube that permits light to travel from the objective to the ocular lens.

**Ocular Lenses** or eyepieces are located on top of the body tube and usually have a magnification power of 10X. To calculate the total magnification of a specimen, multiply the magnification power of the objective by the magnification power of the ocular lens. For example, the 10X ocular and the 40X objective provide a magnification of 400X.

**FOCUSBING SYSTEM**

Focusing is accomplished by moving the stage up or down with the coarse and fine control knobs. Whether the stage needs to be raised or lowered depends on each individual sample and objective being used. The coarse control knob is used initially to bring the specimens image into approximate focus. Once this is accomplished, the fine control knob sharpens the image.

**Coarse Control Knob** is the larger inner knob. Rotating the coarse control knob allows the image to appear in approximate focus.

**Fine Control Knob** is the smaller outer knob. Rotating this control knob renders the image clear and well-defined.

**FOCUSING THE MICROSCOPE**

Focusing the microscope must be done in a specific order to avoid accidentally damaging the objective lens, the specimen, or both. The process of focusing consists of adjusting the relationship between the optical system of the microscope and the object to be examined so that a clear image of the object is obtained. The distance between the upper surface of the glass slide on the microscope stage and the faces of the objective lens varies depending upon which of the three objectives is in the focusing position. It is important to obtain a focus with the low-power objective first, then change to the higher objective.

With the low-power (10X) objective in focusing position, observe the following steps in focusing.

1. The person using the microscope will be seated facing the microscope so that the ocular lenses are facing the person. The head of the person will be lowered to one side of the microscope until the eyes are approximately at the level of the stage.
2. Using the coarse adjustment knob, the body tube will be lowered until the face of the objective is within 1/4 inch of the object. Most microscopes are constructed in such a way that the low-power (10X) objective cannot be lowered and make contact with the object on the stage. While looking through the ocular, use the coarse adjustment knob to elevate the lenses until the image becomes visible. Once the object is clearly visible, the fine adjustment knob is used to obtain a clear and distinct image. The focusing knob must not be moved while changing lenses.
3. If the high-power objective (40X) is to be used next, it is brought into position by revolving the nosepiece (a distinct "click" indicates it is in proper alignment). The fine adjustment knob is used only to bring the object into exact focus.

4. If the specimen is too dark, increase lighting by opening the iris diaphragm of the condenser located at the base of the microscope on the light source.

5. The oil-immersion objective (100X) is used for detailed study of stained blood and bacterial smears. The distance between the objective lens and the object is very short. Great care must be taken to not damage the specimen. After focusing with the high-power objective and scanning for well-defined cells, turn the objective. Place a small drop of immersion oil, free of bubbles, on the slide. Center the drop in the circle of light coming through the condenser. Revolve the objective carousel to bring the oil-immersion objective into place. Do not attempt coarse adjustment at this time or the lens and specimen may be damaged. The final step in focusing is done with the fine adjustment knob. It is with this lens in particular that lighting is important. The final focus, clear and well-defined, will be obtained only when proper light adjustment is made.

CARE OF THE MICROSCOPE

The microscope is an expensive and delicate instrument that must be given proper care. Moving or transporting microscopes will be accomplished by grasping the arm of the scope in one hand and supporting the weight of the scope with the other hand under the base. Avoid sudden jolts and jars. Keep the microscope clean at all times. When not in use, microscopes should be enclosed in dustproof cover or stored in their case. Remove dust with a lint-free lens tissue.

Lenses may be wiped carefully with lens tissue. When the oil-immersion lens is not being used, remove the oil with lens tissue. Use lens cleaning solution on lenses only when required to remove dried oil and only in the minimal amount necessary. Never use alcohol or similar solvents to clean lenses since alcohol will damage the lens assembly.

COMPLETE BLOOD COUNT

LEARNING OBJECTIVES:

Identify the parts of a complete blood count.
Identify the normal values for each part.

A complete blood count routinely consists of the following tests:
- Total red blood cell (RBC) count
- Hemoglobin determination (Hgb)
- Hematocrit calculation (Hct)
- Total white blood cell (WBC) count
- White Blood Cell Differential count

The complete blood count, commonly referred to as a CBC, is used in the diagnosis of many diseases. Blood collected for these tests are capillary or venous blood. CBCs may be performed either manually or by using automated hematology analyzers. The manual methods performed by laboratory technicians and Independent Duty Corpsmen are used in isolated locations and onboard some Naval vessels where a hematology analyzer is not practical.

RED BLOOD CELL COUNTS

The red cell count is used in the diagnosis of many diseases. A red cell count that drops below normal values may indicate anemia. A red cell count that rises above the normal values may indicate dehydration.
Manually counting red blood cells (erythrocytes) is a time-consuming procedure that provides only limited value in an operational setting, so it is no longer included in this manual.

HEMOGLOBIN DETERMINATION

A routine test performed on practically every patient is the Hemoglobin determination, or hemoglobinometry. It is the measurement of the concentration of hemoglobin within the patient’s red blood cells. The primary function of hemoglobin is delivery and release of oxygen to the tissues and facilitation of carbon dioxide excretion. The formation of hemoglobin takes place during the development of red cells located in bone marrow.

Values are affected by age, sex, disease, and altitude. Different situations affect the function of hemoglobin in different ways. For example, iron deficiency anemia may drop hemoglobin from a normal value to a critically low value. Above-normal values may occur when dehydration develops. Changes in altitude affect the oxygen content of the air and, therefore, also affect hemoglobin values. At higher altitudes there is less oxygen in the air, resulting in an increase in red cell counts and hemoglobin values. At lower altitudes there is more oxygen, resulting in a decrease in red cell counts and hemoglobin values.

The normal values for hemoglobin determinations are:

<table>
<thead>
<tr>
<th>Grams per 100 ml blood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woman ........ 12 to 16</td>
</tr>
<tr>
<td>Men ............. 14 to 18</td>
</tr>
</tbody>
</table>

In manual methods for determining blood hemoglobin, blood is mixed with cyanomethoglobin. This process hemolyzes, or destroys the red cells, disrupting the integrity of the red cells' membrane and causing the release of hemoglobin, which, in turn, is converted to a brownish-colored solution which is then compared with a color standard.

HEMATOCRIT (PACKED CELL VOLUME) DETERMINATION

The hematocrit, or packed RBC volume, is the ratio of the volume of RBCs to the volume of whole blood. It is usually expressed as a percentage. The normal values for hematocrit determinations are:

<table>
<thead>
<tr>
<th>Percentage of blood volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woman ........... 37 to 47%</td>
</tr>
<tr>
<td>Men .............. 42 to 52%</td>
</tr>
</tbody>
</table>

When hematocrit determinations are below normal, medical conditions such as anemia may be present. Above-normal hematocrit determinations indicate medical conditions like dehydration.

Automated hematology analyzers currently supply most hematocrits. When hematology analyzers are not available, determinations can be manually performed by the microhematocrit method. This method calls for the blood to be centrifuged. The percentage of packed red cells is found by calculation and reported as a percentage.

TOTAL WHITE BLOOD CELL COUNT

The total white cell (leukocyte) count determines the number of white cells per cubic millimeter of blood. A great deal of information can be derived from white cell studies. The white blood cell (WBC) count and the differential count are common laboratory tests, and they are almost a necessity in determining the nature and severity of systemic infections. Normal WBC values in adults range from 4,800 to 10,800 cells per cubic millimeter; reported as 4.8 to 10.8 X 10^6/ml (per cubic millimeter.)

White blood cell counts are performed either manually or with automated hematology analyzers. Only the manual method will be covered in this chapter. After a brief introduction on abnormal white blood cell counts, the Unopette method will be covered for manually counting white blood cells.
Abnormal White Cell Counts

When the WBC rises above normal values, the condition is referred to as **leukocytosis**. **Leukocytosis** frequently occurs when systemic or local infections (usually due to bacteria) are present. In severe medical conditions, white cell counts will exceed 50,000/mm³.

Counts for infections are highly variable based on each individual patient, onset of infection, and a patient’s individual response. Other physiological conditions that can cause leukocytosis may occur as follows:

- Shortly after birth
- Pregnancy
- Appendicitis
- Ulcers
- Emotional stress
- Anxiety
- Strenuous exercise

An abnormally low white cell count, known as **leukopenia**, may be caused by the following conditions:

- Severe or advanced bacterial infections such as typhoid, paratyphoid, and sometimes tularemia
- When a bacterial infection has been undetected for a period of time
- Infections caused by viruses and rickettsiae, such as measles, rubella, smallpox, infectious hepatitis, psittacosis, dengue fever, and influenza
- Protozoal infections (such as malaria) and helminthic infections (such as trichinosis)
- Overwhelming infections when the body’s defense mechanisms break down
- Anaphylactic shock
- Radiation

WHITE BLOOD CELL DIFFERENTIAL COUNT

A total WBC is not necessarily indicative of the severity of a disease, since some serious ailments may show a low or normal overall white cell count. For this reason, a differential white cell count is performed. This consists of an examination of blood to determine the presence and the number of different types of white blood cells usually expressed in a percentage. This study often provides more helpful information in determining the severity and type an infection than any other single procedure used in the examination of the blood.

The role of white blood cell is to control various disease conditions. Although these cells do most of their work outside the circulatory system, they use the blood for transportation to sites of infection. The amount and type of cells in the circulating blood can provide valuable information about the body’s immediate response to infection or disease.

Five types of white cells are normally found in the circulating blood. They are:

- Neutrophils
- Eosinophils
- Basophils
- Lymphocytes
- Monocytes

Cell Identification

To perform a differential white cell count, a laboratory technician or HM must be able to identify the different types of white blood cells. The ability to properly identify the different types of white cells is not difficult to develop, but does require a thorough knowledge of staining characteristics and morphology (the study of the form and structure of organisms). This knowledge can be gained only by extensive, supervised practice, but an introduction is included in this chapter for a better understanding.
Laboratories use a blood smear to obtain a differential white cell count. To prepare a blood smear, a blood specimen is spread across a glass slide, stained to enhance leukocyte identification, and examined microscopically. Material requirements and the step-by-step procedure for performing a blood smear will be covered later in this chapter.

**NEUTROPHILS.**—account for the largest percentage of leukocytes found in a normal blood sample, and function by ingesting invading bacteria. On a stained blood smear, the cytoplasm of a neutrophil has numerous fine, barely visible lilac-colored granules and a dark purple or reddish purple nucleus (Fig. 19-6). The nucleus may be oval, horseshoe or “S”-shaped, or segmented (lobulated). They are subclassified according to their age or maturity, which is indicated by changes in the nucleus.

**Neutrophilic Band.**—sometimes called a "stab" cell, is an older or intermediate neutrophil. It has started to elongate and has curved itself into a horseshoe, C or U-shape. As the band ages, it matures into a segmented neutrophil (Fig. 19-7).
**EOSINOPHIL**.—The function is to destroy parasites and respond in immediate allergic reactions. The cytoplasm of an eosinophil contains numerous large reddish-orange granules (Fig. 19-8). The most common cause of increased eosinophils worldwide is parasitic, in particular helminthic, infections.

![Figure 19-8.—Eosinophil](image)

Image reprinted with permission from:

**BASOPHIL**.—A rise in basophils is associated with inflammatory disorders and certain leukemias. Scattered deep bluish-purple granules that are darker than the nucleus, characterize the cell as a basophil (Fig. 19-9). Granules may overlay the nucleus as well as the cytoplasm.

![Figure 19-9.—Basophil](image)

Image reprinted with permission from:

**LYMPHOCYTE**.—The function is associated with immune response and the body's defense against viral infection. The cytoplasm of a lymphocyte is clear sky blue, scanty, with few unevenly distributed, blue granules with a halo around them (Fig. 19-10). It is generally round, oval, or slightly indented, and the chromatin (a network of fibers within the nucleus) is lumpy and condensed at the periphery.

![Figure 19-10.—Lymphocyte](image)

Image reprinted with permission from:
MONOCYTE.—The largest of the normal white blood cells, controls microbial and fungal infections, and removes damaged cells from the body. The monocyte has an indented nucleus and an abundant pale bluish-gray cytoplasm (Figs. 19-11 and 19-12).

Figure 19-11.—Monocyte


Figure 19-12.—Monocyte


BACTERIOLOGY

LEARNING OBJECTIVE:

*Identify bacteria classifications, common bacteria, and procedural steps for making smears, performing Gram staining, and reading and reporting smears.*

Bacteriology is the study of bacteria. Of primary interest to the HM is medical bacteriology, which deals with the bacteria that cause disease in man. Bacteria are found almost everywhere, and the human body harbors vast numbers. Many bacteria are beneficial and essential to human life; only a few are harmful to man.

BACTERIA CLASSIFICATION

Since there are thousands of types of bacteria, a method of classification is essential. Bacteria are classified according to their respective:

- Disease-producing ability
- Growth requirements
- Morphologic characteristics
- Toxins produced
- Gram’s stain reaction

Disease-Producing Ability

The disease-producing ability of bacteria is referred to as either pathogenic or nonpathogenic. Pathogens are bacteria that cause diseases, and nonpathogens are harmless bacteria. Bacteria that are essential to the body are, in their proper environment, called common or normal flora. For example, certain bacteria in the throat are normal flora, but when found elsewhere (such as in the blood stream, possibly as a result of tooth extraction), they may cause diseases such as septicemia and endocarditis.
Growth Requirements

The four growth requirements for bacteria are:
- Temperature
- Oxygen
- Nutrition
- Moisture

TEMPERATURE REQUIREMENTS.—
Temperature requirements are divided into the following three categories.
- **Psychrophilic** "cold loving" bacteria that reproduce best at low temperatures (4°C)
- **Mesophilic** bacteria that reproduce best at body temperature (35 °C) and are the primary pathogens in man
- **Thermophilic** bacteria that reproduce best at higher temperatures (42 °C)

OXYGEN REQUIREMENTS.—The amount of oxygen needed for an organism to grow or reproduce varies with the type of organism. **Aerobes** are organisms that reproduce in the presence of oxygen. **Anaerobes** are organisms that do not reproduce in the presence of oxygen. Other bacteria have varying oxygen requirements.

NUTRITION REQUIREMENTS.—Nutrition requirements for the various types of bacteria depends on what particular environment is required in the body or laboratory setting.

MOISTURE REQUIREMENTS.—Moisture is indispensable for bacterial growth providing an environment for metabolic reactions to take place.

Morphologic Characteristics

The structural (or morphologic) characteristics of bacteria are based on three distinct shapes or categories:
- **Coccus** (pl. cocci) spherical, appears singly, in pairs, chains, clusters, or packets
- **Bacillus** (pl. bacilli) rod-shaped, appears singly, in chains, or in different organizations, (i.e. railroad tracks or school of fish)
- **Spirochetes** (pl. spirilla) helical, spiral-, corkscrew-shaped, appearing singly only

Toxins Produced

Generally, toxins produced are waste products of metabolism in a bacterial cell. Some bacteria produce toxins that cause febrile or fatal reactions. Toxins are divided into two categories:
- **Endotoxin** - Comprises part of the cell wall and is released as the bacterial cell is destroyed. Endotoxins are less potent than exotoxins, but may affect the patient during the course of antibiotic therapy
- **Exotoxin** - Produced by bacteria and found outside the bacterial cell in the surrounding medium. Exotoxins are highly poisonous and associated with septic shock

Gram Stain Reaction

A gram-stained smear is a key diagnostic tool. It can detect bacteria in patient specimens and is critical in identifying cultured bacteria. This differential stain is based on the cell wall differences between **gram positive** and **gram negative** bacteria. Gram positive cells retain the primary crystal violet stain during decolorization and retain the violet stain; gram negative do not, and are counterstained pink. The basic staining and morphological characteristics (gram negative rods, gram positive cocci, gram negative diplococci) provide an initial classification of bacteria that enable selection of the correct antibiotic therapy.
COMMON BACTERIA

Bacteria are named by genus and species. The first word (capitalized) indicates the genus; the second word (not capitalized) indicates the species, a subdivision of the genus. For example:

<table>
<thead>
<tr>
<th>GENUS</th>
<th>SPECIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neisseria</td>
<td>gonorrhoeae</td>
</tr>
</tbody>
</table>

Table 19-2 provides familiarization with commonly encountered bacteria. This table lists the bacteria’s morphologic shape, Gram stain response, genus and species, and the type of infection it produces.

<table>
<thead>
<tr>
<th>Morphologic Shape</th>
<th>Gram-Positive or -Negative</th>
<th>Genus &amp; Species</th>
<th>Type of Infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cocci</td>
<td>Positive</td>
<td>Streptococcus pneumonia</td>
<td>Pneumonia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Streptococcus pyogenes (Beta Streptococci Group A)</td>
<td>Strep throat</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Staphylococcus aureus</td>
<td>Boils, furuncles, osteomyelitis, pneumonia, septicemia, endocarditis, and impetigo</td>
</tr>
<tr>
<td></td>
<td>Negative</td>
<td>Neisseria gonorrhoeae</td>
<td>Gonorrhea</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Neisseria meningitis (meningococcus)</td>
<td>Meningitis</td>
</tr>
<tr>
<td>Bacilli</td>
<td>Positive</td>
<td>Corynebacterium diphtheriae</td>
<td>Diphtheria</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clostridium (all are anaerobic and spore producers) perfringens (welchii) tetani botulinum</td>
<td>Gas gangrene Tetanus Botulism</td>
</tr>
<tr>
<td></td>
<td>Negative</td>
<td>Yersinia (Pasteurella) pestis</td>
<td>Bubonic plague</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brucella abortus</td>
<td>Brucellosis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bordetella pertussis</td>
<td>Whooping cough</td>
</tr>
</tbody>
</table>

Table 19-2.—Common Pathogenic Bacteria

BACTERIOLOGIC METHODS

There are a variety of methods used in the laboratory to identify bacteria. However, only a few of these bacteriologic methods can be performed in isolated duty locations or onboard Naval vessels by HMs. One of these methods is the smear. The smear permits healthcare personnel to examine specimens microscopically.
Smear

Smears may be prepared from clinical specimens (i.e. discharge or CSF) or from culture media spread across a glass slide for microscopic examination. To enhance the visualization of microorganisms on the smear, Gram staining is used. Once the smear is stained, it is ready to be examined under the microscope. Normally, smears are examined by laboratory technicians who report their findings.

Gram-positive organisms are easy to see because they stain a deep blue or blue-black (Fig. 19-13).

Gram-negative organisms stain a deep pink, but since the background material is also pink, minute and detailed inspection is necessary before reporting the results (Fig. 19-14).

![Figure 19-13.—Gram Positive Organisms](image)

*Figure 19-13.—Gram Positive Organisms*


![Figure 19-14.—Gram Negative Organisms](image)

*Figure 19-14.—Gram Negative Organisms*


In the presence of gonorrhea (caused by Neisseria gonorrhoeae), the smear will reveal varying intracellular and extracellular gram-negative, bean-shaped cocci in pairs (diplococci). Such a finding could be considered diagnostic for gonorrhea in urethral discharge from symptomatic males. It is important to point out that only a few of the many WBCs on the slide may contain bacteria, and sometimes it requires considerable search to find one.
SEROLOGY

LEARNING OBJECTIVE:

Identify principles and procedures for the Rapid Plasma Reagin (RPR) Card Test and the Monospot Test.

Serology consists of procedures by which antigens and reacting serum globulin antibodies may be measured qualitatively and quantitatively. These tests have been devised to detect either antigens present or antibodies produced in a number of conditions. Most tests are based on agglutination reactions between an antigen and a specific antibody. The reactions result in a visual clumping of test solution when antigens and antibodies react. The HM may have the opportunity to perform simple screening serology tests.

An antigen is a substance that, when introduced into an individual’s body is recognized as foreign by an individual’s immune system and causes a detectable reaction.

Antibodies are specific defensive proteins produced when an antigen stimulates individual cells. The primary function of an antibody in body defenses is to combine with antigens. Antibodies are produced by the host in response to the presence of an antigen and are capable of reacting with antigens in some detectable way.

The antigen-antibody reaction takes place when antibodies bind with specific antigens depending on a close three-dimensional fit. Agglutination tests are widely used to detect and measure the presence of antigen-antibody reactions.

Principles and procedures of two serologic tests, the Rapid Plasma Reagin (RPR) card test and the Monosticon DRI-DOT® Slide Test are covered in the following sections.

RAPID PLASMA REAGIN (RPR) CARD TEST

The RPR Card test is a non-specific, easily performed screening test for syphilis. Reactions are occasionally observed with other acute and chronic conditions associated with tissue damage. Everything needed for the test is in a kit that is available commercially. This test kit is very useful aboard ship and at small Naval station settings. The kit is standard throughout Navy medicine.

Principle of the RPR Card Test

In the RPR Card test method of syphilis detection, a specific antigen (carbon-particle cardiolipin) detects "reagin," a substance present in the serum of persons who are infected with syphilis or suffering from similar tissue damage. Reagin is usually developed 1 - 4 weeks after the appearance of a primary chancre. Reactive specimens appear as black clumps against a white background. Nonreactive specimens appear as an even, light-gray color.

The RPR is a non-specific screening test and is not reported as positive or negative for disease. It is reported as reactive or non-reactive.

MONOSPOT TEST

Mononucleosis imitates many diseases so well that diagnosis is confirmed only by selective serologic testing. The Monospot Test is an accurate, 2-minute disposable test designed to detect the presence of infectious mononucleosis antibodies in serum, plasma, or whole blood. Although there are numerous tests for infectious mononucleosis, all have the same principle, and similar methods.

Principle of the Monospot

The Monospot Test consists of specially prepared, stable sheep or horse erythrocyte antigen (dyed) and guinea pig antigen on a disposable slide. When serum, plasma, or whole blood is mixed with these antigens on the slide, the test result for infectious mononucleosis will be positive or negative.
A positive result is indicated by agglutination, or clumping, and a negative result is indicated by no agglutination (Fig. 19-15). A negative monospot may not necessarily rule out the presence of infectious mononucleosis.

![Illustration of Positive and Negative Monosticon DRI-DOT® Slide Test Results](image)

### FUNGUS TEST

**LEARNING OBJECTIVE:**

*Identify how potassium hydroxide (KOH) preparation is used in the detection of fungi.*

Fungi (sing. fungus) are chlorophyll-free, heterotrophic (not self-sustaining) of the same family of plants as algae and lichens. They reproduce by spores that germinate into long filaments called hyphae. As the hyphae continue to grow and branch, they develop into a mat of growth called the mycelium (pl. mycelia). From the mycelium, spores are produced in characteristic patterns. These spores, when dispersed to new substances, germinate and form new growths. Reproduction is often asexual, usually by budding (as in yeast), but certain fungi have sexual reproduction. Common superficial infections of the skin caused by fungi are athlete’s foot and ringworm of the scalp.

A simple and frequently used method of detecting fungi is the potassium hydroxide (KOH) preparation. Fungi are seen in clustered round buds with thick walls, accompanied by fragments of mycelia.

Scrapings from the affected area of the skin are mounted in commercially prepared 10% KOH for positive laboratory diagnosis.

To detect fungi in infected tissue using the KOH preparation, follow the steps below:

1. Place skin, hair, or nail scrapings from the affected area on a glass slide and add one drop of 10% KOH.
2. Place a coverslip on the preparation.
3. Warm the preparation gently over the tip of a flame, being careful not to boil it, and allow it to stand until clear. Do not allow the preparation to dry out.
4. Examine the preparation by using the high-power objective on microscope with subdued light.
   - Fungi on the skin and nails appear as refractile, or reflective, fragments of fungal elements.
   - Fungi in the hair appear as dense clouds around the hair stub or as linear rows inside the hair shaft.

### URINALYSIS

**LEARNING OBJECTIVES:**

*Identify the three types of urine specimens.*

*Identify the methods used to preserve urine specimens.*

*Identify the steps for performing a urinalysis.*

The analysis of urine is considered the beginning of laboratory medicine. Urine is readily available, easily collected, and contains information about many of the body’s major metabolic functions.

The physical and chemical properties of normal urine are constant and abnormalities are easily detected. The use of simple tests provides the provider with information for the diagnosis and management of many diseases.
This section outlines the three types of urine specimens, methods used to preserve urine specimens, the procedure for performing a routine and microscopic examination of urine specimens, and some simple interpretations of the findings.

**URINE SPECIMENS**

Urine specimens for routine examinations must be collected in aseptically clean containers. Unless circumstances warrant, avoid catheterization as it may cause a urinary tract infection. Specimens of female patients are likely to be contaminated with albumin (protein) and blood from menstrual discharge, or with albumin and pus from vaginal discharge. For bacteriologic studies, care must be taken to ensure that the external genitalia have been thoroughly cleansed as directed by laboratory procedures for clean-catch specimen collection. The patient must void the initial stream of urine into the toilet or a suitable container and the remainder directly into a sterile container. All urine specimens should either be examined when freshly voided, or refrigerated to prevent decomposition of urinary constituents and to limit bacterial growth. The following sections will cover three types of urine specimens: random, first morning, and 24-hour.

**Random Urine Specimen** is the most commonly received specimen because of the ease of collection and convenience for the patient. These specimens are collected without regard to the time of day or fasting state. This sample is useful for routine screening tests to detect obvious abnormalities. It may produce erroneous results caused by dietary intake or physical activity just prior to the collection of the specimen. It is the least valid specimen, and patients may later be requested to collect additional specimens under more controlled conditions.

**First Morning Urine Specimen** is the first urine voided upon rising. It is the ideal screening specimen, because it is usually concentrated and more likely to reveal abnormalities. If positive results are obtained from the first morning specimen, the physician may order a 24-hour specimen for quantitative studies.

**Twenty-Four Hour Urine Specimen** measures the exact output of urine over a 24-hour period. Use the following steps to collect this specimen.

1. Have patient empty bladder early in the morning and record time. Discard this urine.
2. Collect all urine voided during next 24 hours.
3. Instruct patient to empty bladder at 0800 the following day (end of 24-hour period). Add this urine to pooled specimen.

Refrigerate specimen during collection. Depending on the test being performed, add a preservative to the first specimen voided.

The normal daily urine volume for adults ranges from 600 to 2,000 ml, averaging about 1,500 ml. The amount of urine excreted in 24 hours varies with fluid intake and the amount of water lost through perspiration, respiration, and bowel activity. Diarrhea or profuse sweating reduces urinary output; diabetes is associated with increased urinary output.
PRESERVATION OF URINE SPECIMENS

To delay decomposition of urine, use the following methods of preservation:

- Refrigeration
- Preservatives
  - Hydrochloric acid
  - Other preservatives as directed by laboratory staff

**NOTE:**
Before adding a preservative to a urine specimen, contact the laboratory performing the testing to find out what preservative and quantity to use. Preservative requirements vary from laboratory to laboratory.

ROUTINE URINE EXAMINATION

A routine urinalysis includes the examination of physical characteristics, chemical characteristics, and microscopic structures in the sediment. A sample for urinalysis (routine and microscopic) should be at least 12 ml in volume (adult), and either a random or first morning specimen. Children may only be able to provide a small volume, but 10-15 ml is preferred.

**Physical Characteristics**

Physical characteristics evaluated during a routine urinalysis include color, appearance, and specific gravity.

**COLOR** - The normal color of urine varies from straw to amber. Diluted urine is generally pale; concentrated urine tends to be darker. The following are terms used to describe the color of urine:

- Colorless
- Light straw
- Straw
- Dark straw
- Light amber
- Amber
- Red, abnormal color

The color of urine may be changed by the presence of blood, drugs, or diagnostic dyes. Examples are:

- **Red or red-brown** - caused by the presence of blood
- **Yellow or brown** (turning greenish with yellow foam when shaken) - caused by the presence of bile
- **Olive green to brown-black** - caused by phenols (an extremely poisonous compound, used as an antimicrobial agent)
- **Dark orange** - caused by Pyridium® (a topical analgesic used in the treatment of urinary tract infections)

**CLARITY**

Urine’s appearance may be reported as clear, hazy, slightly cloudy, cloudy, or turbid. Freshly passed urine is usually clear or transparent. Urine can appear cloudy when substances such as blood, leukocytes, crystals, pus, or bacteria are present. A report of transparency is of value only if the specimen is fresh. After standing, all urine becomes cloudy because of decomposition, salts, and the action of bacteria. Upon standing and cooling, all urine specimens will develop a faint cloud composed of mucus, leukocytes, and epithelial cells. This cloud settles to the bottom of the specimen container and is of no significance.

**SPECIFIC GRAVITY**

The ability of the kidneys to selectively reabsorb essential chemicals and water is one of the body’s most important functions. Specific gravity is defined as the density of a solution compared to an equal volume of distilled water. The specific gravity varies directly with the amount of solids dissolved in the urine, and normally ranges from 1.015 to 1.030 during a 24-hour period.
The first morning specimen of urine is more concentrated and will have a higher specific gravity than a specimen passed during the day. A high fluid intake may reduce the specific gravity to below 1.010. In the presence of disease, the specific gravity of a 24-hour specimen may vary from 1.001 to 1.060.

Specific gravity is measured with an index refractometer, available as standard equipment at most duty stations (Fig. 19-16). It may be held manually or mounted on a stand like a microscope. The specific gravity of urine is determined by the index of light refraction through solid material.

Chemical Characteristics

Chemical characteristics evaluated during a routine urinalysis include pH, protein, glucose, ketones, blood, bilirubin, urobilinogen, nitrite, leukocytes, and specific gravity depending on the test strip used. Each manufacturer of reagent strips includes a color chart for multiple chemical determinations. The strip is dipped into the urine specimen and compared to the color values for the various tests on the accompanying chart. The color chart also indicates numerical pH values, which should be reported. Since this test is based on color changes, those with color deficiency may need to take extra care to interpret the results.

Urinalysis Reagent Strips

Reagent strips consist of chemical-impregnated absorbent pads attached to a plastic strip. A color-producing chemical reaction takes place when the absorbent pad comes in contact with urine. Color reactions are interpreted by comparing the color produced on the pad with a chart supplied by the manufacturer of the reagent strips. Several colors or intensities of a color for each substance being tested appear on the chart. By careful comparison of the colors on the chart and the strip, a semi-quantitative value of trace, 1+, 2+, 3+, or 4+ can be reported.

Testing methodology includes dipping the reagent strip completely, but briefly, into a well-mixed specimen; removing the excess urine from the strip when withdrawing it from the specimen; waiting the specified length of time for reactions to take place; and comparing the colored reactions against the manufacturer's chart using a good light source.

Improper technique can result in errors. Formed elements such as red and white blood cells sink to the bottom of the specimen and will be undetected in an unmixed specimen. Allowing the strip to remain in the urine for an extended period may cause leaching of reagents from the pads. Likewise, excess urine remaining on the strip after its removal from the specimen can produce a run-over between chemicals on adjacent pads, producing distortion of the colors.
To ensure against run-over, blotting the edge of the strip and holding the strip horizontally while comparing it with the color chart is recommended. The amount of time needed for reactions to take place varies from an immediate reaction to two minutes. The required reaction time is written on the comparison chart located on the side of the reagent strip container (Fig. 19-17).

The strip must be held close to the color chart without actually placing it on the chart. Reagent strips and color charts from different manufacturers are not interchangeable. Specimens that have been refrigerated must be allowed to return to room temperature prior to reagent strip testing, since some enzymatic reactions on the strips are temperature dependent.

In addition to the use of correct testing technique, reagent strips must be protected from deterioration caused by moisture, volatile chemicals, heat, and light. Reagent strips are packaged in opaque containers with a desiccant to protect them from light and moisture. Strips are removed just prior to testing, and the bottle is tightly resealed immediately after strips are removed.

All bottles are stamped with an expiration date that represents the functional life expectancy of the chemical pads. Reagent strips should not be used past the expiration date. Care must be taken not to touch the chemical pads when removing the strips.

**Microscopic Examination of Urine Sediment**

Microscopic examination of urine sediment at 40X is usually performed in addition to routine chemical procedures. This examination requires a degree of skill acquired through practice under the immediate supervision of an experienced technician. The specimen used for microscopic examination should be as fresh as possible. Red cells and many formed solids tend to disintegrate upon standing, particularly if the specimen is warm or alkaline.

*Figure 19-17.—Urine Dipstick*

*Used with permission of Siemens Healthcare Diagnostics Inc.*
**CLINICALLY SIGNIFICANT FINDINGS.**—
Leukocytes, erythrocytes, and casts may all be of clinical significance when found in urine sediment.

**Leukocytes.**—Normally, 0 to 3 leukocytes per high-power field will be seen on microscopic examination (Fig. 19-18). More than 3 cells per high-power field may indicate disease somewhere in the urinary tract. Estimate the number of leukocytes present per high-power field and report it as the "estimated number per high-power field."

**Figure 19-19.—RBC in Urine**

**Erythrocytes.**—Red cells are not usually present in normal urine. If erythrocytes are found, estimate their number per high-power field and report it. Erythrocytes may be differentiated from white cells in several ways (Fig. 19-19):

- White cells are larger than red cells
- When focusing with the high-power lens, the red cells may appear as swollen or perfectly rounded with a distinct circle; the white cells tend to appear granular with a visible nucleus
- One drop of 2% acetic acid added to the urine sediment disintegrates any red cells, but it does not affect the white

**Figure 19-20.—Epithelial Cells**
Casts.—These urinary sediments are formed by coagulation of albuminous material in the kidney tubules. Casts are cylindrical and vary in diameter (Figs. 19-21 and 19-22). The sides are parallel, and the ends are usually rounded. Casts in the urine always indicate some form of kidney disorder and should always be reported. If casts are present in large numbers, the urine is almost sure to be positive for albumin.

RESULTS AND READINESS

LEARNING OBJECTIVES:

1. Explain the clinical significance of critical results.
2. Identify the significance of laboratory function as they relate to operational readiness.

CRITICAL RESULTS

Some test results that the HM may encounter in performing routine testing are indicative of life-threatening conditions that need to be communicated to the provider immediately. Each treatment facility has specific guidance for critical results. Below are results that will always be considered critical regardless of location.

- White Blood Cell (WBC) count above 50,000 indicates acute infection
- Hemoglobin concentration below 7 indicates severe anemia that may require a transfusion
- Glucose and ketones both positive on the urine reagent strip may indicate uncontrolled diabetes
- Bacteria present in a gram stain from direct patient smears

If the HM encounters any of the above results, they should report the results to a provider immediately. Other critical test results may be defined locally and should be included in the laboratory department Standard Operating Procedures manual along with reporting procedures.

Figure 19-21.—Cast


Figure 19-22.—Cast

Walking Blood Bank\textsuperscript{22} (WBB)

Whole blood transfusions may be required in an emergency situation. The Walking Blood Bank (WBB) will be used in a mass casualty situation if necessary and feasible in the operational setting. WBB donors should only be used in a true emergency when the delay necessary to transfer a patient to a shore-based medical facility would be detrimental to a critical patient. The WBB is established on numerous operational platforms by maintaining a list of all personnel eligible as blood donors (walking blood bank). A minimum file of ten percent of certain ship's company is required to be enrolled in the walking blood bank.

Although transfusion at sea is a rare event, the availability of a well-planned transfusion program is required, and will be coordinated by the Senior Medical Department Representative and embarked laboratory personnel. The life-saving nature of blood products requires strict regulations and oversight. HMs may be requested to volunteer as members of the WBB, recruit members of the operational platform for the WBB, or assist the laboratory staff when directed by the surgeon to initiate the WBB in an emergency or mass casualty situation.

LABORATORY RESULTS AND READINESS\textsuperscript{22}

Certain laboratory results are tracked for individual, medical, and operational readiness.

\textbf{G6PD, Sickle Cell, ABO/Rh (Blood Type), and DNA Reference specimen}\ are usually collected and documented upon creation of treatment record at point of accession.

\textbf{Current HIV-} Requirement varies based on platform.

It is important for treatment records to be adequately screened upon a Sailor's reporting to each new command to document these items into the appropriate readiness tracking programs. If deficiencies are found, these tests should be recollected, tested, and documented as soon as possible.

SUMMARY

Clinical laboratory medicine is a very dynamic field of medicine, with new testing procedures and equipment being invented all the time. This chapter is an introduction to some basic laboratory tests that do not require state-of-the-art equipment and that can be easily performed in isolated duty stations and aboard naval vessels. These tests will assist with establishing diagnoses and will enable the medical staff to provide the best possible medical care for the patients.
CHAPTER 20

EMERGENCY RESCUE: SUPPLIES, EQUIPMENT & PROCEDURES

INTRODUCTION

This chapter outlines first aid equipment/supplies and the rescue/transportation of the injured patient. A Hospital Corpsman (HM) will be expected to recognize the uses and application procedures for many dressings and bandages, be able to identify the protective equipment needed in specific emergencies, and where and when to use them.

This will familiarize HMS with the phases of a rescue operation; stages of extrication; the precautionary steps to be taken in special rescue situations; recognizing the different patient-moving devices and lifting techniques; various forms of emergency transportation; how to identify essential basic life support supplies used in operational and non-operational rescue efforts; and provide the preparatory, en route, and procedures for patients being transported to medical treatment facilities.

EQUIPMENT AND SUPPLIES

LEARNING OBJECTIVE:

Identify initial equipment and supply needs.

In a first aid situation, the HM must always be ready to improvise. In many field emergency situations, standard medical equipment and supplies may not be immediately available, or the supplies are exhausted.

When assigned to Marine Corps units, HMs carry a medical equipment and supplies in a special bag. It is referred to as a “Unit One Bag” which is currently being replaced by the Modular Lightweight Load Carrying Equipment (MOLLE) bag or a “Stomp” bag.

Unique operational requirements or command decisions may modify the contents of these bags. As a HM, it is important to be familiar with the emergency medical equipment at the command, since a call may come at a moment’s notice and requiring use of these items to help save or sustain a life.

DRESSINGS AND BANDAGES

There are many different types of dressing bandages. HMs should be familiar with the various standard dressings and bandages, the respective functions, and proper application in first aid and emergency situations.

DEFINITION OF A DRESSING

A dressing is a sterile pad or compress (usually made of gauze or cotton wrapped in gauze) used to cover wounds to control bleeding and prevent further contamination. Dressings should be large enough to cover the entire area of the wound and extend at least 1" in every direction beyond the wound edges. If the dressing is not large enough, the edges of the wound are almost certain to become contaminated.

Battle Dressing

A battle dressing is a combination compress and bandage in which a sterile gauze pad is fastened to a gauze, muslin, or adhesive bandage. Most of the Navy first aid kits contain both large and small battle dressings of this kind. Most prepackaged battle dressings are 4 tailed bandages for use in bandaging extremity, abdominal, and head wounds (Fig. 20-1).
Any part of a dressing that comes in direct contact with a wound should be sterile (free from microorganisms). The dressings that HMs find in first aid kits have been sterilized. However, once they come in contact with fingers, clothing, or any other unsterile object, they are no longer sterile. If the HM drags a dressing across the casualty’s skin or allows it to slip after it is in place, the dressing is no longer sterile.

Should an emergency arise when a sterile dressing is not available, the cleanest cloth at hand may be used such as a freshly laundered handkerchief, towel, or shirt. Unfold these materials carefully so that the part that goes next to the skin is not touched. **Always be ready to improvise when necessary, but never put materials directly in contact with wounds if those materials are likely to stick to the wound, leave lint, or be difficult to remove.**

**DEFINITION OF A BANDAGE**

Standard bandages are made of gauze or muslin and are used over a sterile dressing to secure the dressing in place, to close off its edge from dirt and germs, and to create pressure on the wound and control bleeding. A bandage can also support an injured part or secure a splint. The most common types of bandages are the roller and triangular bandages.
Roller Bandage (Fig. 20-2) consists of a long strip of material (usually gauze, muslin, or elastic) wound into a cylindrical shape. Roller bandages come in various widths and lengths. Most of the roller bandages in first aid kits have been sterilized, so pieces may be cut off and used as compresses in direct contact with wounds.

Figure 20-2.—Roller Bandage

Image provided by: Department of the Army. (2009). Soldier’s handbook and training guide for MOS 68W STP 8-68W13-SM-TG.

General Application

Applying a roller bandage:

1. Hold the roll in the right hand so that the loose end is on the bottom
2. The outside surface of the loose or initial end is next applied to and held on the body part by the left hand.
3. The roll is then passed around the body part by the right hand, which controls the tension and application of the bandage. Two or three of the initial turns of a roller bandage should overlie each other to properly secure the bandage.
4. Perform pulse check of the extremity upon completion of applying roller bandage.

NOTE:

In applying the turns of the bandage, it is often necessary to transfer the roll from one hand to the other.

Bandages should be applied evenly, firmly, but not too tightly.

Excessive pressure may cause interference with the circulation and lead to disastrous consequences.

In bandaging an extremity, it is advisable to leave the fingers or toes exposed so the circulation of these parts may be readily observed.

It is likewise safer to apply a large number of turns of a bandage, rather than to depend upon a few turns applied too firmly to secure a compress.

Wet Bandage Application

Applying a wet bandage (or one that may become wet, HMs must allow for shrinkage. The turns of a bandage should completely cover the skin to prevent the possibility of pinching and discomfort as any uncovered areas of skin may become pinched between the turns, with resulting discomfort. In bandaging any extremity, it is advisable to include the whole extremity except the finger and toes so that uniform pressure may be maintained throughout. It is also desirable when bandaging a limb that the limb is placed in the position it will occupy when the dressing is finally completed, as variations in the flexion and extension of the limb will cause changes in the pressure of certain parts of the bandage.
Starting and Finishing the Roller bandage

1. The initial turns of a bandage on an extremity (including spica bandages of the hip and shoulder) should be applied securely, and, when possible, around the part of the limb that has the smallest circumference.

2. In bandaging the arm or hand, the initial turns are usually applied around the wrist, and in bandaging the leg or foot, the initial turns are applied immediately above the ankle.

3. The final turns of a completed bandage are usually secured in the same manner as the initial turns, by employing two or more overlying circular turns.

4. As both edges of the final circular turns are exposed, they should be folded under to present a neat, cuff like appearance.

5. The terminal end of the completed bandage is turned under and secured to the final turns by either a safety pin or adhesive tape. When these are not available, the end of the bandage may be split lengthwise for several inches, and the two resulting tails may be secured around the part by tying.

Roller Bandage for Elbow

A spica or figure-eight type of bandage is used around the elbow joint to retain a compress in the elbow region and to allow a certain amount of movement.

1. Flex the elbow slightly (if it can be done without causing further pain or injury), or anchor a 2 or 3 inch bandage above the elbow and encircle the forearm below the elbow with a circular turn.

2. Continue the bandage upward across the hollow of the elbow to the starting point.

3. Make another circular turn around the upper arm, carry it downward, repeating the figure-eight procedure, and gradually ascend the arm.

4. Overlap each previous turn about two-thirds of the width of the bandage.

5. Secure the bandage with two circular turns above the elbow; and tie. To secure a dressing on the tip of the elbow, reverse the procedure and cross the bandage in the back (Fig. 20-3).

6. Perform pulse check of the extremity upon completion of applying roller bandage.
Roller Bandage for Hand and Wrist

For the hand and wrist, a figure-eight bandage is ideal.

1. Anchor the dressing at the wrist, whether the wound is on the hand or wrist, with several turns of a 2 or 3 inch bandage. If on the hand, anchor the dressing with several turns and continue the bandage diagonally upward and around the wrist and back over the palm.

2. Make as many turns as necessary to secure the compress properly (Fig. 20-4).

Roller Bandage for Ankle and Foot

The figure-eight bandage is also used for dressings of the ankle, such as for supporting a sprain.

1. While keeping the foot at a right angle, start a 3-inch bandage around the instep for several turns to anchor it.

2. Carry the bandage upward over the instep and around behind the ankle, forward, and again across the instep and down under the arch, thus completing one figure-eight.

3. Continue the figure-eight turns overlapping one-third to one-half the width of the bandage and with an occasional turn around the ankle, until the compress is secured or until adequate support is obtained (Fig. 20-5).

Figure 20-4.—Roller Bandage for Hand and Heel

Figure 20-5.—Roller Bandage for Ankle and Foot

4. Perform pulse check of the extremity upon completion of applying roller bandage.

Roller Bandage for Heel

Due to the shape of the heel, it is one of the most difficult parts of the body to bandage.

1. Place the free end of the bandage on the outer part of the ankle and bring the bandage under the foot and up.

2. Carry the bandage over the instep, around the heel, and back over the instep to the starting point. Overlap the lower border of the first loop around the heel and repeat the turn, overlapping the upper border of the loop around the heel. Continue this procedure until the desired number of turns is obtained, and secure with several turns around the lower leg.
Roller Bandage for Arm and Leg

The spiral reverse bandage must be used to cover wounds of the forearm and lower extremities; only such bandages can keep the dressing flat and even. A spiral reverse bandage is a bandage that is turned and folded back on itself as necessary to make it fit the contour of the body more securely.

1. Make two or three circular turns around the lower and smaller part of the limb to anchor the bandage and start upward.
2. Make reverse laps on each turn, overlapping about one-third to one-half the width of the previous turn.
3. Continue as long as each turn lies flat.
4. Continue the spiral and secure the end when completed.
5. Perform pulse check of the extremity upon completion of applying roller bandage.

Four-Tailed Bandage

A piece of roller bandage may be used to make a four-tailed bandage. The four-tailed bandage is good for bandaging any protruding part of the body because the center portion of the bandage forms a smoothly fitting pocket when the tails are crossed over. This type of bandage is created by splitting the cloth from each end, leaving as large a center area as necessary. The four-tailed bandage is often used to hold a compress on the chin, or on the nose (Fig. 20-6).

Barton Bandage

The Barton bandage is frequently used for fractures of the lower jaw and to retain compresses to the chin.

1. As in the progressive steps illustrated below (Fig. 20-7), the initial end of the roller bandage is applied to the head, just behind the right mastoid process.

2. The bandage is then carried under the bony prominence at the back of the head, upward and behind the left ear, obliquely across the top of the head.
3. Bring the bandage downward in front of the right ear.
4. Pass the bandage obliquely across the top of the head, crossing the first turn in the midline of the head, and then backward and downward to the point of origin behind the right mastoid.

Figure 20-6.—Wrapping a Four-Tailed Bandage

Figure 20-7.—Using a Barton Bandage
5. Carry the bandage around the head under the left ear, around the front of the chin, and under the right ear to the point of origin.

6. This procedure is repeated several times, each turn exactly overlaying the preceding turn.

7. Secure the bandage with a pin or strip of adhesive tape at the crossing on top of the head.

**TRIANGULAR BANDAGE**

Triangular bandages are usually made of muslin. They are made by cutting a 36 to 40 inch square of a piece of cloth and then cutting the square diagonally, thus making two triangular bandages (in sterile packs on the Navy’s medical stock list). A smaller bandage may be made by folding a large handkerchief diagonally. The longest side of the triangular bandage is called the base; the corner directly opposite the middle of the base is called the point; and the other two corners are called ends (Fig. 20-8).

The triangular bandage is useful as it can be folded in a variety of ways to fit almost any part of the body. Padding can be added to areas that may become uncomfortable.

**Triangular Bandage for Head**

This bandage is used to retain compresses on the forehead or scalp.

1. Fold back the base about 2 inches to make a hem.

2. Place the middle of the base on the forehead, just above the eyebrows, with the hem on the outside.

3. Let the point fall down over the back of the head.

4. Bring the ends of the triangle around the back of the head above the ears, cross them over the point, carry them around the forehead, and tie in a **SQUARE KNOT** (Fig. 20-9).

5. Hold the compress firmly with one hand and, with the other, gently pull down the point until the compress is snug.

6. Bring the point up and tuck it over and in the bandage where it crosses the back part of the head.

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**Figure 20-8.—Triangular Bandage**

[Diagram of a triangular bandage]

**Figure 20-9.—Triangular Bandage for the Head**

[Diagram of a triangular bandage for the head]
**Triangular bandage for shoulder**

1. Cut or tear the point, perpendicular to the base, about 10 inches.
2. Tie the two points loosely around the patient’s neck, allowing the base to drape down over the compress on the injured side (Fig. 20-10).
3. Fold the base to the desired width, grasp the end, and fold or roll the sides toward the shoulder to store the excess bandage.
4. Wrap the ends snugly around the upper arm, and tie on the outside surface of the arm.

**Triangular Bandage for Chest**

1. Cut or tear the point, perpendicular to the base, about 10 inches.
2. Tie the two points loosely around the patient’s neck, allowing the bandage to drape down over the chest.
3. Fold the bandage to the desired width, carry the ends around to the back, and secure by tying.

**Triangular Bandage for Hip or Buttock**

1. Cut or tear the point, perpendicular to the base, about 10 inches.
2. Tie the two points around the thigh on the injured side.
3. Lift the base up to the waistline, fold to the desired width, grasp the ends, fold or roll the sides to store the excess bandage, carry the ends around the waist, and tie on the opposite side of the body.

**Triangular Bandage for Side of Chest**

1. Cut or tear the point, perpendicular to the base, about 10 inches.
2. Place the bandage, points up, under the arm on the injured side.
3. Tie the two points on top of the shoulder.
4. Fold the base to the desired width, carry the ends around the chest, and tie on the opposite side.
**Triangular Bandage for Foot or Hand**

This bandage is used to retain large compresses and dressings on the foot or the hand.

For the foot:
1. After the compresses are applied, place the foot in the center of a triangular bandage and carry the point over the ends of the toes and over the upper side of the foot to the ankle.
2. Fold the excess bandage at the side of the foot, cross the ends, and tie in a square knot in front.

For the hand:
1. After the dressings are applied, place the base of the triangle well up in the palmar surface of the wrist.
2. Carry the point over the ends of the fingers and back of the hand well up on the wrist.
3. Fold the excess bandage at the side of the hand, cross the ends around the wrist, and tie a square knot in front.

**Cravat Bandage**

A triangular bandage can be folded into a strip for easy application during an emergency. When folded as shown in Figure 20-11, the bandage is called a cravat. When necessary, a cravat can be improvised from common items such as T-shirts, bed linens, trouser legs, scarves, or any other item of pliable and durable material that can be folded, torn, or cut to the desired size.

1. Bring the point of the triangular bandage to the middle of the base and continue to fold until a 2 inch width is obtained.
2. The cravat may be tied, or it may be secured with safety pins (if the pins are available).

**Cravat Bandage for Head**

This bandage is useful to control bleeding from wounds of the scalp or forehead.

1. After placing a compress over the wound, place the center of the cravat over the compress.
2. Carry the ends around to the opposite side.
3. Cross them and continue to carry them around to the starting point.
4. Tie in a square knot.

**Cravat Bandage for Eye**

1. After applying a compress to the affected eye, place the center of the cravat over the compress on a slant so that the lower end is pointed downward.
2. Bring the lower end around under the ear on the opposite side.
3. Cross the ends in back of the head, bring them forward, and tie them over the compress.
4. Figure 20-12 shows the proper application of a cravat bandage for the eye.

![Figure 20-11.—Cravat Bandage](image)

![Figure 20-12.—Cravat Bandage for the Eye](image)
Cravat Bandage for Temple, Cheek, or Ear  
(also called a Modified Barton)

1. After a compress is applied to the wound, place the center of the cravat over it and hold one end over the top of the head.
2. Carry the other end under the jaw and up the opposite side, over the top of the head.
3. Cross the two ends at right angles over the temple on the injured side.
4. Continue one end around over the forehead and the other around the back of the head to meet over the temple on the uninjured side.
5. Tie the ends in a square knot.

Cravat Bandage for Elbow or Knee

1. After applying the compress (Fig. 20-13), and if the injury or pain is not too severe, bend the elbow or knee to a right-angle position before applying the bandage.
2. Place the middle of a wide cravat over the point of the elbow or knee.
3. Carry the upper end around the upper part of the elbow or knee, bringing it back to the hollow (antecubital or popliteal space).
4. Carry the lower end entirely around the lower part, bringing it back to the hollow.
5. Ensure that the bandage is smooth and fits snugly; tie in a square knot outside of the hollow.

Cravat Bandage for Arm or Leg

The width of the cravat used will depend upon the extent and area of the injury.

For a small area:

1. Place a compress over the wound and center the cravat bandage over the compress.
2. Bring the ends around in back, cross them, and tie over the compress.

For a small extremity:

1. It may be necessary to make several turns around to use the entire bandage for tying.
2. If the wound covers a larger area, hold one end of the bandage above the compress.
3. Wind the other end spirally downward across the compress until it is secure, then upward and around again.
4. Tie a knot where both ends meet (Fig. 20-14).

Figure 20-13.—Cravat Bandage for the Elbow

Figure 20-14.—Cravat Bandage for the Arm
Cravat Bandage for Axilla (Armpit)

This cravat is used to hold a compress in the axilla. It is similar to the bandage used to control bleeding from the axilla.

1. Place the center of the bandage in the axilla over the compress.
2. Carry the ends up over the top of the shoulder and cross them.
3. Continue across the back and chest to the opposite axilla, and tie them.
4. Do not tie too tightly or the axillary artery will be compressed, adversely affecting the circulation of the arm (Fig. 20-15).

![Figure 20-15.—Cravat Bandage for Axilla](image)

5. Perform pulse check of the extremity upon completion of applying roller bandage.

BATTLE DRESSING

A battle dressing is a combination compress and bandage in which a sterile gauze pad is fastened to a gauze, muslin, or adhesive bandage. Most Navy first aid kits contain both large and small battle dressings of this kind. Most pre-packaged battle dressings are 4 tailed bandages for use in bandaging extremity, abdominal and head wounds (see Fig. 20-1).

COMBAT APPLICATION TOURNIQUET® (C-A-T®)

The Combat Application Tourniquet® (C-A-T®, Fig. 20-16) is a small and lightweight one-handed tourniquet that completely occludes arterial blood flow in an extremity. The C-A-T® uses a Self-Adhering Band and a Friction Adaptor Buckle to fit a wide range of extremities combined with a one-handed windlass system. The windlass uses a free moving internal band to provide true circumferential pressure to an extremity. The windlass is then locked in place; this requires only one hand, with the Windlass Clip™. The C-A-T® also has a Hook-and-Loop Windlass Strap™ for further securing of the windlass during patient transport.

![Figure 20-16.—C-A-T® Tourniquet.](image)

Asherman Chest Seal

Utilized as standard rapid management in emergency situations, the Asherman Chest Seal (ACS™) is a sterile occlusive dressing for treating an open pneumothorax and preventing a tension pneumothorax in chest injuries from gunshot, stab wounds, or other penetrating chest trauma. The unique one-way valve is designed to let air and blood escape while preventing re-entry of either. It has been proven to be more effective treatment than standard petroleum gauze. The ACS™ is 5.5” in diameter, includes a gauze pad (4” x 4”) to clean and dry the wound, and is clear so the wound can be observed.
MONITORING DEVICES

*Automated External Defibrillator (AED)* is a portable electronic device capable of analyzing cardiac rhythms and selecting the appropriate strength of defibrillation (the application of electrical therapy which stops the arrhythmia, allowing the heart to reestablish an organized electrical message to the heart tissue). The user simply places two self-adhesive pads on the torso of a cardiac arrest casualty and presses a button on the AED. The AED analyzes the rhythm and recommends the appropriate treatment. Some systems will go into an automatic analysis of the heart rhythm without pushing a button. Initially reserved for use by trained medical responders such as firefighters and EMTs, the devices are being used with great success in various public settings such as in airports and training environments.

**CAUTION:**

Not all AED’s are approved for use in operational platforms.

*Pulse Oximeter* is a medical device that measures the oxygen saturation of a patient's blood and changes in blood volume in the skin, producing a photoplethysmograph (measured changes in light absorption). It is often attached to a medical monitor allowing staff to monitor a patient's oxygenation. Some monitors also display the heart rate. Portable, battery-operated pulse oximeters are available for home blood-oxygen monitoring. A blood-oxygen monitor displays the percentage of arterial hemoglobin in the oxyhemoglobin configuration. Acceptable normal ranges are 95 to 100 percent, although values down to 90 percent are common. The pulse oximeter should be used in conjunction with other findings from the physical examination to monitor patient airway, breathing, and shock.

INTRAVENTOUS FLUIDS AND DELIVERY DEVICES

**LEARNING OBJECTIVE:**

Describe the appropriate intravenous fluids based upon their uses.

There are two types of fluids used for intravenous drips; crystalloids and colloids. Crystalloids are aqueous solutions of mineral salts or other water-soluble molecules. Colloids contain larger insoluble molecules, such as gelatin; blood itself is a colloid. The most commonly used crystalloid fluid is normal saline, a solution of sodium chloride at 0.9% concentration, which is close to the concentration in the blood (isotonic). Ringer's lactate or Ringer's acetate is another isotonic solution often used for large-volume fluid replacement.

*Normal Saline* (NS) is the commonly-used term for a solution of 0.91% w/v (percent weight by volume) of Sodium Chloride NaCl. Less commonly, this solution is referred to as physiological saline or isotonic saline, neither of which is technically accurate. NS is used frequently in intravenous drips (IVs) for patients who cannot take fluids orally and have developed or are in danger of developing dehydration or hypovolemia. NS is typically the first fluid used when hypovolemia is severe enough to threaten the adequacy of blood circulation and has long been believed to be the safest fluid to give quickly in large volumes. However, it is now known that rapid infusion of NS can cause **metabolic acidosis**. The amount of normal saline infused depends on the needs of the patient (e.g. ongoing diarrhea or heart failure) but is typically between 1.5 and 3 liters a day for an adult.

*Lactated Ringers Solution* (LR) is often used for fluid resuscitation after a blood loss due to trauma, surgery, or a burn injury. Overall, it is used to increase body fluid and buffer acidosis. Previously, it was used to induce urine output in patients with renal failure.
The intravenous dose of LR solution is usually calculated by estimated fluid loss and presumed fluid deficit. For fluid resuscitation the usual rate of administration is 20 to 30 ml/kg body weight/hour. LR solution is not suitable for maintenance therapy because the sodium content is considered too high for adults, in view of electrolyte daily requirement.

Hetastarch is a synthetic plasma expander that works by producing expansion of plasma blood volume. It is used to prevent shock following severe blood loss caused by trauma, surgery, or some other problem. It increases the blood volume, allowing red blood cells to continue to deliver oxygen to the body. It is not a substitute for blood or plasma. It does not have oxygen-carrying capacity. Dosage for plasma volume expansion: Adults: 500-1000 mL (up to 1500 mL/day) or 20 mL/kg/day (up to 1500 mL/day).

INFUSION EQUIPMENT

Intravenous Infusion Set

A standard IV infusion set consists of a pre-filled, sterile container (glass bottle, plastic bottle or plastic bag) of fluids with an attached drip chamber which allows the fluid to flow one drop at a time, making it easy to see the flow rate (and also reducing air bubbles); a long sterile tube with a clamp to regulate or stop the flow; a connector to attach to the access device; and connectors to allow "piggybacking" of another infusion set onto the same line, e.g. adding a dose of antibiotics to a continuous fluid drip.

Intraosseous Device

When it is difficult to establish IV access in casualties in shock, an intraosseous (IO) device offers an alternative route for administering fluids and medications. This allows the medical provider to avoid more difficult and invasive techniques like central venous cannulation or saphenous cut down. An intraosseous device, such as the Pyng FAST-1 ™, delivers fluid through the bone marrow of the sternal manubrium.

The technique of using this device is readily applicable in low light conditions or when there is an absence of the tibia (common spot for some IO devices) such as trauma from land mines or improvised explosive device (IED).

Infusion Pump

An infusion pump allows precise control over the flow rate and total amount delivered. Infusion pumps can administer fluids in ways that would be impractically expensive or unreliable if performed manually by nursing staff. These pumps can administer as little as 0.1 mL per hour injections (too small for a drip), injections every minute, injections with repeated boluses requested by the patient, up to maximum number per hour (e.g. patient-controlled analgesia), or fluids whose volumes vary by the time of day.

BREATHING AIDS

LEARNING OBJECTIVE:

Describe breathing aids and their uses.

As a HM, it is imperative to become familiar with the breathing aids that may be available to help maintain an open airway and to restore breathing in emergency situations. Breathing aids include oxygen, artificial airways, bag-valve mask ventilator, pocket face mask, and suction devices.

USE OF OXYGEN (O2)

In an emergency situation, HMs will have a size D or E cylinder of oxygen available.
SETTING UP A D-SIZED OXYGEN TANK

Condition

The HM needs to set up a D-sized oxygen tank. The HM has already performed a patient care hand-wash. The HM will need a full oxygen cylinder with a regulator/flowmeter, non-sparking cylinder wrench, oxygen regulator/flowmeter for D cylinders, yoke attachment, humidifier, sterile water, oxygen cylinder transport carrier and/or stand oxygen, oxygen administration device, and warning signs. The HM is not in a CBRNE environment.

Standards: Set up the oxygen tank without violating safety precautions or endangering patients or yourself.

Performance Steps

Take body substance isolation (BSI) precautions.

Obtain the necessary equipment.

Oxygen cylinder (Fig. 20-17).

NOTE:
Check the oxygen cylinder tag to determine whether the tank is "FULL", "IN USE" (partially full), or "EMPTY" (Fig. 20-18).

CAUTION:
Always ensure that the cylinder selected contains oxygen and not some other compressed gas. United States oxygen cylinders are color coded green, silver or chrome with a green area around the valve stem on top. The international color code is white.

Figure 20-17.—D type oxygen cylinder

Performance Steps

1. Cylinder with regulator/flowmeter. (Fig. 20-19).

![Figure 20-19 – Cylinder Regulator](image)

**NOTE:**
When the cylinder regulator pressure gauge reads 200 psi or lower, the oxygen tank is considered empty.

The pressure-compensated flowmeter is affected by gravity and must be maintained in an upright position.

2. Humidifier.

3. Sterile water.


5. Oxygen cylinder transport carrier and/or stand.

6. Oxygen administration device appropriate for the patient as ordered by the medical officer (nasal cannula, non-rebreather mask, or bag-valve mask device with reservoir).

7. Warning signs.
   a. "NO SMOKING".
   b. "OXYGEN IN USE".

**CAUTION:**
Because of the extreme pressure in oxygen tanks, they should be handled with great care. Do not allow tanks to be banged together, dropped, or knocked over.

8. Secure the oxygen cylinder.
   a. Upright position or as directed in local standard operating procedures.
   b. Secured with straps or in a stand.
   c. Away from doors and areas of high traffic.

9. Remove the cylinder valve cap.

**NOTE:**
The cylinder valve cap may be noisy or difficult to remove; however, the threads of the cylinder cap should never be oiled.

10. Use either the hand wheel or a non-sparking wrench to "crack" (slowly open and quickly close) the cylinder to flush out any debris.

11. Attach the regulator/flowmeter to the cylinder.
   a. Locate the three holes on the oxygen cylinder stem and ensure that an "O" ring is present (Fig. 20-20).

![Figure 20-20.—Three holes on the oxygen cylinder stem](image)

**NOTE:**
If the "O" ring is not present, an oxygen leak will occur.
b. Examine the yoke attachment and locate the three corresponding pins on the yoke attachment (Fig. 20-21).

![Diagram of Yoke Regulator Attachment](image)

**NOTE:**
The compressed gas industry uses a "pin-indexing system" for portable gas cylinders. The locations of the pins on the yoke match only the regulator/flowmeter for an oxygen cylinder.

c. Slide the yoke attachment over the cylinder stem, ensuring that the pins are seated in the proper holes.

d. Turn the vise-like screw on the side of the yoke attachment to secure it.

e. Open the valve to test for leaks, and then close it.

i. If you hear a leak, check the regulator connection and obtain a new Regulator/flowmeter and/or cylinder, if necessary.

ii. When in-wall oxygen is available, the flowmeter will be attached to the oxygen outlet as follows:

1. Turn the flow adjusting valve of the flowmeter to the OFF position.

2. Insert the flowmeter adapter into the opening outlet and press until a firm connection is made.

f. Fill the humidifier bottle to the level indicated (about two-thirds full) with sterile water.

g. Attach the humidifier to the flowmeter.

**NOTE:**
If an oxygen tube connector adapter is present, remove it from the flowmeter by turning the wing nut.

i. Attach the humidifier to the flowmeter with the nut on the humidifier.

ii. Secure the nut by hand-tightening it.

**NOTE:**
Humidifiers and tubing should be changed IAW local policy or when obviously contaminated.

12. Post warning signs.

**CAUTION:**
"OXYGEN" and "NO SMOKING" signs should be posted in the areas where oxygen is in use or stored.
Bag-Valve Mask (BVM) Ventilator

The BVM ventilator is designed to help ventilate an unconscious casualty for long periods while delivering high concentrations of oxygen. When using external cardiac compressions, the cardiac output is cut to 25 to 30 percent of the normal capacity, and artificial ventilation does not supply enough oxygen through the circulatory system to maintain life for a long period. For this reason, this system can be useful in extended CPR attempts.

Various types of BVM systems come in adult and pediatric sizes and are in use in the Navy. Essentially, they consist of a self-filling ventilation bag, an oxygen reservoir, plastic face masks of various sizes, and tubing for connecting to an oxygen supply.

Oxygen can be added by hooking the BVM up to an oxygen supply. The rescuer’s breath dilutes the oxygen flow in artificial ventilation, requiring adjustment to the flow rate to increase the oxygen concentration. At 5 liters per minute, the oxygen concentration will be approximately 50 percent. At 15 liters per minute, this concentration will increase to 90 percent.

Limitations of the Bag-Valve Mask (BVM) Ventilator

The bag-valve mask ventilator is difficult to use unless the user has had sufficient practice with it. The system can be hard to clean and reassemble properly; the bagging hand can tire easily; and an airtight seal at the face is hard to maintain, especially if a single rescuer must also keep the airway open. In addition, the amount of air delivered to the casualty is limited to the volume that the hand can displace from the bag (approximately 1 liter per compression).

Procedures for Operating the Bag-Valve Mask Ventilator

To use the BVM ventilator:

1. Connect the bag up to an oxygen supply and adjust the flow in the range of 10 to 15 liters per minute, depending on the desired concentration (15 liters per minute will deliver an oxygen concentration of 90 percent).

2. After opening the airway or inserting an oropharyngeal airway, place the mask over the face and hold it firmly in position with the index finger and thumb, while keeping the jaw tilted upward with the remaining fingers (Fig. 20-22).

3. Use the other hand to compress the bag once every 5 seconds.

4. Observe the chest for expansion. If none is observed, the face mask seal may not be airtight, the airway may be blocked, or some component of the BVM ventilator may be malfunctioning.
Pocket Face Mask

A face mask designed with an oxygen-inlet flow valve for mouth-to-mask ventilation can be used to give oxygen-enriched artificial ventilation. The pocket face mask system cannot achieve oxygen concentrations as high as the BVM system. It has the advantage of providing greater air volume (up to 4 liters per breath) and being much easier to use (both hands are free to maintain the airway and keeping the mask firmly in place). The pocket face mask acts as a barrier device preventing the rescuer from coming in contact with the patient’s body fluids and breath, which are possible sources of infection.

To use the pocket face mask:

1. Stand behind the head of the casualty
2. Open the airway by tilting the head backward.
3. Place the mask over the casualty’s face (for adults, the apex goes over the bridge of the nose; for infants, the apex fits over the chin, with the base resting on the bridge of the nose).
4. Form an airtight seal between the mask and the face, and keep the airway open by pressing down on the mask with both thumbs while using the other fingers to lift the jaw up and back.
5. Ventilate into the open chimney of the mask.

The oxygen cylinder is usually fitted with a yoke-style pressure-reducing regulator, with gauges to show tank pressure and flow rate (adjustable from 0 to 15 liters per minute). A humidifier can be attached to the flow meter nipple to help prevent tissue drying caused by the water-vapor-free oxygen. An oxygen line can be connected from the flow meter nipple or humidifier to a number of oxygen delivery devices that will be discussed later.

When available, oxygen should be administered, as described below, to cardiac arrest patients and to self-ventilating patients who are unable to inhale enough oxygen to prevent hypoxia (oxygen deficiency). **Hypoxia is characterized by tachycardia, nervousness, irritability, and finally cyanosis.**

Oxygen must never be used near open flames since it supports burning. Oxygen cylinders must be handled carefully since they are potentially lethal missiles if punctured or broken.

**ARTIFICIAL AIRWAYS**

The oropharyngeal and nasopharyngeal airways are primarily used to keep the tongue from occluding (closing) the airway.

**Oropharyngeal Airway**

The oropharyngeal airway (Fig. 20-23) can be used only on unconscious casualties because a conscious person will gag on it. This airway comes in various sizes for different age groups and is shaped to rest on the contour of the tongue and extend from the lips to the pharynx. Selecting the correct size oropharyngeal airway is very important to its effectiveness. An airway of proper size will extend from the corner of the patient’s mouth to the tip of the earlobe on the same side of the patient’s face.

![Figure 20-23 - Oropharyngeal Airways](image)

A method of insertion is to depress the tongue with a tongue blade and slide the airway in. Another method is to insert the airway upside down into the casualty’s mouth; then rotate it 180° as it slides into the pharynx; this technique is for **adults** only (Fig. 20-24). For full step by step directions for application of the oropharyngeal airway refer to Chapter 21.

**Figure 20-24 Oropharyngeal insertion**


**Nasopharyngeal Airway**

The nasopharyngeal airway may be used on conscious casualties as it is better tolerated because it generally does not stimulate the gag reflex. Selecting the correct size nasopharyngeal airway is very important to its effectiveness. An airway of proper size will extend from the patient’s nasal opening to the tip of the earlobe on the same side of the patient’s face. It is made of flexible material designed to be lubricated and then gently passed up the nostril and down into the pharynx. If the airway meets an obstruction in one nostril, withdraw it and try to pass it up the other nostril. See Figure 20-25 for proper insertion of the nasopharyngeal airway. For full step by step directions for the nasopharyngeal airway refer to Chapter 21.

**Figure 20-25 A: Select the correct size; B: Lubricate the tip and insert along the curve of the nostril; and C: Nasopharyngeal airway inserted**

**Suction Devices**

The patient’s airway must be kept clear of foreign materials, blood, vomitus, and other secretions. Materials that remain in the airway may be forced into the trachea and eventually into the lungs. This causes complications ranging from severe pneumonia to a complete airway obstruction. Use suction to remove such materials.

In the field, a HM may have access to a fixed (installed) suction unit or a portable suction device. Both types of suction devices are equipped with flexible tubing, suction tips and catheters, and a non-breakable collection container.

Maintenance of suction devices consists of testing the suction pressure regularly and cleaning the device after each use.

Before using a suction device, always test the apparatus. Once the suction pressure has been tested, attach a suction catheter or tip. Position the patient on their side and open the patient’s mouth. This position permits secretions to flow from the patient’s mouth while suction is being delivered. Use caution in patients with suspected neck or spinal injuries. If the patient is fully and securely immobilized on a backboard, the backboard may be tilted to place the patient on the side. If the HM suspects such injuries but the patient is not immobilized, suction as best as possible without turning the patient. Carefully insert the suction tip or catheter at the top of the throat. DO NOT push the tip down into the throat or into the larynx. Apply suction no more than a few seconds at a time, since supplemental oxygen or ventilations cease while suctioning which will keep oxygen from the patient. Suction may be repeated after a few breaths.

**RESCUE AND TRANSPORTATION**

**LEARNING OBJECTIVES:**

*Identify protective equipment items that are used during patient rescues.*

*Explain how and when each protective equipment item should be used.*

It is a basic principle of first aid that an injured person must be given essential treatment **before** being moved. However, it is impossible to treat an injured person who is in a position of immediate danger. If the casualty is drowning, or if the life is endangered by fire, steam, electricity, poisonous or explosive gases, or other hazards, rescue must take place before first aid treatment can be given.

The life of an injured person may well depend upon the manner in which rescue and transportation to a medical treatment facility are accomplished. Rescue operations must be accomplished quickly. After rescue and essential first aid treatment have been given, further transportation must be accomplished in a manner that will not aggravate the injuries. In these operations, a HM may be responsible to direct others as well as acting as the primary rescuer.

This section will cover the use of common types of protective equipment; rescue procedures; special rescue situations; ways of moving the patient to safety; and procedures for transporting the injured after first aid has been given.

**PROTECTIVE EQUIPMENT**

The use of appropriate items of protective equipment will increase the HM’s ability to affect rescue from life-threatening situations. Protective equipment that is generally available on naval vessels and some shore activities include the oxygen breathing apparatus (OBA); hose (air line) masks; protective (gas) masks; steel-wire lifelines; and devices for detecting oxygen insufficiency, explosive vapors, and some poisonous gases.
Oxygen Breathing Apparatus

An oxygen breathing apparatus (OBA) is provided for emergency use in compartments containing insufficient oxygen. The apparatus is used for rescue purposes as it is a self-contained unit. The wearer is not dependent upon outside air or any type of air line within the effective life of the canister. Independence of the outside atmosphere is achieved by having air within the apparatus circulated through a canister. Never allow oil or grease to come in contact with any part of an OBA as the oxygen can become violently explosive in its presence. If any part of the apparatus becomes contaminated with oil or grease smudges, clean it before it is stowed.

Another device used is a Self Contained Breathing Apparatus (SCBA). The source of oxygen comes from a bottle that is usually strapped to the back. The effective life of the canister (as used in the OBA) or bottle varies from 20 to 45 minutes, depending on the particular apparatus and the type of work being done. One of the newer types of OBA is designed so that personnel can change canisters without leaving the toxic atmosphere.

If a HM requires entering an extremely hazardous area, a lifeline must be worn. The lifeline should be tended by two persons, one of whom is also wearing a breathing apparatus.

Hose (Air Line) Masks

Hose masks are part of the allowance of all ships having repair party lockers. They are smaller than the oxygen breathing ensembles and used by individuals entering voids or other spaces that have very small access hatches. The hose or air line mask consists of a gas mask face piece with an adjustable head harness and a length of air hose. Note that the air line mask uses air rather than pure oxygen. It must NEVER be connected to an oxygen bottle, oxygen cylinder, or other source of oxygen. Even a small amount of oil or grease in the air line could combine rapidly with the oxygen and cause an explosion.

Safety belts are furnished with each air line mask and MUST BE WORN. A lifeline must be fastened to the safety belt; and the lifeline should be loosely lashed to the air hose to reduce the possibility of fouling. The air hose and lifeline must be carefully tended so that they do not become fouled or cut. The person wearing the air line mask and the person tending the lines should maintain communication by means of standard divers' line-pull signals.

Protective (Gas) Masks

Protective masks provide respiratory protection against chemical, biological, and radiological warfare agents. They do not provide protection from the effects of carbon monoxide, carbon dioxide, and a number of industrial gases. Protection from these gases is discussed in the section, "Rescue from Unventilated Compartments."

In emergencies, protective masks may be used for passage through a smoke-filled compartment or for entry into such a compartment to perform a job that can be done quickly (such as to close a valve, secure a fan, or de-energize a circuit). However, they provide only limited protection against smoke. The length of time personnel can remain in a smoke-filled compartment depends on the type of smoke and its concentration. Protective masks are only designed to filter air that passes through the canister.

Lifelines

The standard Navy lifeline is a steel-wire cable, 50 feet long. Each end is equipped with a strong hook that closes with a snap catch. The line is very pliable and will slide freely around obstructions.
Lifelines are used as a precautionary measure to aid in the rescue of persons. Rescue, if necessary, should be accomplished by having another person equipped with a breathing apparatus follow the lifeline to the person being rescued, rather than by attempting to drag the person out. Attempts to drag a person from a space may result in fouling the lifeline on an obstruction.

An important point to remember is that a stricken person must never be hauled by a lifeline attached to the waist. The casualty may be dragged along the deck a short distance, but the weight must never be suspended on a line attached to the waist. If not wearing a harness of some kind, pass the line around the chest under the armpits and fasten it in front or in back.

When tending a lifeline, rescue personnel must wear gloves to be able to handle the line properly. Pay out the line carefully to keep it from fouling. Try to keep the lifeline in contact with grounded metal; do not allow it to come in contact with any energized electrical equipment.

Detection Devices

The detection devices used to test the atmosphere in closed or poorly ventilated spaces include the oxygen indicator, for detecting oxygen deficiency; combustible-gas indicators, for determining the concentration of explosive vapors; and toxic-gas indicators, such as the carbon monoxide indicator, for finding the concentration of certain poisonous gases. The devices are extremely valuable and used whenever necessary. However, they MUST BE USED ONLY AS DIRECTED. Improper operation of these devices may lead to false assurances of safety or, worse, to an increase in the actual danger of the situation. For example, the use of a explosion proof safety lamp in a compartment filled with acetylene or hydrogen could cause a violent explosion.

RESCUE PROCEDURES

If a HM is faced with rescuing a person threatened by fire, explosive or poisonous gases, or some other emergency, the scene survey must be completed to determine the extent of the danger and ability to cope with it. In a large number of accidents, the rescuer rushes in and becomes the second casualty. Do not take unnecessary chances!

Phases of Rescue Operations

In disasters where there are multiple patients (as in explosions or ship collisions), rescue operations should be performed in phases. These rescue phases apply only to extrication operations.

- The first phase is to remove lightly pinned casualties, such as those who can be freed by lifting boxes or removing a small amount of debris
- The second phase removes those casualties who are trapped in more difficult circumstances but who can be rescued by use of the equipment at hand and in a minimum amount of time
- The third phase removes casualties where extrication is extremely difficult and time consuming
  - This type of rescue may involve cutting through decks, breaching bulkheads, removing large amounts of debris, or cutting through an expanse of metal
  - An example would be rescuing a worker from beneath a large, heavy piece of machinery
- The fourth phase is the removal of dead bodies
Stages of Extrication

As part of the four rescue phases outlined above, the extrication process takes place in stages.

- The first stage is gaining access to the casualty(s). Much will depend on the location of the accident, damage within the accident site, and the position of the casualty(s). The means of gaining access must take into account the possibility of causing further injury to the casualty.

- The second stage involves giving lifesaving emergency care. If necessary, establish and maintain an open airway, start artificial respiration, and control hemorrhage.

- The third stage is disentanglement. The careful removal of debris and other impediments from the casualty(s) will prevent further injury to both the casualty(s) and the rescuer.

- The fourth stage is preparing the casualty(s) for removal, with special emphasis on the protection of possible fractures.

- The fifth stage is removing the casualty(s) from the trapped area and transporting to an ambulance or sickbay. This may be as simple as helping the casualty(s) walk out of the area or as difficult as carrying the casualty(s) out of a burning space.

Special Rescue Situations

The procedure a HM follows in an emergency situation will be determined by the nature of the disaster or emergency encountered. Some of the more common rescue situations and the appropriate procedures for each are outlined below.

Providing Care while Receiving Combat Fire

Most medical personnel carry small arms to defend themselves in the field. In unit operations, the additional firepower provided by the HM may be essential in obtaining tactical fire superiority.

The risk of injury to other personnel and additional injury to the previously wounded soldiers/sailors will be reduced if immediate attention is directed to the suppression of hostile fire. The medical personnel may therefore initially need to assist in returning fire instead of stopping to care for the casualty. The best medicine on any battlefield is fire superiority. As soon as the medic is directed, or is able to, keeping the casualty from sustaining additional injuries is the first major objective. Wounded soldiers/sailors who are unable to participate further in the engagement should lay flat and still if no ground cover is available, or move as quickly as possible if nearby cover is available. If there is no cover and the casualty is unable to move himself to find cover, he should remain motionless on the ground so as not to draw additional fire. There are typically limited medical personnel available. If they sustain injuries, no other medical personnel may be available until the time of evacuation in the CASEVAC phase.

Combat is a frightening experience, and being wounded, especially seriously, can generate tremendous anxiety and fear. Engaging a casualty with reassurance is therapeutically beneficial, and communication is just as important in patient care on the battlefield as it is in the MTF.

Key Points

1. Return fire as directed or required.
2. The casualty(s) should also continue to return fire if able.
3. Try to keep from getting shot.
4. Try to keep the casualty from sustaining any additional wounds.
5. Airway management is generally best deferred until the Tactical Field Care phase.
6. Stop any life-threatening hemorrhage with a tourniquet.
7. Reassure the casualty.
Rescue from Fire

If a HM must go to the aid of a person whose clothing is on fire, smother the flames by wrapping the casualty in a coat, blanket, or rug. Leave the head UNCOVERED. If there is no material to smother the fire, roll the casualty over SLOWLY and put out the flames with hands beginning around the head and shoulders, and then work downward toward the feet. If the casualty tries to run, force them to the ground. The casualty MUST lie down while trying to extinguish the fire. Running will cause the clothing to burn rapidly. Sitting or standing may cause the casualty to be killed instantly by inhaling flames or hot air.

CAUTION:
Inhaling flames or hot air can kill. Do not put the face directly over the flames. Turn face away from the flame when inhaling.

If a rescuer’s clothing catches fire, roll up in a blanket, coat, or rug. KEEP HEAD UNCOVERED. If material to smother the fire is not available, lie down, roll over slowly, and pat at the flames with hands.

If trying to escape from an upper floor of a burning building, be cautious opening doors into hallways or stairways. Always feel a door before opening. If the door feels hot, do not open it if there is any other possible way out. Opening doors or windows will create a draft making the fire worse. Do not open any door or window until actually ready to get out.

If the HM is removing an injured person from an upper story of a burning building, it may be accomplished by improvising a lifeline by tying sheets, blankets, curtains, or other materials together. Use square knots to connect the materials to each other. Secure one end of the line around some heavy object inside the building, and fasten the other end around the casualty under the arms. First, lower the casualty to safety and then follow down the lifeline. Do not jump from an upper floor of a burning building except as a last resort.

It is often said that the "best" air in a burning room or compartment is near the floor, but this is true only to a limited extent. There is less smoke and flame down low, near the floor, and the air may be cooler. But it is also true that carbon monoxide and other deadly gases are just as likely to be present near the floor as near the ceiling. If possible, use an oxygen breathing apparatus or other protective breathing equipment when inside a burning compartment. If protective equipment is not available, cover mouth and nose with a wet cloth to reduce the danger of inhaling smoke, flame, or hot air.

CAUTION:
A wet cloth gives no protection against poisonous gas or lack of oxygen.

RESCUE FROM STEAM-FILLED SPACES

It is sometimes required to rescue a person from a space in that has a steam leak. Since steam rises, escape upward may not be possible. If the normal exit is blocked by escaping steam, move the casualty to the escape trunk or, if there is none, move to the lowest level in the compartment.
RESCUE FROM ELECTRICAL CONTACT

Rescuing a person who has received an electrical shock can be difficult and dangerous. Extreme caution must be used to avoid electrocution of the rescuer (Fig. 20-26).

![Figure 20-26.—Moving an Electrical Shock Victim Away from the Electrical Source](image)

CAUTION:
Do not touch the casualty’s body with the wire or any other object that may be conducting electricity.

The first step is to look for the power switch. If found, turn the power off immediately. Do not waste time hunting for the switch as every second is important.

If the switch cannot be found, try to remove the wire from the casualty with a DRY broom handle, branch, pole, oar, or similar NON-CONDUCTING object. It may be possible to use a DRY rope or DRY clothing to pull the wire away from the casualty. The contact can be broken by cutting the wire with a WOODEN-HANDLED axe. This is extremely dangerous as the cut ends of the wire are likely to curl and lash back at the person’s hands before having time to get out of the way. When trying to break an electrical contact, always stand on some non-conducting material such as a DRY board, DRY newspapers, or DRY clothing.

Rescue from Unventilated Compartments

Rescuing a person from a void, gasoline or oil tank, or any closed compartment or unventilated space can be a hazardous operation. Aboard naval vessels and at naval shore stations, no person is permitted to enter any such space or compartment until a gas free engineer in concurrence with a damage control officer (DCO), or some person designated by the DCO, has indicated that the likelihood of suffocation, poisoning, and fire or explosion has been eliminated as far as possible. The rescue of a person from any closed space should be performed under the supervision of the DCO or in accordance with the DCO’s instructions. In general, observe the following precautions when attempting to rescue a person from any closed or poorly ventilated space:

- If possible, test the air for oxygen deficiency, poisonous gases, and explosive vapors
- Wear a hose (air line) mask or oxygen breathing apparatus.
  - The air line mask is preferred for use in spaces that may contain high concentrations of oil or gasoline vapors
  - Do not depend on a protective mask or a wet cloth held over the face to protect from oxygen deficiency or poisonous gases
  - Before going into a compartment that may contain explosive vapors, be sure that people are stationed nearby with fire-extinguishing equipment
- When going into any space that may be deficient in oxygen or contain poisonous or explosive vapors, be sure to maintain communication with someone outside
  - Wear a lifeline and be sure that it is tended by a competent person
Do not use, wear, or carry any object or material that might cause a spark

- Matches, cigarette lighters, flashlights, candles or other open flames, and ordinary electrical lights must NEVER be taken into a compartment that may contain explosive vapors
- The types of portable lights used by cleaning parties in boilers, fuel tanks, and similar places may be taken into a suspect compartment
- This is a steam-tight, glove-type light whose exposed metal parts are either made of non-sparking alloy or protected in some way so they will not strike a spark.

If it is necessary to go into a space that may contain explosive vapors, do not wear clothing that has any exposed spark-producing metal. For example, do not wear boots or shoes that have exposed nail heads or rivets, and do not wear coveralls or other garments that might scrape against metal and cause a spark.

Particular caution must be made concerning the use of the steel-wire lifeline in compartments that may contain explosive vapors. If the steel-wire line is used, ensure it is carefully tended and grounded at all times. When other considerations permit, use a natural fiber rope line instead of the steel-wire lifeline when entering these compartments.

Rescue from the Water

Never attempt to swim to the rescue of a drowning casualty unless properly trained in lifesaving methods and then only if there is no better way of reaching the casualty. A drowning casualty may panic and fight against the rescuer in a violent manner making rescue difficult. The rescuer must avoid injury to themselves or the casualty. A non-trained rescuer can help a drowning casualty by holding out a pole, oar, or stick for the casualty to grasp; or by throwing a lifeline or some buoyant object that will support the casualty in the water.

Various methods are used aboard ship to pick up survivors from the water. The methods used in any particular instance will depend upon weather conditions, the type of equipment available aboard the rescue vessel, the number of people available for rescue operations, the physical condition of the people requiring rescue, and other factors.

It is frequently difficult to get survivors up to the deck of the rescuing vessel, even after they have been brought alongside the vessel. Cargo nets are often used, but many survivors are unable to climb them without assistance. Persons equipped with lifelines (and, if necessary, dressed in anti-exposure suits) can be sent over the side to help survivors up the nets.

A seriously injured person should never, except in an extreme emergency, be hauled out of the water by means of a rope or lifeline. Special methods must be devised to provide proper support, both to keep the casualty in a horizontal position and to provide protection from any kind of jerking, bending, or twisting motion. The Stokes stretcher (Fig.3-25) can often be used to rescue an injured survivor. People on the deck of the ship can then bring the stretcher up by means of hand-lines. Life preservers, balsa wood, unicellular material, or other flotation gear can be used, if necessary, to keep the stretcher afloat.

Treatment of Radioactive Contaminated Personnel

Treatment of life-threatening injuries, e.g., severe trauma, shock, hemorrhage, and respiratory distress, always takes precedence over decontamination procedures. This includes treatment of possible symptoms from irradiation and dose estimation procedures. Medical emergency response personnel teams must not be impeded when proceeding to render emergent care for reasons such as issuing dosimeters or controlling access to restricted areas. To stop emergency response personnel in such situations clearly displays a lack of understanding and good judgment.
It is instructive to note no health care worker in the United States has ever suffered radiation injury secondary to rendering emergency care to a contaminated patient. These points must be stressed because of a number of events that have occurred.

Under no circumstances will any individual be denied access to necessary treatment or Treatment Facilities because of radioactive contamination. Medical treatment of emergency medical conditions (conditions which can become medically critical or life threatening) and medical conditions with the risk of morbidity (conditions which will result in permanent injury or deficits) must always take precedence over decontamination or containment procedures. Concerns about the spread of radioactivity, i.e., radioactive contamination, or the possible contamination of medical personnel are nonetheless appropriate and should be attended to after the patient has been stabilized.

MOVING THE CASUALTY TO SAFETY25

In an emergency, there are many ways to move a casualty to safety. Ranging from one-person carries to stretchers and spine boards. The casualty’s condition and the level of danger will dictate the appropriate method. Give all necessary first aid BEFORE moving the casualty.

Stretcher

The military uses a number of standard stretchers. When using a stretcher, the HM should consider a few general rules:

- Use standard stretchers when available and be ready to improvise safe alternatives
- When possible, bring the stretcher to the casualty
- Always fasten the casualty securely to the stretcher
- Always move the casualty FEET FIRST so the rear stretcher bearer can watch for signs of breathing difficulty

**Stokes Stretcher**

The Navy service litter most commonly used for transporting sick or injured persons is the Stokes stretcher (Fig. 20-27). It is a wire basket supported by iron rods. Even if the stretcher is tipped or turned, the casualty can be held securely in place, making the Stokes adaptable to a variety of uses. This stretcher is particularly valuable for transferring injured persons to and from boats. As mentioned before, it can also be used with flotation devices to rescue injured survivors from the water. Additionally, it can be used for direct ship-to-ship transfer of injured persons. Fifteen-foot tending lines are attached to each end for shipboard use in moving the casualty. It is limited to one casualty or 400 lbs.
The Stokes stretcher should be padded with three blankets: two of them should be placed lengthwise so that one will be under each of the casualty's legs), and the third should be folded in half and placed in the upper part of the stretcher to protect the head and shoulders. The casualty should be lowered gently into the stretcher and made as comfortable as possible. The feet must be fastened to the end of the stretcher so that the casualty will not slide down. Another blanket (or more, if necessary) should be used to cover the casualty. The casualty must be fastened to the stretcher by means of straps that go over the chest, hips, and just above the knees. Note that the straps go **OVER** the blanket or other covering, thus holding it in place.

**Kendrick Extrication Device (KED)**

Semi-rigid support used to immobilize casualties with minor neck and back injuries. It has the same limitations as the Stokes Litter (Fig. 20-28).

**Miller (Full Body) Board**

The Miller Board (Fig. 20-29) is constructed of an outer plastic shell with an injected foam core of polyurethane foam. It is impervious to chemicals and elements. It can be used in virtually every confined-space rescue and vertical extrication. It provides for full body immobilization through a harness system, including a hood and two-point contact for the head (forehead and chin) to stabilize the head and cervical spine. The narrow design allows passage through hatches and crowded passageways. It fits within a Stokes (basket) stretcher and will float a 250-pound person.

![Figure 20-28 – Kendrick Extrication Device](image)

![Figure 20-29.—Miller (Full-Body) Board](image)
Improvised Stretchers

Standard stretchers should be used whenever possible to transport a seriously injured person. If none are available, it may be necessary to improvise. Shutters, doors, boards, and even ladders may be used as stretchers. All stretchers of this kind must be very well padded (to reduce pressure points) and care must be taken to see that the casualty is fastened securely in place.

At times, a blanket may be used as a stretcher. The casualty is placed in the middle of the blanket in the supine position. Three or four people kneel on each side and roll the edges of the blanket toward the casualty. When the rolled edges are tight and large enough to grasp securely, the casualty should be lifted and carried.

Stretchers may be improvised by using two long poles (about 7 feet long) and strong cloth (such as a rug, a blanket, a sheet, a mattress cover, two or three gunny sacks, or two coats).

CAUTION:
Many improvised stretchers do not give sufficient support in cases where there are fractures or extensive wounds of the body. They should be used only when the casualty is able to stand some sagging, bending, or twisting without serious consequences.

An example of this type of improvised stretcher would be one made of 40 to 50 feet of rope or 1-1/2-inch fire hose loosely weaved between two long poles.

Reeves Sleeve

Reeves Sleeve is designed for rapid immobilization of spinal and neck injuries in tight places. It is constructed of lightweight vinyl-coated polyester that is easily washed with soap and water.

It has one vertical lift point and four horizontal lift points for helicopter hoist capability allowing the sleeve to hoist patients from any angle. For head and cervical support, it includes removable Velcro head-securing blocks, adjustable head- and chin-securing straps, a chest- and arm-securing flap with Velcro, a leg-securing flap with Velcro and a spine board compartment for added strength and rigidity. Six chest and six leg straps with buckles and a yellow "fail-safe" strap are used for security. This stretcher has a load capacity of over 1,000 lbs.

Spineboards

Spineboards are equipment used in the immobilization of suspected or real fractures of the spinal column. They are made of fiberglass or exterior grade plywood, come in two sizes, short (18" × 32") and long (18" × 72"), and are provided with handholds and straps. Spineboards have a runner on the bottom to allow clearance to lift (Fig. 20-30).

A short spineboard is primarily used in extrication of a sitting casualty, especially in automobile wrecks (where it would be difficult to maneuver the casualty out of position without doing additional damage to the spine). The long board makes a firm litter, protecting the back and neck, and providing a good surface for CPR and a good sliding surface for difficult extractions.
The short and long boards are often used together. For example, at an automobile accident site, the HM’s first task is to assess the whole situation and to plan the rescue. If bystanders must be used, it is essential that they be briefed in thorough detail on what the HM wants them to do.

Securing the casualty to the spineboard:

1. After all accessible bleeding has been controlled and the fractures splinted, the short spineboard should be moved into position behind the casualty.
2. A neck collar should be applied in all cases and will aid in the immobilization of the head and neck.
3. The head should then be secured to the board with a headband or a 6-inch self-adhering roller bandage.
4. The casualty’s body should then be secured to the board by use of the supplied straps around the chest and thighs.
5. The casualties may then be lifted out.
6. If the casualty is too large, or further immobilization of the lower extremities is necessary, the long spineboard may be slid at a right angle behind the short spineboard, and the casualty maneuvered onto the side and secured to the longboard.

Emergency Rescue Lines

The steel-wire lifeline can be used to haul a person to safety. An emergency rescue line can be made from any strong fiber line. Both should be used only in extreme emergencies, when an injured person must be moved and no other means is available.

Figure 20-31 shows an emergency rescue line used to hoist a person from a void or small compartment. The running bowline is passed around the body, just below the hips, and a half hitch is placed just under the arms. The guideline is tied loosely to the casualty’s ankles to prevent banging against bulkheads and hatchways.

Rescue Drag and Carry Techniques

The HM may be required to evacuate a sick or injured casualty from an emergency scene to a location of safety. A casualty carried by manual means must be properly handled; otherwise the injuries may become more serious or possibly fatal. Situation permitting, evacuation or transport of a casualty should be organized and unhurried.

Manual carries can be tiring for the bearer(s) and involve the risk of increasing the severity of the casualty’s injury. In some instances, however, they are essential to save life and limb.
Manual carries should be accomplished by one or two stretcher bearers, if possible. They provide more comfort to the casualty, are less likely to aggravate injuries, and are also less tiring for the stretcher bearers. The distance a casualty can be carried depends on many factors:

- Strength and endurance of the stretcher bearer(s)
- Weight of the casualty
- Nature of the casualty’s injury
- Obstacles encountered during transport

The HM should choose the most effective evacuation technique (one or two rescuer) that will be the least harmful to both the rescuer and the casualty.

**ONE-RESCUER TECHNIQUES**

If a casualty can stand or walk, assist them to a safe place.

If there are no indications of injury to the spine or an extremity but the casualty is not ambulatory, they can be carried by means of any of the following:

- **Fireman’s Carry:** One of the easiest ways to carry a casualty (unconscious or unable to walk (Fig. 20-32).

- **Pack-strap Carry:** With the pack-strap carry, shown in Figure 20-33, it is possible to carry a heavy casualty for a considerable distance. Use the following procedure:

  1. Place the casualty in a supine position.
  2. Lie down sideways along the casualty’s uninjured or less injured side. The HM’s shoulder should be next to the casualty’s armpit.
  3. Pull the casualty’s far leg over the HM’s leg, holding it there if necessary.
  4. Grasp the casualty’s far arm at the wrist and bring it over the HM’s upper shoulder as the HM rolls and pulls the casualty onto the back.
  5. Raise up the HM’s knees, holding the free arm for balance and support. Hold both the casualty’s wrists close against the HM’s chest with the other hand.
  6. Lean forward as the HM rises to his/her feet, and keep both of his/her shoulders under the casualty’s armpits. Do not attempt to carry a seriously injured person by means of the pack-strap carry, especially if the arms, spine, neck, or ribs are fractured.
• **Arm Carry**: The technique for a one-person arm carry is shown in Figure 20-34. Never try to carry a person who is seriously injured with this method. Unless that casualty is smaller than the rescuer, the HM will not be able to carry the casualty very far using this technique.

*Figure 20-34.—Arm Carry*

• **Blanket Drag**: A variant of the blanket drag is the clothes drag, where the rescuer drags the casualty by the clothing on the casualty’s upper body (Fig. 20-35).

*Figure 20-35.—Blanket Drag*

• **Tied-hands Crawl**: The tied-hands crawl, shown in Figure 20-36, may be used to drag an unconscious casualty for a short distance. It is useful when required to crawl underneath a low structure. It is the least desirable method as the casualty’s head is not supported.

  1. Place the casualty in the supine position.
  2. Cross the wrists and tie them together.
  3. Kneel astride the casualty and lift the arms over the HM’s head so that the wrists are at the back of the neck.
  4. When crawling forward, raise shoulders high enough so that the casualty’s head will not bump against the deck.

*Figure 20-36.—Tied-Hands Crawl*
TWO-RESCUER TECHNIQUES

If the casualty is ambulatory, the HM and assistant should assist the casualty to safety. If the casualty has either a spinal injury or a fractured extremity, there are a number of two-rescuer techniques that can be used to move the casualty to safety.

- **Chair Carry**: The chair carry can often be used to move a sick or injured person away from a position of danger. The casualty is seated on a chair and the chair is carried by two rescuers. This is a particularly good method to use when the HM must carry a person up or down stairs or through narrow, winding passageways. **This carry must NEVER be used to move a person who has an injured neck, back, or pelvis.**

- **Arm Carry**: The two-person arm carry, shown in Figures 20-37 and 20-38, can be used in some instance to move an injured person. However, this carry should not be used to carry a person who has serious wounds or broken bones. **This carry must not be used to move seriously injured persons.**

**TRANSPORTATION OF THE INJURED**

LEARNING OBJECTIVES:

*Describe the different forms of emergency transportation.*

*Identify essential BLS equipment and supplies on Navy ambulances.*

Thus far this chapter has dealt with emergency methods used to move an injured person out of danger and into a location to facilitate first aid being administered.

Casualties should not be moved before the type and extent of injuries are evaluated and the required emergency medical treatment is given. The exception to this occurs when the situation dictates, i.e. a fire. The situation will dictate the urgency of casualty movement.

**Emergency Vehicles**

In most peacetime emergency situations, some form of ambulance will be available to transport the casualty to a treatment facility.
There are many differences in design and storage capacity and most ambulances are equipped to meet the same basic emergency requirements. They contain equipment and supplies for emergency airway care, artificial ventilation, suction, oxygenation, hemorrhage control, fracture immobilization, shock control, blood pressure monitoring, and poisoning. They also contain litters, spineboards, and other extrication equipment.

Deployed units at sea, in the field, and at certain commands near air stations will also have access to helicopter MEDEVAC support (Fig. 20-39). Helicopters are ideal for use in isolated areas but are of limited practical use at night, in adverse weather, under certain tactical conditions, or in developed areas where buildings and power lines interfere. In addition to taking these factors into consideration, the HM must decide if the casualty’s condition is serious enough to justify a call for a helicopter. Some injuries require very smooth transportation or are affected by pressure changes that occur in flight. The final decision will be made by the unit commander, responsible for requesting the helicopter support.

![Figure 20-39.—Loading a patient onto a helicopter for MEDEVAC](Image provided by: Department of the Army. (2009). Soldier’s handbook and training guide for MOS 68W STP 8-68W13-SM-TG.)

1. **AIRCRAFT DESIGNED FOR MEDEVAC:**

   a. **UH-1V**: Crew of 2 pilots, 1 crew chief and 1 medic. Standard configuration is 3 litters and 4 ambulatory. The maximum configuration is 6 litters or 9 ambulatory. Red Cross Markings 4: one on the nose, the belly, and each cargo door.

   b. **UH-60A**: Same crew as the UH-1V. Standard configuration is 4 litters and 1 ambulatory. The maximum configuration is 6 litters and 1 ambulatory or 7 ambulatory or some configuration thereof. Red Cross Markings 5: one on the nose, belly, one on each cargo door, and one on top.

   c. **CH-47**: Crew of 2 pilots, 2 crew chiefs and 1 medic for every 6 litter patients. The standard configuration is 16 ambulatory and 12 litters. The maximum configuration is 31 ambulatory or 1 ambulatory and 24 litters. This aircraft has no Red Cross markings. The primary mission of this aircraft is mass casualty evacuation. Various configurations are noted below.

<table>
<thead>
<tr>
<th>CONFIGURATION</th>
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<tbody>
<tr>
<td>AMBULATORY</td>
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<td>31</td>
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<td>20</td>
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<td>24</td>
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**NOTE:**
The capacity of all aircraft may be reduced because of temperature, humidity or age of the aircraft. Any aircraft may be used for CASEVAC.
Preparing the Patient for Transport

Once emergency medical care has been completed on-scene, the patient must be transferred to the treatment facility. A process known as packaging provides the means of properly positioning, covering, and securing the patient to avoid any unnecessary aggravation to the patient’s condition. Covering helps maintain the patient’s body temperature, prevents exposure to the elements, and provides privacy. Do not "package" a badly traumatized patient; it is more important to transport the critical or unstable patient to the treatment facility quickly. The most important aspect of each rescue or transfer is to complete it as safely and efficiently as possible.

Care of Patient en Route\(^2\)\(^6\)

The emergency care a HM can offer patients en route is limited only by the availability of supplies, the level of external noise and vibrations, and the competency and ingenuity the HM possesses. There are three phases to en route care in the military operational environment. The degree to which they affect the scenarios varies by situation; they are relevant to some degree in the operational and non-operational environments. The phases are:

- **Care Under Fire**
  The Care Under Fire (CUF) defines the care to be provided while there is a direct and ongoing threat to the patient and HM. CUF is aid which can be rendered very quickly to address an immediate life threat. This is commonly viewed as the placement of a tourniquet on a bleeding extremity, moving the wounded out of the line of fire if able, and little more.

- **Tactical Field Care**
  The Tactical Field Care (TFC) phase is that point in time when the threat is reduced or resolved but the patient is still in a tactically unstable environment. Perhaps the direct fire has temporarily stopped, or the Corpsman and his or her patient have found some cover where the HM can focus safely on patient rather than achieving fire superiority.

  During this phase the HM can perform an initial patient evaluation assessing for H-A-B-C (life-threatening Hemorrhage, Airway, Breathing, and Circulation). The HM can re-check that tourniquet applied earlier, dress wounds, perform a needle thoracotomy or start IVs as needed, and employ other emergency measures. It is important to remember that the TFC phase can be dynamic and the threat may quickly return, so dedicated efforts such as CPR are not initiated.

- **Tactical Evacuation Care**
  The Tactical Evacuation Care phase (TACEVAC), formerly called the Casualty Evacuation (CASEVAC) stage, will consist of medical treatment rendered during movement to the appropriate treatment facility. This care may range from continued treatment provided by the first responder during a hasty evacuation to a safe zone, to advanced medicine performed by dedicated medical crews en route to a trauma center. Movement of the patient away from the threat zone and toward definitive medical care is the defining feature of this phase.

  The principles of Tactical Combat Casualty Care have been constantly refined and have been in widespread use among military and civilian tactical teams for over a decade, with a track record of saving lives. Further incorporation of these guidelines and practices into teams not yet using them will help ensure the safety, health, and survivability of its members. In this particular section the HM will focus on the steps of preparing for the TACEVAC outside of patient care procedures.

REQUEST MEDICAL EVACUATION\(^2\)\(^3\)

Once the HM has a casualty requiring medical evacuation (MEDEVAC) a medical evacuation will be requested. The HM will need a patient pickup site, operational communications equipment, MEDEVAC request format, and unit signal operation instructions (SOI).
Transmit a MEDEVAC request. At a minimum, transmit line numbers 1 through 5 during the initial contact with the evacuation unit. Transmit lines 6 through 9 while the aircraft or vehicle is en route, if not included during the initial contact.

**STEPS**

1. Collect all applicable information needed for the MEDEVAC request, i.e. 9-Line.
   a. Determine the grid coordinates for the pickup site.
   b. Obtain radio frequency, call sign, and suffix.
   c. Obtain the number of patients and precedence.
   d. Determine the type of special equipment required.
   e. Determine the number and type (litter or ambulatory) of patients.
   f. Determine the security of the pickup site.
   g. Determine how the pickup site will be marked.
   h. Determine patient nationality and status.
   i. Obtain pickup site chemical, biological, radiological, and nuclear (CBRN) contamination information normally obtained from the senior person in charge of the site or medic.

**NOTE:**

CBRN line 9 information is only included when contamination exists.

2. Record the gathered MEDEVAC information using the authorized brevity codes (Table 20-1).

**NOTE:**

Unless the MEDEVAC information is transmitted over secure communication systems, it must be encrypted.

3. Transmit the MEDEVAC request.
   a. Contact the unit that controls the evacuation assets.
   b. Use effective call sign and frequency assignments from the SOI.
   c. Give the following in the clear "I HAVE A MEDEVAC REQUEST:" wait one to three seconds for a response. If no response, repeat the statement.
   b. Transmit the MEDEVAC information in the proper sequence.
      a. State all line item numbers in clear text. The call sign and suffix (if needed) in line 2 may be transmitted in the clear.
<table>
<thead>
<tr>
<th>LINE</th>
<th>ITEM</th>
<th>EXPLANATION</th>
<th>WHERE/HOW OBTAINED</th>
<th>WHO NORMALLY PROVIDES</th>
<th>REASON</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Location of the pick-up site</td>
<td>Encrypt the grid coordinates of the pickup site. When using the DRYAD Numeral Cipher, the same “SET” line will be used to encrypt the grid zone letters and the coordinates. To preclude misunderstanding, a statement is made that grid zone letters are included in the message (unless unit SOP specifies its use at all times)</td>
<td>From map</td>
<td>Unit leader(s)</td>
<td>Required so evacuation vehicle knows where to pick up patient. Also, so that the unit coordinating the evacuation mission can plan the route for the evacuation vehicle (if the evacuation vehicle must pick up from more than one location).</td>
</tr>
<tr>
<td>2</td>
<td>Radio frequency, call sign, and suffix</td>
<td>Encrypt the frequency of the radio at the pickup site, not a relay frequency. The call sign (and suffix if used) of person to be contacted at the pickup site may be transmitted in the clear.</td>
<td>signal operation instructions</td>
<td>ROI</td>
<td>Required so that evacuation vehicle can contact requesting unit while en route (obtain additional information or change in situation or directions)</td>
</tr>
<tr>
<td>3</td>
<td>Number of patients by precedence: A - Urgent B - Urgent Surgical C - Priority D - Routine E - Convenience</td>
<td>Report only applicable information and encrypt the brevity codes. A - URGENT B - URGENT-SURG C - PRIORITY D - ROUTINE E - CONVENIENCE If two or more categories must be reported in the same request, insert the word “BREAK” between each category.</td>
<td>From evaluation of patient(s)</td>
<td>Corpsman or senior person present</td>
<td>Required by unit controlling vehicles to assist in prioritizing missions.</td>
</tr>
<tr>
<td>4</td>
<td>Special equipment required: A - None B - Hoist C - Extraction equipment D - Ventilator</td>
<td>Encrypt the applicable brevity codes. A - None B - Hoist C - Extraction equipment D - Ventilator</td>
<td>From evaluation of patient/situation</td>
<td>Corpsman or senior person present</td>
<td>Required so that the equipment can be placed on board the evacuation vehicle prior to the start of the mission.</td>
</tr>
<tr>
<td>5</td>
<td>Number of patients: A - Litter B - Ambulatory</td>
<td>Report only applicable information and encrypt the brevity code. If requesting medical evacuation for both types, insert the word “BREAK” between the litter entry and ambulatory entry. L × # of patients - Litter A × # of patients - Ambulatory (sitting)</td>
<td>From evaluation of patient(s)</td>
<td>Corpsman or senior person present</td>
<td>Required so that the appropriate number of evacuation vehicles may be dispatched to the pickup site. They should be configured to carry the patients requiring evacuation</td>
</tr>
</tbody>
</table>

Table 20-1.—MEDEVAC Request Form
<table>
<thead>
<tr>
<th>LINE</th>
<th>ITEM</th>
<th>EXPLANATION</th>
<th>WHERE/HOW OBTAINED</th>
<th>WHO NORMALLY PROVIDES</th>
<th>REASON</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Number and type of wound, injury, or illness (Peacetime)</td>
<td>Specific information regarding patient wounds by type (gunshot or shrapnel). Report serious bleeding, along with patient’s blood type, if known.</td>
<td>From evaluation of patient(s)</td>
<td>Corpsman or senior person present</td>
<td>Required to assist evacuation personnel in determining treatment and special equipment needed.</td>
</tr>
<tr>
<td>6</td>
<td>Security at pick-up site:</td>
<td>From evaluation of situation</td>
<td>From evaluation of situation assist an aircraft in planning its approach.</td>
<td>Unit leader</td>
<td>Required to assist the evacuation crew in assessing the situation and determining if assistance is required. More definitive guidance can be furnished the evacuation vehicle while it is en route (specific location of enemy to assist an aircraft in planning its approach).</td>
</tr>
<tr>
<td>7</td>
<td>Method of marking pick-up site:</td>
<td>Based on situation and availability of materials</td>
<td>Based on situation and availability of materials</td>
<td>Corpsman or senior person present</td>
<td>Required to assist the evacuation crew in identifying the specific location of the pickup. Note that the color of the panels or smoke should not be transmitted until the evacuation vehicle contacts the unit (just prior to its arrival). For security, the crew should identify the color and the unit verifies it.</td>
</tr>
<tr>
<td>7</td>
<td>Patient nationality and status:</td>
<td>From evaluation of patient(s)</td>
<td>From evaluation of patient(s)</td>
<td>Corpsman or senior person present</td>
<td>Required to assist in planning for destination facilities and need for guards. Unit requesting support should ensure that there is an English-speaking representative at the pickup site.</td>
</tr>
<tr>
<td>8</td>
<td>Terrain description (Peacetime)</td>
<td>Include details of terrain features in and around proposed landing site. If possible, describe relationship of site to prominent terrain feature (lake, mountain, tower).</td>
<td>Personnel present</td>
<td>From area survey</td>
<td>Required to allow evacuation personnel to assess route/avenue of approach into area. Of particular importance if hoist operation is required.</td>
</tr>
<tr>
<td>9</td>
<td>NBC Contamination:</td>
<td>From situation</td>
<td>From situation</td>
<td>Corpsman or senior person present</td>
<td>Required to assist in planning for the mission (determine which evacuation vehicle will accomplish the mission and when it will be accomplished).</td>
</tr>
</tbody>
</table>

Table 20-1.—MEDEVAC Request Form (continued)
Establish a Helicopter landing site

The HM needs to establish a helicopter landing site. The HM will need smoke grenades, strobe lights, flashlights or vehicle lights, marker panels, and the equipment and personnel to clear the site if required.

Identify a landing site large enough for a helicopter to land and take off. Mark and identify all obstacles that cannot be removed and designate the touchdown site.

CAUTION: Comply with unit SOP and or local environmental regulations concerning the cutting of live vegetation, digging holes, and or erosion prevention.

1. Select the landing site. The factors which should be considered are:
   a. The size of the landing site.
      a. A helicopter requires a relatively level landing area 30 meters in diameter. This does not mean that a loaded helicopter can land and take off from an area of that size. Most helicopters cannot go straight up or down when fully loaded. Therefore, a larger landing site and better approach and departure routes are required.
      b. When obstacles are in the approach or departure routes, a 10 to 1 ratio must be used to lay out the landing site. For example, during the approach and departure, if the helicopter must fly over trees that are 15 meters high, the landing site must be at least 150 meters long (10 x 15 = 150 meters).
      
   b. The ground slope of the landing site. When selecting the landing site, the ground slope must be no more than 15 degrees. Helicopters cannot safely land on a slope of more than 15 degrees.
      
   a. When the ground slope is less than 7 degrees, the helicopter should land up slope.
      b. When the ground slope is 7 to 15 degrees, the helicopter must land side slope (Fig. 20-40).

Figure – 20-40 Slope Landing

c. Surface conditions.
   a. The ground must be firm enough that the helicopter will not bog down during loading or unloading. If firm ground cannot be found, the pilot must be told and required to hover at the landing site during the loading or unloading.
   b. Rotor wash on dusty, sandy, or snow-covered surfaces may cause loss of visual contact with the ground. Therefore, these areas should be avoided.
   c. Loose debris that can be kicked up by the rotor wash must be removed from the landing site. Loose debris can cause damage to the blades, engines and personnel in the area.

   d. Obstacles.
   a. Landing sites should be free of tall trees, telephone lines, power lines or poles; similar obstructions on the approach or departure ends of the landing site must also be cleared.
   b. Ensure obstructions that cannot be removed (such as large rocks, stumps, or holes) were marked clearly within the landing site.
2. Establish security for the landing site. Landing sites should offer some security from enemy observation and direct fire. Good landing sites will allow the helicopter to land and depart without exposing it to unneeded risks. Security is normally established around the entire landing site.

3. Mark the landing site and touchdown point.
   a. When and how the landing site should be marked is based on the mission, capabilities, and situation of the unit concerned. Normally, the only mark or signals required are smoke (colored) and a signalman. VS-17 marker panels may be used to mark the landing site, but MUST NOT be used any closer than 50 feet to the touchdown point. In addition to identifying the landing site, smoke will give the pilot information on the wind direction and speed.
   b. At night, the landing site and touchdown point are marked by an inverted "Y" composed of four lights. Strobe lights, flashlights, or vehicle lights may also be used to mark the landing site.

GUIDE A HELICOPTER TO A
LANDING POINT

How to guide the helicopter to a safe landing identified by MEDEVAC request, identifying the landing site to the pilot and controlling the landing using the correct arm-and-hand signals.

1. As the aircraft approaches, provide the pilot with tactical and security information. Provide information on the conditions that may affect the landing such as terrain, weather, landing site markings, and possible obstacles (Fig. 20-41).
   a. Confirm information or answer any questions the pilot may have pertaining to the landing site.
   b. Maintain communications with the pilot during the entire operation.
   c. Mark or identify the landing site:
      a. Day--The only signals required are colored smoke and a signalman. VS-17 marker panels may be used to mark the landing site, but are NOT used any closer than 50 feet to the touchdown point. In addition to identifying the landing site, the smoke will give the pilot the wind direction and speed.
      b. Night--The landing site and touchdown point are marked by an inverted "Y" composed of four lights (Fig. 20-42).

Figure 20-41.—Helicopter on the ground

*Image provided by: Department of the Army. (2009). Soldier's handbook and training guide for MOS 68W STP 8-68W13-SM-TG.*

2. Identify the landing site and guide pilot in.
   a. Once the pilot is within the HM’s area, radio contact will be established with the unit for positive identification.
   b. The pilot will be oriented to the landing site by using the clock method (12 o'clock is always the direction of flight). The pilot will be provided with the corresponding time position of the HM’s location. For example: "The LZ is now at 3 o'clock to HM’s position."
   c. Mark or identify the landing site:
3. Use arm-and-hand signals.
   a. Figures 20-43 A-H provide common arm and hand signals used to guide aircraft.

   Figure 20-43A.—Arm Guidance

   Figure 20-43E.—“Move to Left” Signal
   Figure 20-43H.—“Land” Signal

   Figure 20-43G.—“Move Downward” Signal

   Figure 20-43F.—“Move Upward” Signal
4. Proper positioning when using arm-and-hand signals.

   a. The signaling person’s position when directing a helicopter is to the right front of the aircraft in order to be seen by the pilot. The position for utility helicopters is 30 meters to the right front of the aircraft during day or night operations.

   b. Signals at night are given by using lighted batons or flashlights. In the illustrations, the person is using a lighted wand. This is a flashlight with a plastic wand attached to the end and used when there is decreased visibility.

   c. The speed of the arm movement indicates the desired speed of aircraft compliance with the signal.

   **NOTE:**
   The "hover" signal should be used to change from one arm-and-hand signal to another.

   For example, the signal person desires to land an approaching helicopter and the signal "move ahead" has been given to pilot. The helicopter is now positioned directly over the desired landing area.

   Before giving the pilot to the signal to move downward, the signal person should execute the "hover" signal. This gives the pilot time to change from the "move ahead" to the "move downward" signal.
HAZARDOUS MATERIAL EXPOSURE

LEARNING OBJECTIVE:

Explain hazardous material personal safety guidelines and hazardous material information sources.

Hazardous materials are substances with the potential of harming people or the environment. They can be gaseous, liquid, or solid, and can include chemical or radioactive materials. (Radiological exposure is covered in depth in Chapter 23 of this manual). The most common substances involved in incidents of hazardous material (Hazardous) exposure are volatile organic compounds, pesticides, ammonia, chlorine, petroleum products, and acids.

The HM’s initial action at the scene of a hazardous materials incident must be to assess the situation as the safety of the HM, patient, and the public are of primary concern. The HM must determine the nature of the HAZMAT and then establish a safety zone. After this has been accomplished, a casualty having been exposed to hazardous materials can be rescued, transported to an appropriate facility, and properly decontaminated.

The Department of Transportation (DOT) publication, Emergency Response Guidebook (ERG series, published every four years), RSPAP5800.8, is a useful tool for first responders during the initial phase of a hazardous materials/dangerous goods incident. ERG series addresses labeling, identification, toxicity, safety/contamination zones, and decontamination procedures. It is available at http://www.phmsa.dot.gov/hazmat.

NOTE:
It is imperative that all personnel involved with hazmat incident response be familiar with this publication.

DETERMINING THE NATURE OF THE HAZARDOUS MATERIAL

When an incident involving the exposure of hazardous material occurs, it is important to any rescue operation to determine the nature of the substance(s) involved. All facilities that produce HAZMAT are required by law to prominently display this information, as is any vehicle transporting it. Any carton or box containing such material must also be properly labeled. The name of the substance may also be displayed, along with a required four-digit identification number (sometimes preceded by the letters UN or NA - United Nations-North America number. It is also known as the UN or DOT number).

The various kinds of hazardous materials have different labels to assist in the identification. These are diamond-shaped signs having specific colors to identify the type of HAZMAT involved. Table 20-2 provides a list of the Department of Transportation (DOT)-mandated classifications of hazardous materials.

<table>
<thead>
<tr>
<th>HAZMAT Type</th>
<th>Label Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Explosives</td>
<td>Solid Orange Color</td>
</tr>
<tr>
<td>Non-Flammable Gases</td>
<td>Solid Green Color</td>
</tr>
<tr>
<td>Flammable Liquids</td>
<td>Solid Red Color</td>
</tr>
<tr>
<td>Flammable Solids</td>
<td>White and Red Stripes</td>
</tr>
<tr>
<td>Oxidizers &amp; Peroxides</td>
<td>Solid Yellow Color</td>
</tr>
<tr>
<td>Poisons &amp; Biohazards</td>
<td>Solid White Color</td>
</tr>
<tr>
<td>Radioactive Materials</td>
<td>Half White / Half Yellow with black radiation Symbol</td>
</tr>
<tr>
<td>Corrosives</td>
<td>Half White / Half Black</td>
</tr>
<tr>
<td>Other</td>
<td>Usually White</td>
</tr>
</tbody>
</table>
The ERG series provides a list of hazardous materials and appropriate emergency response actions. It is a tool enabling first responders to quickly identify the specific or generic classification of the material(s) involved in the incident, and to protect themselves and the general public during the initial phase of the incident.

SAFETY GUIDELINES

The HM’s first objective should be to try to read the labels and identification numbers FROM A DISTANCE. If necessary, use binoculars. DO NOT enter into the area unless absolutely certain that there has not been a hazardous spill. Relay any and all information available to the dispatch center where it can be used to identify the HAZMAT.

Once the HAZMAT has been identified, it can be classified as to the danger it presents (i.e., toxicity level). Based on this classification, the appropriate specialized equipment (known as personal protective equipment or PPE) can be determined to provide adequate protection level from secondary contamination to rescue personnel and healthcare providers.

Toxicity Levels

The National Fire Protection Association (NFPA) has developed a system to indicate the health, flammability, and reactivity hazards of chemicals. It is called the NFPA 704 Labeling System and is made up of symbols arranged in squares to comprise a diamond-shaped label (Fig. 5-7). Each of the four hazards is indicated by a different colored square:

- **Red** indicates the flammability

Table 20-2 – Classification of HAZMAT

- **Yellow** indicates the reactivity
- **White** indicates any special hazards
- **Blue** indicates health hazards
The health hazard levels are
- **4** - deadly
- **3** - extreme danger
- **2** - hazardous
- **1** - slightly hazardous
- **0** - normal material

### Protection Levels

The protection levels A, B, C, and D indicate the type and amount of protective equipment required in a given hazardous circumstance. Level A provides the greatest amount of protection and is used for the most hazardous incident(s).

- **Level A** - positive pressure-demand, full-face piece self-contained breathing apparatus (SCBA) or positive pressure-demand supplied air respirator with escape SCBA; fully encapsulating, chemical-resistant suit; inner chemical-resistant gloves; chemical-resistant safety boots/shoes; and two-way radio communication.

- **Level B** - positive pressure-demand, full-face piece SCBA or positive pressure-demand supplied air respirator with escape SCBA; chemical-resistant clothing (overalls and long-sleeved jacket with hooded one- or two-piece chemical splash suit or disposable chemical-resistant one-piece suit); chemical-resistant safety boots/shoes; hard hat; and two-way communication.

- **Level C** - full-face piece, air-purifying canister-equipped respirator; chemical-resistant clothing (overalls and long-sleeved jacket with hooded one- or two-piece chemical splash suit or disposable chemical-resistant one-piece suit); inner and outer chemical-resistant gloves; chemical-resistant safety boots/shoes; hard hat; and two-way communication.

- **Level D** - coveralls, safety boots/shoes, safety glasses or chemical splash goggles, and hard hat.

The HM is required to wear gloves at all four protection levels. If the correct type of glove to be used is not known, use neoprene or rubber, and avoid using latex or vinyl. In any instance, contact with HAZMAT should be avoided or minimized, and proper decontamination should be performed promptly. Protect feet from contact with HAZMAT by using a disposable boot/shoe cover made from appropriate material.

### Site Control

For management purposes, site control is divided up into three sections.

- **Exclusion Zone (Hot Zone):** The area the contamination has occurred. The outer boundary of the exclusion zone should be marked either by lines, placards, hazard tape and/or signs, or enclosed by physical barriers. Access control points should be established at the periphery of the exclusion zone to regulate the flow of personnel and equipment. Remain **upwind** of the danger area and avoid low areas where toxic gases/vapors may settle.

- **Contamination-Reduction Zone (Warm Zone):** The transition area between the contaminated area and the clean area. This zone is designed to prevent the clean support zone from becoming contaminated or affected by other site hazards. Decontamination of personnel/equipment takes place in a designated area within the contamination-reduction zone called the "contamination-reduction corridor."

- **Support Zone:** The location of the administrative and other support functions needed to keep the operations in the exclusion and contamination- reduction zones running smoothly. The command post supervisor/incident commander should be present in the support zone. Personnel may wear normal work clothes within this zone.
RESCUE AND PATIENT CARE PROCEDURES

After a safety zone has been established and regardless of the HM’s level of training the HM should follow the procedures outlined below:

- Help isolate the incident site and keep the area clear of unauthorized and unprotected personnel
- Establish and maintain communications with the dispatcher
- Stay upwind and uphill from the site
- Monitor wind and weather changes
- Do not breathe any smoke, vapors, or fumes
- Do not touch, walk, or drive through the spilled materials as this will increase the area of the spill
- Do not eat, drink, or smoke at the site
- Do not touch the face, nose, mouth, or eyes as these are all direct routes of entry into the body
- Eliminate any possible source of ignition (e.g., flares, flames, sparks, smoking, flashes, flashlights, engines, portable radios)
- Notify the dispatcher and give location
- Request the assistance of the HAZMAT response team
- If possible, identify the hazardous material and report it to the dispatcher
- Observe all safety precautions and directions given by the on-site HAZMAT expert. All orders should be given and received face to face
- Stay clear of restricted areas until the on-site HAZMAT expert declares them to be safe

Rescue from Exclusion Zone (Hot Zone)

The most dangerous element of any HAZMAT incident both to the exposed casualties and the rescuers is the rescue from the hot zone. Rescue operations should always be performed using appropriate protective equipment (PPE). Never enter the area unless properly trained to do so. Only the experts should handle this aspect of the rescue. Be prepared to provide supportive care once the casualty is clear of the contaminated area.

As soon as the casualty has been moved to safety, the HM should follow normal primary and secondary survey procedures, including interviews of the casualty and bystanders. Observe the casualty providing basic life support, supplemental oxygen, and monitoring vital signs.

Patient Decontamination Procedures

Decontamination is the process of removing or neutralizing and properly disposing of contaminants that have accumulated on personnel and equipment. Decontamination protects site personnel by minimizing the transfer of contaminants, helps to prevent the mixing of incompatible chemicals, and protects the community by preventing uncontrolled transportation of contaminants from the site. All personnel, clothing, and equipment that leave the contamination area (exclusion zone) must be decontaminated to remove any harmful chemicals that may have adhered to them. Some decontamination methods include those listed below.

- Dilution: the flushing of the contaminated person or equipment with water. It is the most frequently appropriate method of decontamination
- Absorption: the use of special filters and chemicals to absorb the hazardous material
- Chemical washes: specific chemicals used to neutralize the hazardous material
- Disposal and isolation: the proper disposal of contaminated materials instead of attempting to decontaminate them
Decontamination requires the use of PPE, although the level of protection required may be less once the casualty is out of the hot zone. A casualty who is exposed to a gas may not require actual "decontamination" after rescue and only require cessation of exposure and an opportunity to breathe fresh air. However, if a casualty is soaked with a liquid, the HAZMAT may pose an ongoing risk to the casualty and to the rescuers or medical personnel.

NOTE:
It is important to always assume that the casualty has been contaminated with something that could harm the HM and others until determined otherwise.

Once the casualty is medically evaluated, carefully remove any solid material that remains on the patient's clothing. If the material is dry, immediately remove the casualty's clothing while avoiding or minimizing contact with the HAZMAT or loss of the HAZMAT from the clothing. Unless specifically contraindicated by the hazardous nature of the HAZMAT and directed by the incident commander or the supporting medical advisor, flush the patient's skin, clothing, and eyes with water. To the maximum extent possible, control or retain the runoff (which is contaminated) which will be containerized for proper disposal. Remove all of the casualty's clothing, shoes, and jewelry. Place everything that may have contacted the HAZMAT in a special container. Mark the container as contaminated. Continue flushing the skin with water for at least 20 minutes trying to retain the runoff. Using available items, towels or clean rags, mechanically remove the HAZMAT by wiping; avoid rubbing the skin too vigorously. Dry the skin and provide uncontaminated dry clothing or coverings.

The nature of the HAZMAT involved and the threat to the health of others (rescue team, other casualties, medical personnel, and transport crew) determines the degree of decontamination necessary before treatment or transporting the casualty. It is preferred that decontamination be accomplished before treatment or transport. However, the patient's immediate medical condition may be more serious than the contamination itself. For example, ingested HAZMAT may pose little immediate threat to nearby personnel, but be an imminent threat to the casualty's life. Therefore, the consequences of delaying the emergency care of the patient's injuries to accomplish gut decontamination must be carefully evaluated. In some cases, decontamination and emergency medical care can be carried out simultaneously. In some instances, the casualty may require transportation to the treatment facility before decontamination. In these instances, notify both the treatment facility and transportation crew of the patient's medical condition and contamination. Depending on the situation, the transportation crew will have to prepare to carry and care for the contaminated casualty; otherwise, the crew themselves could be contaminated. For example, the transport crew may need to wear level A or B suits and/or respirators. If the casualty is contaminated and the transport requires personal protective devices, it is likely that the vehicle will be contaminated and requires appropriate decontamination. There is also a potential to contaminate the receiving treatment facility and its staff.
Diagnosis, Treatment, and Transport

As soon as the casualty has been removed from danger and moved to safety, follow primary and secondary survey procedures, including interviews of the casualty and bystanders. Observe the casualty and provide the ABCs of basic life support (airway, breathing, and circulation) add "D" and "E" for disability and exposure. Look for signs of trauma and provide proper exposure (i.e., remove clothing) to fully assess the casualty. As a guideline, give the patient supplemental oxygen (4 to 6 liters per minute), start an IV at an area of skin not exposed to the hazardous material (or at least that has been thoroughly decontaminated), monitor vital signs.

If the casualty has swallowed a known or identified toxic material, treat the casualty as a poisoned casualty using the information provided above. Dress wounds and prepare the casualty for transport to a treatment facility for a complete medical evaluation and treatment. Care should be taken during transport to stabilize the casualty by maintaining normal body temperature, administering oxygen, and treating shock.

SUMMARY

This chapter covered first aid equipment, supplies, and rescue/transportation of the casualty. The HM should be able to recognize the various types of dressings and bandages, as well as how and when to apply them. The HM should be familiar with protective equipment, rescue operations, the stages of extrication, and the precautionary steps that must be taken in special rescue situations. Additionally, the HM should be acquainted with the different patient-moving devices and lifting techniques. Further, the HM should be able to identify essential basic life support equipment and supplies and should be able to recognize different forms of emergency transportation. Finally, the HM should now be able to recall preparatory, en route, and turnover procedures for casualties being transported to treatment facilities. The HM may stay informed through contact with the local Poison Control Center, MEDIC releases, or via the World Wide Web on the Internet.
CHAPTER 21

EMERGENCY MEDICAL CARE PROCEDURES

INTRODUCTION

For a Navy Corpsman, the terms “first aid" and "emergency medical procedures" relate to the professional care of the sick and injured before in-depth medical attention can be obtained. Appropriate care procedures may range from providing an encouraging word to performing a surgical cricothyroidotomy to open a patient’s airway. Always remember, however, that first aid measures are temporary expedients to save life, to prevent further injury, and to preserve resistance and vitality. These measures are not meant to replace proper medical diagnosis and treatment procedures. Hospital Corpsmen (HMs) will be able to provide the competent care that makes the difference between life or death, temporary or permanent injury, and rapid recovery or long-term disability if they:

- Understand the relationship between first aid and proper medical diagnosis and treatment
- Know the limits of professional care that HMs can offer
- Keep current on emergency medicine procedures to include:
  - Conducting routine practical scenarios
  - Attending emergency medical and trauma courses of instruction
  - Keeping abreast of new emergency medical equipment

The intent of this chapter is to provide the user a reference to use in the training and performance of certain emergency situations. It was written to provide a quick overview and step by step assessment guidelines to follow in the most emergent situations HMs routinely encounter. The information is based on current practices, as of the date of publishing, as well as lessons learned from combat operations in Iraq and Afghanistan.

There may be operational limitations and local protocols dictated by the General Medical Officer / Medical Director that may require the HM to alter medications or certain procedures. Remember, the Hospital Corpsman Pledge is always in effect.

LAW OF ARMED CONFLICT

The law of armed conflict encompasses all international law regulating the conduct of nations and individuals engaged in armed conflict. As world tension increases, so does the potential for armed conflict. As members of a force dedicated to prevent such a conflict, HMs as medical personnel must face the reality of becoming involved. A basic understanding of the principles and applications of the law of armed conflict will help enhance efforts in providing the best medical care possible while maintaining our moral and ethical obligation.

A combatant is anyone participating in military operations or activities. Generally, this means members of a military force with certain exceptions, and civilian personnel who are actually engaged in hostilities. Noncombatants include all others including civilians not engaged in hostilities, medical personnel, chaplains, other persons captured or detained, and people who surrender, are captured, shipwrecked, sick, or wounded.

GENERAL FIRST AID RULES

LEARNING OBJECTIVE:

Explain general first aid rules.

There are a few general first aid rules that HMs should follow in any emergency:

- Maintain breathing
- Stop bleeding/maintain circulation
- Prevent or treat for shock
Mental preparation is an often overlooked aspect of emergency care. While it is possible to provide life-like training and scenarios to HMs, there is no substitute for being able to handle a real emergency. The HM can take steps in order to prepare for the stressors encountered as a result of a severe trauma or medical scene.

1. Regular exercise and a healthy lifestyle will allow the HM’s body to better handle the physical symptoms it will experience resulting from stress.

2. Keeping abreast of current medical procedures and emergency medicine procedures will keep the HM mentally prepared.

3. Keeping current with the latest and greatest medical equipment and how to operate the equipment at the command is vitally important. As emergency responders, HMs have a large dependence on medical equipment. It is essential that the HM knows the location, function and application of the medical gear to be used. On the way to the scene IS NOT THE TIME to get familiar with the gear.

4. Know the surroundings and the resources available. It is important to think and plan at least three steps ahead. For example: All injured patients are going to be moved to a certain location. What resources will be needed to move the patients; will extra people be needed to help carry the patients or extra gear? These are just a couple of questions to ask before an operation begins or an injury occurs.

These are a few guidelines to keep in mind while reading this chapter. More detail will be provided in the following sections.

**TRIAGE**

**LEARNING OBJECTIVE:**

*Explain the procedures for tactical and non-tactical triage.*

*Triage*, a French word meaning "to sort", is the process of quickly assessing patients in a multiple-casualty incident and assigning patients a priority (or classification) for receiving treatment according to the severity of the illness or injury. In the military, there are two types of triage, *tactical* and *non-tactical*, and each type uses a different set of prioritizing criteria.

The person in charge is responsible for balancing the human lives at stake against the realities of the tactical situation, the level of medical consumable resources on hand, and the realistic capabilities of medical personnel on the scene. Triage is a dynamic process, and a patient’s priority is subject to change as the situation progresses.

**SORTING FOR TREATMENT**

In civilian or non-tactical situations, sorting of casualties from a multiple casualty incident is slightly different from combat situations. There are four basic classes (priorities) of injuries, and the order of treatment of each is different.

**Priority I - Immediate.**

Casualties whose injuries are critical but who will require only minimal time or equipment to manage and who have a good prognosis for survival. An example is the casualty with a compromised airway or massive external hemorrhage.
Priority II - Delayed

Casualties whose injuries are debilitating but who do not require immediate management to salvage life or limb. An example is the casualty with a long bone fracture.

Priority III - Minor

Casualties, often called the “walking wounded” who have minor injuries that can wait for treatment or who may even assist in the interim by comforting other casualties or helping as litter bearers.

Priority IV - Expectant

Casualties whose injuries are so severe that they have only minimal chance of survival. An example is the casualty with a 90% full-thickness burn and thermal pulmonary injury.

Priority V - Dead

Casualties who are unresponsive, pulseless and breathless. In a disaster, resources rarely allow for attempted resuscitation of cardiac arrest casualties.

Next follows a simple non-tactical triage algorithm to assist HMs in non-tactical situations to make objective determinations about a patient’s triage category and subsequent treatment and transportation requirements (Fig 21-1).

Figure 21-1.—START Triage Algorithm (Courtesy Newport Beach Fire Department, Newport Beach, CA)


21-3
Triage in the tactical environment is very different due to the environmental and human hazards, i.e. bullets and ordnance.

Please note the differences as noted in the *Tactical Combat Casualty Care (TCCC)* Triage categories table below (Table 21-1). Review the TCCC Triage Algorithm as well (Fig. 21-2).

<table>
<thead>
<tr>
<th>Triage Category</th>
<th>Category Description</th>
<th>Examples</th>
</tr>
</thead>
</table>
| Immediate       | This group includes those that require lifesaving surgery. The surgical procedures in this category should not be time-consuming and should concern only patients with high chances of survival. | Upper airway obstruction  
Severe respiratory distress  
Life-threatening bleeding  
Tension pneumothorax  
Extensive 2nd or 3rd degree burns  
Untreated poisoning (chemical agent) with severe symptoms  
Heat stroke  
Decompensated Shock  
Rapidly deteriorating level of consciousness  
Any other rapidly deteriorating life-threatening condition |
| Delayed          | This group includes those wounded who are badly in need of time-consuming surgery, but whose general condition permits delay in surgical treatment without unduly endangering life. Sustaining treatment will be required. | Compensated shock  
Fracture, dislocation, or injury causing circulatory compromise  
Severe bleeding, controlled by a tourniquet or other means  
Penetrating head, neck, chest, back, or abdominal injuries without airway or breathing compromise or decompensated shock  
Severe combat stress symptoms or psychosis |
| Minimal          | These casualties have relatively minor injuries and can effectively care for themselves or can be helped by non-medical personnel. | Uncomplicated closed fractures and dislocations or minor lacerations  
Frostbite  
Strains and sprains  
Minor head injury (loss of consciousness of less than 5 minutes with normal mental status and equal pupils) |
| Expectant        | Casualties in this category have wounds that are so extensive that even if they were the sole casualty and had the benefit of optimal medical resource application, their survival would be unlikely. Using a minimal but competent staff, provide comfort measures for these casualties. | Traumatic cardiac arrest  
Massive Brain Injury  
2nd or 3rd degree burns over 70% of the body surface area (BSA)  
Gunshot wound to the head with Glascow Coma Scale of 3 |

Table 21-1.—TCCC Triage Categories
Care under Fire

Drag casualty to cover
Continue with mission/fight

Tactical Field Care
CASEVAC

Scene security and establish
CCP

MINIMAL  EXPECTANT

Perform cursory evaluation

Further evaluation required

Obvious life saving interventions required

Casualty obeys commands

Radial pulse character

Casualty in respiratory distress

DELAYED

IMMEDIATE

Figure 21-2.—Triage Algorithm for Tactical Combat Casualty Care
AIRWAY MANAGEMENT

LEARNING OBJECTIVE:
Perform airway management using simple and advanced airway adjuncts.

OPEN THE AIRWAY

Scenario
The HM is evaluating a casualty who is not breathing.

Objective
Complete all of the steps required to open the casualty's airway without causing unnecessary injury.

Performance Steps
Take Body Substance Isolation (BSI) precautions.

Recovery Position for patients who are unconscious or who have an altered level of consciousness (LOC), i.e. return of spontaneous breathing after rescue breathing:
1. Roll the casualty onto his or her back if necessary.
   a. Kneel beside the casualty.
   b. Raise the near arm and straighten it out above the head.
   c. Adjust the legs so that they are together and straight or nearly straight.
   d. Place one hand on the back of the casualty's head and neck.
   e. Grasp the casualty under the arm with the free hand.
   f. Pull steadily and evenly toward yourself, keeping the casualty's head and neck in line with the torso.
   g. Roll the casualty as a single unit.
   h. Place the casualty's arms at his or her side.

NOTE:
The following steps are employed when the HM must secure a patent (open) airway and either establish or maintain breathing.
2. Establish the airway using the head-tilt/chin-lift or jaw thrust method.
   a. Head-tilt/chin-lift maneuver.

   CAUTION:
   Do not use this method if a spinal injury is suspected.

   NOTE:
   Remove any foreign material or vomit seen in the mouth as quickly as possible.

   i. With the casualty in a supine position, the HM positions beside the casualty's head along one side of the body.
   ii. Place one hand on the casualty's forehead and apply firm, backward pressure with the palm of the hand to tilt the head back.
   iii. Place the tips of the fingers of the other hand under the lower jaw near the boney part of the casualty's chin.
   iv. Lift the chin upward, bringing the entire lower jaw with it, helping to tilt the head back.

   CAUTION:
   Do not use the thumb to lift the lower jaw.
   Do not press deeply into the soft tissue under the chin with the fingers.
   Do not completely close the casualty's mouth.

**CAUTION:**
Use this method if a spinal injury is suspected.

**WARNING:**
Do NOT place suspected spinal injury patients in the recovery position.

i. Kneel above the supine casualty's head. Rest elbows on the surface on which the casualty is lying.

ii. Carefully reach forward and gently place one hand on each side of the casualty's lower jaw, at the angles of the jaw below the ears.

iii. Stabilize the casualty's head with the forearms.

iv. Using the index fingers, push the angles of the casualty's lower jaw forward.

v. Use the thumbs to help position the lower jaw to allow breathing through the mouth as well as the nose.

vi. The completed maneuver should open the airway with the mouth slightly open and the jaw jutting forward.

**CAUTION:**
Do not tilt or rotate the casualty's head.

3. Check for breathing within 3 to 5 seconds. While maintaining the open airway position, place an ear over the casualty's mouth and assess the breathing using the "look, listen, and feel" technique.

   a. Look for the chest to rise and fall.
   
   b. Listen for air escaping during exhalation.
   
   c. Feel for the flow of air on the side of the face.

4. Take appropriate action.

   a. If the casualty resumes breathing on his or her own, maintain the airway and (if no spinal injury is assessed or suspected) place the casualty in the recovery position.
      
      i. Roll the casualty as a single unit onto his or her side.
   
      ii. Place the hand of the upper arm under the chin.

   iii. Flex the upper leg.

   **NOTE:**
   Continue the initial assessment to check the casualty for other injuries.

   b. If the casualty does not resume breathing, perform rescue breathing.

PERFORM ORAL AND NASOPHARYNGEAL SUCTIONING OF A PATIENT23

**Scenario**

The HM is managing a patient that requires suctioning.

**Objective**

Perform oral or nasopharyngeal suctioning to clear the airway without causing injury to the patient.
Performance Steps

CAUTION:
All body fluids should be considered potentially infectious. Always observe body substance isolation (BSI) precautions by wearing gloves and eye protection as a minimal standard of protection.

1. Position the patient in a semi-Fowler's (semi-sitting) position or, in the case of severe trauma, roll the patient onto his side to allow gravity to assist in clearing the airway.

NOTE:
In some cases, such as spinal injuries, the patient must remain in whatever position they are initially found or must be managed while they are immobilized on a long spine board.

2. Check the suction unit for proper assembly of all its parts.

3. Turn on the assembled unit and check to see if it is operational.

NOTE:
Inspect the suction unit regularly to ensure it is in working condition. Switch on the suction, clamp the tubing, and make certain the unit generates a vacuum of more than 300 mm Hg. Check that a battery-charged unit has charged batteries.

4. Select the appropriate catheter and attach it to the suction tubing.
   a. Tonsil-tip (Yankauer) catheters are best for suctioning in the field, as they have wide diameter tips and are somewhat rigid.
   b. Flexible (French, or whistle-tip) catheters are used in situations where rigid catheters cannot be used, such as a patient with clenched teeth or for use in nasopharyngeal suctioning.

5. Prepare equipment.
   a. Open the basin package.
   b. Pour the saline solution into the basin.
   c. Open the suction catheter package.

6. Explain to the patient the reason for suctioning.

7. Pre-oxygenate the patient with 100% oxygen.
   a. If the patient is receiving oxygen therapy, increase the oxygen to 100% for 1 minute.
   b. Monitor the patient's pulse oximeter reading during the entire procedure.
   c. If the patient is not receiving oxygen therapy, have him take a minimum of five deep breaths or administer the breaths with a bag-valve-mask (BVM) system.

NOTE:
After each suctioning attempt or suctioning period, re-oxygenate the patient.

8. Remove the catheter from the package using the dominant hand.

9. Test the patency of the catheter.
   a. Turn the suction unit on with the non-dominant hand.
   b. Insert the catheter tip into the saline solution using the dominant hand.
   c. Occlude the suction control port with the non-dominant thumb and observe the saline entering the drainage bottle.

NOTE:
If no saline enters the bottle, check the suction unit and or replace the catheter and retest for patency.
10. Suction the patient.

a. Oral route.

i. Rigid catheter.

1. Instruct a conscious patient to cough to help bring secretions up to the back of the throat.

2. If the patient is unconscious, use the cross finger method of opening the airway.

3. Place the convex (outward curving) side of the rigid tip against the roof of the mouth and insert to the base of the tongue.

**NOTE:**

A rigid tip does not need to be measured. Only insert the tip as far as YOU can see it. Be aware that advancing the catheter too far may stimulate the patient's gag reflex and cause vomiting.

4. Apply suction by placing the thumb of the non-dominant hand over the suction control port.

**WARNING:**

Never suction for more than 15 seconds at one time for adults, 10 seconds for children, and 5 seconds for infants. Longer periods of continuous suctioning may cause oxygen deprivation and subsequent hypoxic injury to the brain.

5. Clear the secretions from the catheter between each suctioning interval by inserting the tip into the saline solution and suction the solution through the catheter until the catheter is clear of secretions.

6. Repeat steps 10-a-i-1 through 10-a-i-5 until all secretions have been removed or until the patient's breathing becomes easier. Noisy, rattling or gurgling sounds should no longer be heard.

ii. Flexible catheter.

1. Measure the catheter from the patient's earlobe to the corner of the mouth or the center of the mouth to the angle of the jaw.

2. Insert the catheter into the patient's mouth to the correct depth, without the suction applied.

**NOTE:**

If an oropharyngeal airway (OPA) is in place, insert the catheter alongside the airway and then back into the pharynx.

3. Place the thumb of the non-dominant hand over the suction control port on the catheter, applying intermittent suction by moving the thumb up and down over the suction control port.

4. Apply suction in a circular motion while withdrawing the catheter.

5. Suction for no longer than 15 seconds removing secretions from the back of the throat, along outer gums, cheeks, and base of tongue.

**WARNING:**

Advancing the catheter too far into the back of the patient's throat may stimulate the gag reflex. This could cause vomiting and the aspiration of stomach contents.

6. Clear the secretions from the catheter between suctioning by inserting the tip into the saline solution and suction the solution through the catheter until the catheter is clear of secretions.

7. Repeat steps 10-a-ii-1 through 10-a-ii-6 until all secretions have been removed or until the patient's breathing becomes easier. Noisy, rattling or gurgling sounds should no longer be heard.
b. Nasopharyngeal route.
   i. Measure the flexible catheter from the tip of the earlobe to the nose.
   ii. Lubricate the catheter by dipping the tip into the saline solution.
   iii. Insert the catheter into one nostril without suction applied. If an obstruction is met, try the other nostril.
   iv. Quickly and gently advance the catheter 3 to 5 inches.
   v. Perform steps 10-a-ii-3 through 10-a-ii-5 to suction secretions.

11. Re-oxygenate the patient and or ventilate for at least five assisted ventilations.
12. Observe the patient for hypoxemia.
   a. Color change.
   b. Increased or decreased pulse rate.

**WARNING:**
Discontinue suctioning immediately if severe changes in color or pulse rate occur.

13. Place the patient in the recovery (lateral recumbent, coma) position, unless contraindicated by a suspected spinal injury.
14. Record the procedure.
15. Evacuate the patient.

**NOTE:**
If the patient is uncooperative or oral entry is not possible due to facial trauma, nasopharyngeal suctioning may be required.

**Objective**
Insert an OPA without causing further injury to the casualty.

**Performance Steps**

**CAUTION:**
All body fluids should be considered potentially infectious. Always observe body substance isolation (BSI) precautions by wearing gloves and eye protection as a minimal standard of protection.

**WARNING:**
Use an OPA for an unconscious casualty only. Do not use an OPA on a conscious or semiconscious casualty because there may still be an active gag reflex. In such cases, a nasopharyngeal airway (NPA) would be more appropriate. An OPA should not be used in children who may have ingested a caustic or petroleum-based product, as it may induce vomiting.

1. Select the appropriate size of OPA, have three from which to choose.
   a. Place the airway beside the outside of the casualty's jaw.
   b. Measure from the casualty's ear lobe to the corner of the mouth.

**NOTE:**
The measurement from the ear lobe to the corner of the casualty's mouth is equivalent to the depth of insertion in the airway.

2. Perform the head-tilt/chin-lift or jaw thrust maneuver to open the airway.

**WARNING:**
If a neck or spinal injury is suspected, use the jaw thrust maneuver to open the airway.

**INSERT AN OROPHARYNGEAL AIRWAY**

**Scenario**
The HM is assessing an unconscious casualty who requires insertion of an oropharyngeal airway (OPA).
3. Open the casualty's mouth.
   a. Place the crossed thumb and index finger of one hand on the casualty's upper and lower teeth at the corner of the mouth.
   b. Use a scissors motion to pry the casualty's teeth apart.

   **NOTE:**
   If the teeth are clenched, wedge the index finger behind the casualty's back molars to open the mouth.

4. **Insert the OPA.**
   a. Insert the airway with the tip facing the roof of the mouth.
   b. Slide the OPA along the roof of the mouth. Follow the natural contour of the tongue past the soft palate.
   c. Rotate the airway 180° as the tip reaches the back of the tongue.

   **NOTE:**
   The airway may be difficult to insert. If so, use a gauze pad to pull the tongue forward or a tongue depressor to depress the tongue.

   d. Gently advance the airway and adjust it so the flange rests against the casualty's lips or teeth.

   **NOTES:**
   The tip of the airway should rest just above the epiglottis.
   If the flange of the airway did not seat correctly on the lips or if the casualty gags, the airway may be the wrong size. Repeat the procedure using a different size of airway.

   **WARNING:**
   If the casualty starts to regain consciousness and gags or vomits, remove the airway immediately.

5. **Insert the OPA using a tongue depressor.**
   a. Use the tongue depressor to depress the tongue, ensuring the tongue remains forward.
   b. Insert the OPA sideways from the corner of the mouth until the flange reaches the teeth.
   c. Rotate the OPA at a 90° angle, removing the tongue depressor while exerting gentle backward pressure on the OPA until it rests securely in place against the lips or teeth.

6. Monitor the casualty's respirations on a regular basis.
   a. Reassess air exchange and placement every time the casualty is moved.
   b. Assist with respirations if the respiratory rate falls below 8 or rises above 30 per minute or a pulse oximeter reading <90%.

7. Evacuate the casualty.

   **NOTE:**
   The airway may need to be taped or tied in place to avoid dislodgement during evacuation. If so, the casualty must be constantly monitored for the return of consciousness.

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**INSERT A NASOPHARYNGEAL AIRWAY**

**Scenario**

The HM is assessing a patient with a reduced level of consciousness who is unable to maintain his airway.

**Objective**

Insert the appropriate size of NPA, without causing further injury to the patient.
### Performance Steps

#### CAUTION:
All body fluids should be considered potentially infectious. Always observe body substance isolation (BSI) precautions by wearing gloves and eye protection as a minimal standard of protection.

1. Place the patient supine with the head in a neutral position.

2. Select the appropriate size NPA by measuring from the tip of the patient's nose to earlobe.

3. Coat the distal tip (non-flanged end) of the NPA with a water-soluble lubricant.

4. Insert the NPA.
   a. Push the tip of the nose upward gently.
   b. Position the tube so that the bevel of the airway faces toward the septum.
   c. Gently advance the lubricated NPA into the nostril with the curvature of the device following the curve of the floor of the nose. Advance it until the flange rests against the nostril.

   **NOTE:**
   Most NPAs are designed to be placed in the right nostril.

   **CAUTION:**
   Never force the NPA into the patient's nostril. If resistance is met, pull the tube out and attempt to insert it in the other nostril. If the patient becomes intolerant of the airway, gently withdraw it from the nasal passage.

5. Place the patient in the recovery (lateral recumbent, coma) position to prevent aspiration of blood, mucus, or vomitus.

6. Monitor the casualty's respirations on a regular basis.
   a. Reassess air exchange and placement every time the casualty is moved.
   b. Assist with respirations if the respiratory rate falls below 8 or rises above 30 per minute or a pulse oximeter reading <90%.

7. Record the procedure.

8. Evacuate the patient.

### Insert A Combitube®

#### Scenario
An unconscious casualty requires the insertion of an esophageal tracheal Combitube®. An assistant is performing resuscitative measures. No cervical spine injury is present.

#### Objective
Insert the Combitube® and successfully ventilate the casualty without causing further injury.

#### Performance Steps

1. Take Body Substance Isolation (BSI) precautions.
2. Inspect upper airway for visible obstruction.
3. Inspect and test equipment.
4. Lubricate distal end of tube.
5. Perform a tongue-jaw lift.
6. Insert device until casualty's teeth sit between printed black rings, within 3 attempts.

7. Inflate #1 (blue) cuff with appropriate amount of air based on size of tube.

8. Inflate #2 (white) cuff with appropriate amount of air based on size of tube.

9. Direct assistant to ventilate casualty with a BVM through primary tube.

10. Perform steps 5-9 in less than 30 seconds.

11. Watch for rise and fall of the chest, auscultate for breath sounds and over the epigastrium to confirm tube placement.


13. Attach pulse oximeter to casualty, if available.

14. Monitor the casualty's respirations on a regular basis.
   a. Reassess air exchange and placement every time the casualty is moved.
   b. Assist with respirations if the respiratory rate falls below 8 or rises above 30 per minute or a pulse oximeter reading <90%.

15. Secure device to the casualty around casualty's neck.

**Performance Steps**

1. Take body substance isolation (BSI) precautions.

2. Inspect the upper airway for visible obstruction.

3. Direct the assistant to pre-oxygenate the casualty for a minimum of 30 seconds.

4. Inspect and test equipment.

5. Lubricate the distal end of the tube with water soluble lubricant.

6. Perform a tongue-jaw lift.

7. Insert the device until the base connector is aligned with the casualty's teeth.

8. Inflate the cuffs with the appropriate amount of air based on the size of the tube.
   a. Use size 3 if the casualty is less than 61 inches in height. Inflate with 60 ml of air.
   b. Use size 4 if the casualty is 61 inches to 71 inches in height. Inflate with 80 ml of air.
   c. Use size 5 if the casualty is taller than 71 inches in height. Inflate with 80 ml of air.

9. Direct the assistant to ventilate the casualty with a BVM.

10. Auscultate the lung fields and epigastrium, and watch for rise and fall of the chest to confirm tube placement.

11. Assess casualty for spontaneous respirations for 10 seconds.

12. Attach pulse oximeter to casualty.

13. Ventilate casualty when respirations are <8 or > 30 or a pulse oximeter reading <90%.

14. Secure the device to the casualty.

**INSERT A KING LT® AIRWAY**

**Scenario**

An unconscious casualty requires the insertion of an esophageal airway. An assistant is performing resuscitative measures. No cervical spine injury is present.

**Objective**

Insert the King LT® without causing further injury.
15. Monitor the casualty's respirations on a regular basis.
   a. Reassess air exchange and placement every time the casualty is moved.
   b. Assist with respirations if the respiratory rate falls below 8 or rises above 30 per minute or a pulse oximeter reading <90%.

16. Evacuate the casualty.

PERFORM A SURGICAL CRICOARYTHROIDOTOMY

Scenario

The HM has a casualty requiring a surgical cricothyroidotomy.

Objective

Perform a surgical cricothyroidotomy without causing unnecessary injury to the casualty.

Performance Steps

**CAUTION:**
Casualties with a total upper airway obstruction, inhalation burns, or massive maxillofacial trauma who cannot be ventilated by other means are candidates for a surgical cricothyroidotomy.

1. Gather cricothyroidotomy kit or minimum essential equipment.

**NOTE:**
Because of the need for speed, every HM should have an easily accessible cricothyroidotomy kit that contains all required items.

2. Airway tube: ET tube, tracheotomy tube, or any non-collapsible tube that will allow enough airflow to maintain oxygen saturation.

**NOTE:**
In a field setting, an ET tube is preferred because it is easy to secure. Use a size 6.0 to 7.0 ET tube, and ensure the cuff will hold air.

3. Hyperextend the casualty's neck.

**WARNING:**
Do not hyperextend the casualty's neck if a cervical injury is suspected.

4. Locate the cricothyroid membrane.

   a. Place a finger of the non-dominant hand on the thyroid cartilage (Adam's apple), and slide the finger down to the cricoid cartilage.
   b. Palpate for the soft cricothyroid membrane below the thyroid cartilage and just above the cricoid cartilage.
   c. Slide the index finger down into the depression between the thyroid and cricoid cartilage.
   d. Prepare the skin over the membrane with an alcohol swab.

5. Stabilize the larynx with the non-dominant hand.
6. With the cutting instrument in the dominant hand, make a 1-1/2 inch vertical incision through the skin over the cricothyroid membrane.

**NOTE:**
A vertical incision will allow visualization of the cricothyroid membrane, but keep the scalpel blade away from the lateral aspect of the neck. This is important because of the large blood vessels located there, i.e. carotid artery and jugular vein.

**CAUTION**
Do not cut the cricothyroid membrane with this incision.

7. Maintain the opening of the skin incision by pulling the skin taut with the fingers of the non-dominant hand.

8. Stabilize the larynx with one hand and cut horizontally through the cricothyroid membrane.

9. Insert a commercially designed cricothyroidotomy hook or improvise with the tip of an 18-gauge needle formed into a hook through the opening; hook the cricoid cartilage, and lift to stabilize the opening.

10. Insert the end of the ET tube or tracheotomy tube through the opening and towards the lungs. The tube should be in the trachea and directed toward the lungs. Inflate the cuff with 10 cubic centimeters (cc) of air.

11. Assess the casualty for spontaneous respirations (10 seconds).

12. Attach a pulse oximeter to the casualty, if available.

13. Assist with ventilations when respirations are <8 or >30 or a pulse oximeter reading <90%. Direct an assistant to ventilate the casualty with a BVM, if necessary.

14. Auscultate lung fields and watch for rise and fall of the chest to confirm tube placement.

15. Secure the tube, using tape, cloth ties, or other measures, and apply a dressing to further protect the tube and incision.

16. Monitor the casualty's respirations on a regular basis.
   a. Reassess air exchange and placement every time the casualty is moved.
   b. Assist with respirations if the respiratory rate falls below 8 or rises above 30 per minute or a pulse oximeter reading <90%.

17. Evacuate casualty.

**PERFORM A NEEDLE CHEST DECOMPRESSION**

**Scenario**

The HM has a breathing casualty with chest trauma who requires needle chest decompression.

**Objective**

Complete all the steps necessary to perform a needle chest decompression without causing unnecessary injury to the casualty.
Performance Steps

NOTE:
Pneumothorax is defined as the presence of air within the chest cavity. Air enters either from the lungs through a rupture, laceration, or from the outside through a sucking chest wound. Trapped air in the chest cavity under pressure, called a tension pneumothorax, compresses the lung beneath it.

NOTE:
Unrelieved pressure will push and compress the contents of the chest in the opposite direction, away from the side of the tension pneumothorax. This, in turn, will prevent the heart from filling with blood and beating correctly and the good lung from providing adequate respirations.

CAUTION:
This procedure should ONLY be performed if the casualty has a chest trauma and progressive respiratory distress.

1. Locate the insertion site. Locate the second intercostal space approximately two finger widths below the clavicle (between the second and third ribs) at the mid-clavicular line (approximately in line with the nipple) on the same side of the casualty's chest as the injury.

2. Insert a large bore (3.25 inch, 14 gauge) needle and catheter unit.
   a. Firmly insert the needle into the skin over the top of the third rib into the second intercostal space, until the chest cavity has been penetrated, as evidenced by feeling a "pop" as the needle enters the chest cavity.
   b. A hiss of escaping air may be heard.

3. Withdraw the needle while holding the catheter still.

NOTE:
The casualty's respiration should improve.

4. Secure the catheter to the chest wall using tape.

5. Monitor the casualty until medical care arrives or the casualty is evacuated.

ADMINISTER OXYGEN

Scenario
The HM has a patient requiring oxygen administration.

Objective
Administer oxygen therapy using a non-rebreather (NRB) mask or nasal cannula to assist the patient's breathing without causing further harm to the patient. Calculate the duration of flow of the oxygen.

Performance Steps

CAUTION:
All body fluids should be considered potentially infectious. Always observe body substance isolation (BSI) precautions by wearing gloves and eye protection as a minimal standard of protection.

1. Explain the procedure to the patient.
2. Assemble and prepare the equipment.
   a. Inspect the oxygen cylinder and its markings.

   **NOTE:**
   Ensure the cylinder is labeled for medical oxygen; the bottles may be completely green, silver, or chrome with a green area around the valve stem on top.

   b. Attach the regulator/flow meter.
   c. Open the oxygen cylinder.
   d. Check for leaks.
   e. Check oxygen cylinder pressure.

   **NOTE:**
   The safe residual level of the oxygen at which the tank should be replaced has been established to be 200 pounds per square inch (psi).

3. Position the patient in the position of comfort to facilitate breathing unless contraindicated by the mechanism of injury (MOI).

4. Determine the delivery device to use.

   **NOTE:**
   Humidifiers can be connected to flow meters to provide moisture to dry oxygen; oxygen can dry out mucous membranes with prolonged use.

   Humidified oxygen is usually more comfortable to the patient and is particularly helpful for children and for chronic obstructive pulmonary disease (COPD) patients.

   a. A bag-valve-mask (BVM) system is the delivery device of choice for patients with signs of inadequate breathing, i.e. respirations <8 or >30 per minute.

   b. A NRB mask is the delivery device of choice in the pre-hospital setting for patients with signs of inadequate breathing, or who are cyanotic, having chest pain, severe trauma, signs of shock, or an altered mental status.

   c. A nasal cannula is appropriate for patients unable to tolerate the NRB.

5. **Apply the NRB mask.**
   a. Select the correct size of mask.

   **NOTE:**
   The apex of the mask should fit over the bridge of the patient's nose and extend to rest on the chin, covering the mouth and nose completely. NRB masks come in different sizes for adults, children, and infants.

   b. Attach the extension tubing to the regulator/flow meter.
   c. Initiate the oxygen flow and adjust it to the prescribed rate of 10-15 liters/minute (LPM) to deliver up to 90% oxygen.
   d. Pre-fill the reservoir bag using gloved fingers to cover the connection between the mask and the reservoir, if applicable.
   e. Place the mask on the patient and adjust the straps.
   f. Instruct the patient to breathe normally.

6. **Apply the nasal cannula.**
   a. Attach the cannula tubing to the regulator/flow meter.
   b. Adjust the oxygen flow to the prescribed rate of 1-4 LPM to deliver 24-44% oxygen.
   c. Position the cannula so the two small, tube-like prongs fit in the patient's nostrils curving naturally along the base of the nostrils.
   d. Adjust the nasal cannula to hold in place.

7. Continue to monitor the patient for signs of confusion, restlessness, level of consciousness, skin color, increased capillary refill, or changes in vital signs.
8. Check the equipment for security of tubing connections and administration device, oxygen flow, and humidified water level as indicated.

**NOTE:**
Change the delivery device and tubing IAW local protocols.

9. **Calculate the duration of flow of the oxygen cylinder.**
   a. Determine the remaining pressure in the tank by reading the regulator gauge.
   b. Determine the safe residual level of the oxygen tank.

**NOTE:**
The safe residual level of the oxygen at which the tank should be replaced has been established to be 200 psi.

c. Determine the available cylinder pressure by subtracting the safe residual level from the remaining pressure. Example: 2000 psi remaining pressure minus 200 psi safe residual level = 1800 psi available pressure.

d. Determine the conversion factor for the oxygen cylinder in use.

**NOTE:**
Each type of oxygen cylinder, depending on its size, employs a specific conversion factor.

i. D size oxygen cylinder--0.16.
ii. E size oxygen cylinder--0.28.
iii. G size oxygen cylinder--2.41.
vi. M size oxygen cylinder--1.56.

e. Determine the available liters by multiplying the conversion factor by the amount of available pressure. Example: A "D" size cylinder is being used. A 0.16 conversion factor x 1800 psi available pressure = 288 liters of oxygen available for use.

f. Determine the flow rate as prescribed by medical direction.

**WARNING:**
The principle danger in using oxygen is fire.

The presence of oxygen in increased concentrations makes all materials more combustible.

Materials that burn slowly in ordinary air, burn violently and even explosively in the presence of oxygen.

c. Use only non-sparking wrenches on oxygen cylinders.

d. Ensure all electrical equipment is properly grounded.

e. Position oxygen cylinders away from doors and high traffic areas.

f. Do not use oil or grease around oxygen fittings.

g. Secure and store oxygen cylinders in an upright position.

10. Follow safety precautions.
   a. Ensure "OXYGEN" and "NO SMOKING" signs are posted wherever oxygen is used or stored.
   b. Inform the patient and visitors about the restrictions.
LEARNING OBJECTIVES:

Explain the signs and symptoms of shock.

Determine treatment by the type of shock presented.

Shock is a state of inadequate tissue perfusion resulting in a decreased amount of oxygen to vital tissues and organs. There are three major types of shock (Table 21-2):

1. **Hypovolemic** shock is a loss of intravascular volume, which may occur from blood, plasma, or fluid loss. Also known as hemorrhagic shock.

2. **Distributive (Vasogenic)** shock - occurs when the vascular container (blood vessels) dilate (enlarge) without a proportional increase in fluid volume. As a result, the heart’s preload decreases (blood available for pumping out to the body to provide oxygen and nutrients), and thus cardiac output falls leaving the tissues hypoxic and starved for energy.
   - a. **Neurogenic** shock is caused by the failure of the nervous system to control the diameter of blood vessels.
   - b. **Septic shock** is caused by the presence of severe infection which leads to vasodilation.
     - a. **Psychogenic (vasovagal)** shock is typically mediated through the para-sympathetic nervous system. Stimulation of the vagus nerve produces bradycardia which can lead to fainting.

3. **Cardiogenic** shock is caused by the heart failing to pump blood adequately to all vital parts of the body.

<table>
<thead>
<tr>
<th>Vital Sign</th>
<th>Hypovolemic</th>
<th>Distributive</th>
<th>Cardiogenic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skin Temp</td>
<td>Cool, Clammy</td>
<td>Warm, Dry</td>
<td>Cool, Clammy</td>
</tr>
<tr>
<td>Skin Color</td>
<td>Pale, cyanotic</td>
<td>Pink</td>
<td>Pale, Mottled</td>
</tr>
<tr>
<td>Blood Pressure</td>
<td>Drops</td>
<td>Drops</td>
<td>Drops (briefly)</td>
</tr>
<tr>
<td>LOC</td>
<td>Altered</td>
<td>Lucid</td>
<td>Altered (briefly)</td>
</tr>
<tr>
<td>Cap Refill</td>
<td>Slowed</td>
<td>Normal</td>
<td>Slowed (briefly)</td>
</tr>
</tbody>
</table>

Table 21-2.—Differentiating Types of Shock
STAGES OF SHOCK

Shock occurs in three successive stages. The HM's goal is to recognize the signs of the early stages of shock and begin immediate treatment before the permanent damage occurs. The three stages of shock are compensated, decompensated and irreversible.

- Compensated (Non-progressive) Shock: At this stage, the blood pressure is maintained; however, there is a narrowing of the pulse pressure, which is the difference between the systolic and diastolic pressures. Treatment at this stage will typically result in recovery.

- Decompensated (Progressive) Shock: At this stage, the blood pressure is falling because the blood volume has dropped 15 to 25%. The compensatory mechanisms are beginning to fail, and signs and symptoms are much more obvious. At this point, vasoconstriction can have a disastrous effect if allowed to continue. Treatment at this stage will sometimes result in recovery.

- Irreversible Shock: Shock has progressed to a terminal stage. Arterial blood pressure is abnormally low. There are life-threatening reductions in cardiac output, blood pressure, and tissue perfusion. Even aggressive treatment at this stage does not normally result in recovery.

Hypovolemic Shock - a state of shock caused by any loss of fluid volume either by blood loss, dehydration, burns, etc. The container has retained its normal size but the fluid volume has decreased, creating an imbalance. The most common cause of hypovolemic shock on the battlefield is due to massive hemorrhage which causes hemorrhagic shock.

The amount of blood that can be lost before death occurs will vary from individual to individual. The average adult blood volume is 5 to 6 liters. Normally, a loss of approximately 1 liter or 25-40% of the person's total blood volume will create a life-threatening condition. Massive hemorrhage may be fatal within 60-120 seconds. In a tactical environment, treatment should not be delayed. Controlling major hemorrhage should be the first priority over securing an airway.

Signs and symptoms seen with hemorrhagic shock are normally linked with the amount of blood lost and the casualty’s internal reaction to this blood loss. DO NOT rely on BP as the main indicator of shock! More attention should be paid to the casualty’s mental status, quality of distal pulses, and tachycardia. Hemorrhagic shock, which is hypovolemic shock resulting from blood loss, can be categorized into four classes, depending on the severity of hemorrhage. Remember these parameters are only guidelines and should not be taken as absolute amounts of associated blood loss (Table 21-3).

What happened to ABC’s?

The brain can go four to six minutes without oxygen before permanent damage or death. Death from massive hemorrhage may occur within two minutes.
**Class I Shock**

This stage has few clinical manifestations. The casualty's body is able to compensate to maintain homeostasis. “A tactically relevant definition of shock in a combat trauma casualty is an abnormal radial pulse (weak or absent) and an abnormal mentation (LOC) not attributed to drug therapy or brain injuries".

**Class II Shock**

Although the circulating blood volume is reduced, compensatory mechanisms such as the sympathetic nervous system are able to maintain blood pressure and tissue perfusion at a level sufficient to prevent cellular damage.

**Class III Shock**

At this point, unfavorable signs begin to appear. The body’s compensatory systems can no longer maintain adequate perfusion. The classic signs of shock (*tachycardia, tachypnea*, and confusion) become obvious. HMs must see the importance of catching the casualty in the early stages of shock because by the time the casualty gets to this stage, he or she is in significant trouble.

**Class IV Shock**

This is a severe stage of shock! These casualties truly have only minutes to live. Survival depends on immediate control of hemorrhage (surgery for internal hemorrhage) and aggressive resuscitation.

**Signs and Symptoms**

See Table 21-3.

---

**Table 21-3.—Classes of Hemorrhagic Shock**

<table>
<thead>
<tr>
<th></th>
<th>Class I</th>
<th>Class II</th>
<th>Class III</th>
<th>Class IV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amount of Blood Loss</strong></td>
<td>&lt;750ml (&lt;15%)</td>
<td>750-1500ml (15%-30%)</td>
<td>1500-2000ml (30%-40%)</td>
<td>&gt;2000ml (&gt;40%)</td>
</tr>
<tr>
<td><strong>Heart rate</strong></td>
<td>Normal or minimally increased</td>
<td>&gt;100</td>
<td>&gt;120</td>
<td>&gt;140</td>
</tr>
<tr>
<td><strong>Pulse (quality)</strong></td>
<td>Normal</td>
<td>Thready</td>
<td>Thready/ very weak</td>
<td>No Radial/ thready Carotid</td>
</tr>
<tr>
<td><strong>Capillary Refill</strong></td>
<td>Normal</td>
<td>Delayed (3-5 seconds)</td>
<td>Delayed (&gt;5 seconds)</td>
<td>Delayed (&gt;5 seconds)</td>
</tr>
<tr>
<td><strong>Respiratory Rate</strong></td>
<td>Normal</td>
<td>20-30</td>
<td>30-40</td>
<td>&gt;35</td>
</tr>
<tr>
<td><strong>SBP</strong></td>
<td>Normal</td>
<td>Normal</td>
<td>Decreased (&lt;80 mmHg)</td>
<td>Greatly Decreased (approx. 60 mmHg)</td>
</tr>
<tr>
<td><strong>Skin Color</strong></td>
<td>Pink</td>
<td>Pale</td>
<td>White extremities/ Ashen Gray</td>
<td>White extremities/ Ashen Gray/ Cyanotic</td>
</tr>
<tr>
<td><strong>Skin Temperature</strong></td>
<td>Cool</td>
<td>Cool, Moist</td>
<td>Cool Extremities</td>
<td>Cold Extremities</td>
</tr>
<tr>
<td><strong>Mental Status</strong></td>
<td>Normal</td>
<td>Anxiety</td>
<td>Severe Anxiety/ Confused</td>
<td>Lethargic Unconscious</td>
</tr>
</tbody>
</table>
Treatment

See soft tissue injury section for Hemorrhage control procedures.

The field care phase will determine the HM’s actions; Care Under Fire phase use a tourniquet for life-threatening extremity hemorrhage and Tactical Field Care phase use direct pressure and or a hemostatic dressing. Once the bleeding is stopped obtain vascular access, give resuscitative fluids, and coordinate Casualty Evacuation (CASEVAC).

### Three Types of Distributive Shock

<table>
<thead>
<tr>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Septic</td>
</tr>
<tr>
<td>Neurogenic</td>
</tr>
<tr>
<td>Psychogenic</td>
</tr>
</tbody>
</table>

### SEPTIC SHOCK

Shock caused by a systemic infection. In these cases the bacteria multiply rapidly throughout the body releasing toxins into the blood stream. The toxins cause the blood vessels in the periphery (arms and legs) to dilate maldistributing the blood away from critical areas (i.e. brain, heart, and lungs).

### Signs and Symptoms

See Table 21-3.

### Treatment

It typically takes between 5-7 days for septic shock to develop. However, HMs may be called on to care for a casualty who sustained an injury and did not promptly seek medical attention. If so, a HM’s primary focus should be to CASEVAC the casualty to a higher echelon of care. Additionally, the casualty will require IV antibiotic therapy with a broad spectrum antibiotic.

### NEUROGENIC SHOCK

Shock caused by an injury that interrupts the spinal cord's sympathetic nervous system pathway, resulting in significant dilation of peripheral arteries. Because of the loss of sympathetic control of the vascular system which controls the smooth muscle in the walls of the blood vessels, the peripheral vessels dilate below the level of injury.

### Signs and Symptoms

See Table 21-3 and below.

1. Injuries consistent with spinal injury.
2. Bradycardia with hypotension (low heart rate with low blood pressure should be a red flag, start suspecting neurogenic shock).
3. The casualty with neurogenic shock, in the absence of traumatic brain injury, is alert, orientated, and lucid (clear in the mind) when in the supine (laying down on back) position.

### Treatment

1. Maintain ABC’s.
2. Spinal Immobilization (if mechanism of injury causes a high suspicion of spinal injury).
3. Oxygen therapy to keep oxygen saturation >92% (if available).
4. Obtain IV access and give fluids, if necessary.
5. Trendelenburg position (head down, feet elevated).
6. Keep patient warm.
7. CASEVAC.
PSYCHOGENIC (VASOVAGAL) SHOCK

Also known as vasovagal syncope or fainting, this occurs when there is stimulation of the tenth cranial nerve (vagus nerve) which produces bradycardia and hypotension. If the bradycardia and hypotension are severe enough, cardiac output falls, resulting in insufficient blood flow to the brain and the casualty loses consciousness. Typically, normal blood pressure is quickly restored before systemic impairment of perfusion occurs. Common causes are fear, receiving unexpected bad news, or the sight of blood.

Signs and Symptoms

See Table 21-3 and below.

The periods of bradycardia and vasodilation are generally limited to minutes.

Treatment

Because it is a self-limited condition, a vasovagal episode is unlikely to result in true “shock” and normal blood pressure is quickly restored when the casualty is placed in a horizontal position.

CARDIOGENIC SHOCK

Failure of the heart to adequately pump blood throughout the body, resulting from causes that can be categorized as either intrinsic (a result of direct damage to the heart itself, a heart attack, for instance) or extrinsic (related to a problem outside the heart, a tension pneumothorax, for example). In this scenario, the container is the correct size and is filled with the right amount of fluid; it is the pump that is not functioning properly.

Intrinsic Causes

Any injury that weakens the cardiac muscle will affect its output. The damage may result from a myocardial infarction or from a direct bruise to the heart muscle from a blunt cardiac injury that prevents the heart from pumping properly.

Signs and Symptoms

See Table 21-3 and below.

- Abnormal pulse (irregular rate and rhythm)
- Chest pain
- Shortness of breath
- Nausea and vomiting

Treatment

- Maintain ABC’s
- Obtain IV access
- Oxygen therapy to keep oxygen saturation >92% (if available)
- CASEVAC

Extrinsic Causes

External factors that cause the heart not to work properly (i.e., tension pneumothorax and cardiac tamponade)

Why do WE learn something that WE can’t treat?

Answer: Use these signs and symptoms of cardiac tamponade as a way for ruling out tension pneumothorax.

Signs and Symptoms

- Tension Pneumothorax:
- Chest trauma
- Shortness of breath/dyspnea
- Tachycardia
- Cyanosis
- Decreased/absent lung sounds on affected side
- Jugular vein distention and tracheal deviation (away from the side of injury or affected side)
Cardiac Tamponade:
Chest Trauma
Shortness of breath/dyspnea
Tachycardia
Cyanosis
Distant (muffled) heart tones/sounds
Narrowing pulse pressure

Treatment

- Maintain ABC’s
- Oxygen therapy to keep oxygen saturation >92% (if available)
- CASEVAC

Specific treatment for a tension pneumothorax is needle decompression, which will be discussed in a future lesson.

VOLUME RESUSCITATION

Although volume resuscitation of a trauma casualty in shock makes sense, no research has demonstrated improved survival of critically injured trauma casualties when IV fluid therapy has been administered in the field.

In fact, one researcher found that IV fluids administered in the field were beneficial only when three conditions existed:

- Casualty is bleeding at a rate of 25 to 100 mL/min
- IV fluid administration rate is equal to the bleeding rate
- Scene time and transport time exceed 30 minutes

Therefore, transport of the trauma casualty should never be delayed to start an IV.

HMs will receive training on the type of vascular access (PO, IV, or IO) to start and the type of fluids to give in the lesson on Combat Fluid Resuscitation.

In order to understand the best method for assessing a traumatic injury in the field, it is important to realize some key differences in the environments HMs operate. The scene size up provides critical information pertaining to the surroundings. These are general guidelines which are adaptable to both the non-tactical and tactical environments.

### CASUALTY ASSESSMENT AND SHOCK CASUALTIES

**Care Under Fire Phase:**
There are many things that cause shock; the most common is uncontrolled hemorrhage. If the casualty has life-threatening extremity hemorrhage, use a tourniquet. For non-extremity hemorrhage, use direct pressure with a Committee on Tactical Combat Casualty Care (CoTCCC) approved hemostatic dressing.

**Tactical Field Care Phase:**
Shock is very difficult to treat in a hospital setting let alone in a field or combat environment. Reassess treatment started during Care Under Fire Phase to control the hemorrhage. Assess airway and intervene if necessary. Complete a head to toe assessment using DCAP-BTLS* noting and treating additional injuries. Determine if vascular access is required (see Combat Fluid Resuscitation lesson) and give fluids if necessary. If the casualty is able to drink fluids, they should be encouraged to do so. Consider pain medications and give antibiotics if warranted. Reassess all care provided. Document care given, prevent hypothermia, and CASEVAC.

*DCAP-BTLS: deformities, contusions, abrasions, punctures or penetrations, burns, tenderness, lacerations, and swelling.
Scene Assessment / Scene Size Up

The Scene Assessment is broken down into two stages with the first being Scene Assessment and the second being the Scene Size Up. The Scene Assessment process begins from the moment HMs are notified of the incident. Think of it as a mental exercise or checklist. HMs should “Arm Chair Quarterback” the information received once notified and start brainstorming what could potentially be seen once he/she arrives on the actual scene. The size up occurs once HMs can visualize the scene for themselves. The reason for the two step process is simple; as with the communication exercise “Telephone,” what is assessed upon arriving at the scene may be totally different than what was reported through the notification process. The three priorities of the Scene Assessment / Size Up are:

1. Safety.
2. Identification of Patients.

Once on scene, the first priority is always safety. Safety is a relative term when considering a tactical environment. The HM’s responsibility is to place the patient, bystanders, and ultimately him/herself in the safest position relative to the situation.

In the Scene Size Up, consideration should also be paid to the environmental and geographic area that the incident has occurred. For example, a casualty who has been injured in a desert environment may require interventions to treat an environmental injury as well as the physical injuries identified during the patient assessment. An additional example would be arriving on the scene of a patient that has received a gunshot wound and was bleeding onto an absorbent material such as house carpet. This patient may require additional treatment for shock due to the blood loss not readily visible due to the carpet.

The second priority once arriving on scene is identifying the total number of patients. Some of this information may be provided to the HM during the initial notification of incident, but once on the scene it is imperative that the HM visualize each patient and begin a triage process. The third priority in the Scene Assessment / Size Up process is to identify and consider the mechanism of injury (MOI). The MOI will lead to the HM to the index of suspicion (IOS).

The MOI is simply defined as the basic manner in which the casualty was injured. For example, a casualty that was involved in a collision is subject to multiple forces resulting from the collision. Regardless of injury pattern, the MOI is generally described as deceleration trauma (abrupt stopping from being in motion). As an additional example, a casualty that receives a gunshot or stab wound has a MOI of penetrating trauma and conversely a member struck with a bat has a MOI of blunt trauma.

The IOS is derived directly from the MOI and is defined as the injury patterns the casualty will display based on the MOI. Using the examples above, deceleration trauma can result in cervical spine injury, solid organ shear, or musculoskeletal injury. Penetrating trauma can result in hollow organ rupture, sucking chest wounds, and abdominal evisceration. Blunt trauma can result in hollow organ or solid organ rupture. These examples are meant to simply identify potential injury patterns specific to this text. The responder must fully assess and evaluate each patient to positively identify life threatening conditions and treat them accordingly.

Once the Scene Assessment and Size Up are complete the HM will have a better idea of the number of patients and their severity of injury. After completing the patient assessment, he/she will then be able to compose a comprehensive treatment and evacuation plan to deliver the patients to definitive medical care.
PATIENT ASSESSMENT

LEARNING OBJECTIVE:

Assess emergency medical conditions in both tactical and non-tactical environments.

GENERAL IMPRESSION

A simultaneous or global overview of the status of the patient’s respiratory, circulatory, and neurologic systems to identify obvious significant external problems with oxygenation, circulation, hemorrhage or gross deformities. Within 15-30 seconds, the pre-hospital care provider has gained a general impression of the patient’s overall condition. This establishes whether the patient is presently or imminently in a critical condition and rapidly evaluates the patient’s overall systemic condition. This is when the decision regarding ground vs. air transport should be made. Early decision making will ultimately shorten scene time.

SYNCOPE

Uncomplicated syncope (fainting) is the result of blood pooling in dilated veins, which reduces the amount of blood being pumped to the brain. Causes of syncope include getting up too quickly, standing for long periods with little movement, and stressful situations. Signs and symptoms that may be present are dizziness; nausea; visual disturbance from pupillary dilation; sweating; pallor; and a weak, rapid pulse. As the body collapses, blood returns to the head, and consciousness is quickly regained. Revival can be promoted by carefully placing the casualty in the shock position or in a sitting position with the head between the knees. Placing a cool, wet cloth on the patient’s face and loosening his or her clothing can also help. Syncope may also result from an underlying medical problem such as diabetes, cerebrovascular accident (stroke), heart condition, or epilepsy.

CEREBROVASCULAR ACCIDENT

A cerebrovascular accident, also known as stroke or apoplexy, is caused by an interruption of the arterial blood supply to a portion of the brain. This interruption may be caused by arteriosclerosis, by a clot forming in the brain, or by a hemorrhage in the brain. Tissue damage and loss of function result.

Onset of a cerebrovascular accident is sudden, with little or no warning. The first signs include weakness or paralysis on the side of the body opposite the side of the brain that has been injured. Muscles of the face on the affected side may be involved. The patient’s level of consciousness varies from alert to unresponsive. Additionally, motor functions including vision and speech on the affected side are disturbed, and the throat may be paralyzed.

Emergency treatment for a cerebrovascular accident is mainly supportive. Special attention must be paid to the casualty’s airway, since he or she may not be able to keep it clear. Place the casualty in a semi-reclining position or on the paralyzed side.

- Be prepared to use suction if the casualty vomits
- Act in a calm, reassuring manner, and keep any onlookers quiet since the casualty may be able to hear what is going on
- Administer oxygen to combat cerebral hypoxia
- Carefully monitor the casualty’s vital signs and keep a log. Pay special attention to respirations, pulse strength and rate, and the presence or absence of the bilateral carotid pulse
- Transport the casualty to a medical treatment facility as soon as possible
CONVULSIONS

Convulsions, or seizures, are a startling and often frightening phenomenon. Convulsions are characterized by severe and uncontrolled muscle spasms or muscle rigidity. Convulsive episodes occur in one to two percent of the general population.

Although epilepsy is the most widely known form of seizure activity, there are numerous forms of convulsions that are classified as either central nervous system (CNS) or non-CNS in origin. It is especially important to determine the cause in patients who have no previous seizure history. This determination may require an extensive medical workup in the hospital. Since epilepsy is the most widely known form of seizure activity, this section will highlight epileptic seizure disorders.

Epilepsy, also known as seizures or fits, is a condition characterized by an abnormal focus of activity in the brain that produces severe motor responses or changes in consciousness. Epilepsy may result from head trauma, scarred brain tissue, brain tumors, cerebral arterial occlusion, fever, or a number of other factors. Fortunately, epilepsy can often be controlled by medications.

Grand mal seizure is the more serious type of epilepsy. Grand mal seizure may be but is not always preceded by an aura. The casualty soon comes to recognize these auras, which allows him or her time to lie down and prepare for the seizure's onset. A burst of nerve impulses from the brain causes unconsciousness and generalized muscular contractions, often with loss of bladder and bowel control. The primary dangers in a grand mal seizure are tongue biting and injuries resulting from falls. A period of sleep or mental confusion follows this type of seizure. When full consciousness returns, the casualty will have little or no recollection of the attack.

Petit mal seizure is of short duration and is characterized by an altered state of awareness or partial loss of consciousness, and localized muscular contractions. The patient has no warning of the seizure's onset and little or no memory of the attack after it is over.

First aid treatment for both types of epileptic seizure consists of protecting the casualty from self-injury. Additional methods of seizure control may be employed under a medical officer's supervision. In all cases, be prepared to provide suction to the casualty since the risk of aspiration is significant. Transport the patient to a medical treatment facility once the seizure has ended.

DROWNING

Drowning is a suffocating condition in a water environment. Water seldom enters the lungs in appreciable quantities because, upon contact with fluid, laryngeal spasms occur, and these spasms seal the airway from the mouth and nose passages. To avoid serious damage from the resulting hypoxia, quickly bring the casualty to the surface and immediately, even before the casualty is pulled to shore, start artificial ventilation. Do not interrupt artificial ventilation until the rescuer and the casualty are ashore. Once on dry ground, quickly administer an abdominal thrust (Heimlich maneuver) to empty the lungs, and then immediately restart the ventilation until spontaneous breathing returns. Oxygen enrichment is desirable if a mask is available. Remember that an apparently lifeless person who has been immersed in cold water for a long period of time may be revived if artificial ventilation is started immediately.

PSYCHIATRIC EMERGENCIES

A psychiatric emergency is defined as a sudden onset of behavioral or emotional responses that, if not responded to, will result in a life-threatening situation. Probably the most common psychiatric emergency is the suicide attempt. A suicide attempt may range from verbal threats and suicidal gestures to a successful suicide.
Always assume that a suicide threat is real; do not leave the patient alone. In all cases, the prime consideration for the HM is to keep patients from inflicting harm to themselves and to get them under the care of a trained psychiatric professional. When dealing with suicidal gestures or attempts, treat any self-inflicted wounds appropriately.

In the case of ingested substances, do not induce vomiting in a patient who is not awake and alert. For specific treatment of ingested substances, refer to Chapter 22, “Poisoning and Drug Abuse.”

There are numerous other psychiatric conditions that would require volumes to expound upon. In almost all cases, appropriate first aid treatment consists of a calm, professional, understanding demeanor that does not aggravate or agitate the patient. With an aggressive or hostile patient, a show of force may be all that is required. A show of force involves at least 4 and preferably 5 personnel who approach the patient with one person designated to maintain communication with him or her. The intent is to let the patient know that he or she must control his or her behavior or there is a team who will help the patient control the behavior. Almost all cases of psychiatric emergencies will present with a third party often the family or friend of the patient who has recognized a distinct change in the behavior pattern of the patient and who is seeking help for them.

**DERMATOLOGIC EMERGENCIES**

Most dermatologic cases that present as emergencies are not real emergencies. The patient perceives them as such because of the sudden presentation and or repulsive appearance or excessive discomfort. Treat most dermatologic conditions symptomatically. The major exception to symptomatic treatment is toxic epidermal necrolysis (TEN).

Toxic epidermal necrolysis is a condition characterized by sudden onset, excessive skin irritation, painful *erythema* (redness of skin produced by congestion of the capillaries), bullae (large blisters), and exfoliation of the skin in sheets. TEN is also known as the scalded skin syndrome because of its appearance. TEN is thought to be caused by a staphylococcal infection in children and by a toxic reaction to medications in adults.

Since skin is the largest single organ of the body and serves as a barrier to infection, prevention of secondary skin infection is very important. Treatment of skin infections consists of isolation techniques, silver nitrate compresses, aggressive skin care, intravenous antibiotic therapy, and in drug-induced cases, systemic steroids.

**NOTE:**

In the following assessment and treatment sections assume the following is true for the scenarios presented:

1. All required equipment is available.
2. None of the situations takes place in a CBRNE environment.
MEDICAL PATIENT ASSESSMENT

Scenario
The HM has a patient with a complaint that is medical in nature and no significant mechanism of injury.

Objective
Perform a medical patient assessment without causing further injury.

NOTE:
Take Body Substance Isolation (BSI) precautions.

1. Perform scene size-up.
   a. Determine the safest route to access the patient.
   b. Determine the mechanism of injury/nature of illness.
   c. Determine the number of patients.
   d. Request additional help if necessary.
   e. Consider stabilization of the spine.

2. Perform an Initial Assessment.
   a. Form a general impression of the patient and the patient's environment.
   b. Assess the patient's mental status using the Alert, Verbal, Pain, Unresponsive (AVPU) scale.
      i. A - Alert and oriented.
      ii. V - Responsive to verbal stimuli.
      iii. P - Responsive to painful stimuli.
      iv. U - Unresponsive.
   c. Determine the chief complaint/apparent life-threatening condition.
   d. Assess the airway.
      i. Perform an appropriate maneuver to open and maintain the airway if necessary.
      ii. Insert an appropriate airway adjunct, if necessary.
   e. Assess breathing.
      i. Determine the rate, rhythm, and quality of breathing.
      ii. Administer oxygen if necessary using the appropriate delivery device.
   f. Assess circulation.
      i. Check skin color and temperature.
      ii. Assess the pulse for rhythm and force.
         1. Check the radial pulse in adults.
         2. Check the radial pulse and capillary refill in children under 6 years old.
         3. Check the brachial pulse and capillary refill in infants.
      iii. Check for major bleeding.
      iv. Control major bleeding.
      v. Treat for shock.
   g. Identify priority patients and make a transport decision (load and go or stay and play).

NOTE:
High priority conditions that require immediate transport include poor general impression, unresponsive, responsive but not following commands, difficulty breathing, shock, complicated childbirth, chest pain with systolic blood pressure less than 100, uncontrolled bleeding, and severe pain.
3. Conduct a rapid physical exam if the patient is unconscious. Inspect each of the following areas for deformities, contusions, abrasions, punctures or penetration, burns, tenderness, lacerations, swelling (DCAP-BTLS).

   a. Assess the head.
   b. Assess the neck.
   c. Assess the chest.
   d. Assess the abdomen.
   e. Assess the pelvis.
   f. Assess the extremities.
   g. Assess the posterior.

4. Gather a SAMPLE history from the patient: signs and symptoms, allergies, medications, past/pertinent medical history, last oral intake, and events preceding illness or injury.

   NOTE:
   If the patient is unable to provide this information, gather as much information about the SAMPLE history as possible from the patient's family and or bystanders.

   a. Signs and symptoms. Gather history of the present illness (OPQRST) from the patient.

      i. Respiratory.

         1. Onset - When did it begin?
         2. Provocation - What was the patient doing when this came on?
         3. Quality - Can the patient describe the feeling he or she has?
         4. Radiation - Does the feeling seem to spread to any other part of the body? Does the patient have pain or discomfort anywhere else in the body?
         5. Severity - On a scale of 1 to 10, how bad is the breathing trouble (10 is worst, 1 is best)?
         6. Time - How long has the patient had this feeling?
         7. Interventions - Has the patient taken any medication to help him or her breathe? Did it help?

      ii. Cardiac.

         1. Onset - When did it begin?
         2. Provocation - What was the patient doing when this came on?
         3. Quality - Can the patient describe the feeling he or she has?
         4. Radiates - Does the feeling seem to spread to any other part of the body? Does the patient have pain or discomfort anywhere else in the body?
         5. Severity - On a scale of 1 to 10, how bad is the breathing trouble (10 is worst, 1 is best)?
         6. Time - How long has the patient had this feeling?
         7. Interventions - Has the patient taken any medication to help? Did it help?

      iii. Altered mental status.

         1. Description of the episode - Can the patient describe what happened? How did the episode occur?
         2. Onset - How long ago did it occur?
         3. Duration - How long did it last?
         4. Associated symptoms - Was the patient sick or complaining of not feeling well before this happened?
         5. Evidence of trauma - Was the patient involved in falls or accidents recently?
         6. Interventions - Has the patient taken anything to help with this problem? Did it help?
         7. Seizures - Did the patient have a seizure?
8. Fever - Did the patient have a fever? What was the patient's temperature?

iv. Allergic reaction.
1. History of allergies - Does the patient have any allergies?
2. What the patient exposed to - Is there any chance that he or she was exposed to something to which he or she is allergic?
3. How was the patient exposed - How did he or she come into contact with [_________] (whatever the patient is allergic to)?
4. Effects - What kind of symptoms is the patient having? How long after he or she was exposed did the symptoms start?
5. Progression - How long after exposure did the symptoms start? Are they worse now than they were before?
6. Interventions - Has the patient taken anything to help? Did it help?

v. Poisoning/overdose.
1. Substance - What substance was involved?
2. When did the patient ingest/become exposed - When did the exposure/ingestion occur?
3. How much did the patient ingest - How much did the patient ingest?
4. Over what time period - Over how long a period did the ingestion occur?
5. Interventions - What interventions did the family or bystanders take?
6. Estimated weight - What is the patient's estimated weight?

vi. Environmental emergency.
1. Source - What caused the injury?
2. Environment - Where did the injury occur?
3. Duration - How long was the patient exposed?
4. Loss of consciousness - Did the patient lose consciousness at any time?
5. Effects (general or local) - What signs and symptoms is the patient having? What effect did being exposed have on the patient?

vii. Obstetrics.
1. Is the patient pregnant?
2. How long has she been pregnant (weeks or months)?
3. Is the patient having pain or contractions?
4. Is the patient bleeding? Is the patient having any discharge?
5. Does she feel the need to push?
6. When was her last menstrual period?

viii. Behavioral.
1. How does the patient feel?
2. Determine suicidal tendencies - Does the patient have a plan to hurt himself or herself or anyone else?
3. Is the patient a threat to self or others?
4. Is there a medical problem?
5. Interventions?
   b. Allergies?
   c. Medications?
   d. Past pertinent history?
   e. Last oral intake?
   f. Event(s) leading to present illness?
5. Perform a focused physical examination on the affected body part/system.
6. Obtain baseline vital signs.
7. Provide medication, interventions, and treatment as needed.
8. Re-evaluate the transport decision.
9. Consider completing a detailed physical examination.
   a. Repeat the initial assessment.
   b. Repeat vital signs.
   c. Repeat the focused assessment regarding the patient's complaint or injuries.

**RESPIRATORY EMERGENCY ASSESSMENT**

**Scenario**

The HM has a conscious patient with a respiratory emergency.

**Objective**

Correctly identify and treat a respiratory emergency without causing further harm to the patient.

**Performance Steps**

### NOTE:
Take Body Substance Isolation (BSI) precautions.

1. Examine the patient.
   a. Assess the airway and open it, if necessary.

### CAUTION:
A patient experiencing respiratory distress can rapidly progress to full arrest. Always be prepared to utilize advanced airway procedures.

   i. Ask the patient a question requiring more than a yes or no answer.

   ii. Note whether or not the patient can speak in full sentences.

   iii. Look for the presence of drooling that may indicate a partial or complete airway obstruction.

   b. Assist with artificial ventilations if respiratory effort and rate are inadequate.

   i. Look for the rise and fall of the chest during inspiration and expiration.

   ii. Listen for the presence of noisy respirations (e.g., *stridor*, wheezing).

   c. Apply supplemental oxygen by mask or nasal cannula.

   d. Place the patient in the position of comfort.

### NOTE:
Any casualty complaining of difficulty breathing should receive supplemental oxygen.

2. Perform a focused physical examination.
   a. Listen to the anterior and posterior lung fields with the stethoscope.

   b. Look at the chest and abdomen and note the presence of any retractions.

   c. Check the skin for the presence of cyanosis.

   d. Check the lower extremities for the presence of *edema*.

   e. Obtain a complete set of vital signs to include pulse oximetry, if available.

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3. Obtain a focused history.
   a. Ask the patient if there is an existing condition such as asthma.
   b. Ask the patient if he is taking any medications.
   c. Question the patient about allergies to medications.
   d. Ask the patient if difficulty breathing was of sudden or gradual onset.

4. Assist the patient in using a metered dose inhaler.

   **NOTE:**
   This step may only be performed if the casualty has an inhaler prescribed to him.
   a. Perform the five rights of medication dosage.
   b. Have the patient exhale deeply.
   c. Have the patient place his lips around the opening and press the inhaler to activate the spray as he inhales deeply.
   d. Instruct the patient to hold his breath as long as possible before exhaling.
   e. Repeat steps 4b through 4d.


   **NOTE:**
   This step may only be performed with a medical officer's order for a nebulizer treatment.
   a. Set up the nebulizer per manufacturer's guidelines.
   b. Instill the appropriate medicine IAW local SOP.
   c. Connect the nebulizer to an oxygen source.

   **NOTE:**
   Compressed air can be used but it does not supply the casualty with supplemental oxygen.
   d. Turn on the flow of oxygen and check for the formation of mist (smoke).

6. Have the patient place his lips on the mouth piece and slowly inhale and exhale the mist.

7. Monitor the patient's vital signs every 5 minutes. If available, attach the casualty to a pulse oximeter.


9. Evacuate the patient.

**CARDIAC EMERGENCIES**

A number of heart conditions are commonly referred to as heart attacks. These conditions include angina pectoris, acute myocardial infarction, and congestive heart failure. Together these heart conditions are the cause of at least half a million deaths per year in the United States. Heart conditions occur more commonly in men in the 50-to-60-year age group. Predisposing factors are the lack of physical conditioning, high blood pressure and blood cholesterol levels, smoking, diabetes, and a family history of heart disease.

**Angina Pectoris**

Angina pectoris, also known simply as angina, is caused by insufficient oxygen being circulated to the heart muscle. This condition results from a spasm of the coronary artery, which allows the heart to function adequately at rest but does not allow enough oxygen-enriched blood to pass through the heart to support sustained exercise. When the body exerts itself, the heart muscle becomes starved for oxygen. The result of this condition is a squeezing, substernal pain that may radiate to the left arm and to the jaw.

Angina is differentiated from other forms of heart problems because the pain results from exertion and subsides with rest. Many people who suffer from angina pectoris carry nitroglycerin tablets. If the casualty of a suspected angina attack is carrying a bottle of these pills, place one pill under the tongue. Relief will be almost instantaneous.
Other first aid procedures include providing supplemental oxygen, reassurance, comfort, monitoring vital signs, and transporting the casualty to a medical treatment facility.

**Acute Myocardial Infarction**

Acute myocardial infarction results when a coronary artery is severely occluded by arteriosclerosis or completely blocked by a clot. The pain associated with myocardial infarction is similar to that of angina pectoris but is longer in duration, not related to exertion or relieved by nitroglycerin, and leads to death of heart-muscle tissue. Other symptoms are sweating, weakness, and nausea. Additionally, although the patient’s respiration are usually normal, his pulse rate increases and may be irregular, and his blood pressure falls. The casualty may have an overwhelming feeling of doom. Death may result.

**Congestive Heart Failure**

A heart suffering from prolonged hypertension, valve disease, or heart disease will try to compensate for decreased function by increasing the size of the left ventricular pumping chamber and increasing the heart rate. This condition is known as congestive heart failure. As blood pressure increases, fluid is forced out of the blood vessels and into the lungs, causing pulmonary edema. Pulmonary edema leads to rapid shallow respirations, the appearance of pink frothy bubbles at the nose and mouth and distinctive rattling sounds (known as *rales*) in the chest. Increased blood pressure may also cause body fluids to pool in the extremities resulting in peripheral edema. Emergency treatment for congestive heart failure is essentially the same as that for acute myocardial infarction. Do not start CPR unless the patient’s heart function ceases. If an intravenous line is started, it should be maintained at the slowest rate possible to keep the vein open since an increase in the circulatory volume will make the condition worse. Immediately transport the patient to a medical treatment facility.

**CARDIAC EMERGENCY ASSESSMENT**

**Scenario**

The HM has a conscious patient who is complaining of chest pain. The HM has already taken the appropriate body substance isolation (BSI) precautions. The HM has already done the initial patient assessment, focused history, and physical.

**Objective**

Complete all necessary steps to manage a patient with a cardiac emergency, without causing any further injury.

1. Identify the signs and symptoms of cardiac emergency or compromise.
   a. Pain, pressure, or discomfort in the chest or upper abdomen (epigastrium).
   b. Dyspnea.
   c. Palpitations.
   d. Sudden onset of sweating with nausea or vomiting.
   e. Anxiety (feeling of impending doom or irritability).
   f. Abnormal pulse.
      i. Bradycardia (less than 60 beats per minute).
      ii. Tachycardia (greater than 100 beats per minute).
   g. Abnormal blood pressure.
      i. Hypotensive (systolic pressure less than 90).
      ii. Hypertensive (systolic pressure greater than 140).
h. Pulmonary edema.
   i. Shortness of breath.
   ii. Dyspnea.
   iii. Rales upon auscultation.
i. Pedal edema.

2. Administer the appropriate treatment.
   a. Place the patient in a position of comfort.

   **NOTE:**
   This is normally in the Fowler's position.

   b. Apply a high concentration of oxygen via a non-rebreather mask.

   c. Assist the patient in taking nitroglycerin, if available.

   **NOTE:**
   Administer the nitroglycerin only if ALL of the following conditions are met:
   - Patient complains of chest pain.
   - Patient has a history of cardiac problems.
   - Patient has a current prescription for nitroglycerin.
   - Patient has the nitroglycerin.
   - Patient's systolic blood pressure is greater than 100.

   i. Check the five rights.
   ii. Remove the oxygen mask.
   iii. Ask the patient to open his or her mouth and to lift the tongue.
   iv. Place the tablet or spray (if using mist) under the tongue with a gloved hand.

   **CAUTION:**
   Avoid contacting the nitroglycerin tablet or mist with bare skin. The vasodilation affects could cause unconsciousness.

   v. Have the patient close his or her mouth and hold the tablet under the tongue.
   vi. Replace the oxygen mask.
   vii. Recheck the blood pressure within two minutes.

   **NOTE:**
   If the blood pressure falls below 100, treat the patient for shock and transport immediately.

   d. If the patient experiences no relief, repeat step 2c every 5 minutes until the patient has taken a total of three tablets.

   e. If the patient experiences no relief after three nitroglycerin tablets or his condition worsens, initiate an IV at to keep vein open (KVO/TKO) rate.

3. Transport promptly to the nearest medical treatment facility.

4. Perform an ongoing assessment while en route.

5. Document all interventions.

**ALLERGIC REACTION ASSESSMENT**

**Scenario**

The HM has a patient demonstrating signs and symptoms of an allergic reaction.

**Objective**

Treat a patient with an allergic reaction without causing further harm.

**Performance Steps**

1. Recognize the causes of allergic reactions.
   a. Drugs (penicillin).
   b. Insect bites (bee stings).
   c. Pollen.
   d. Food (peanuts).
2. Recognize the early manifestations of an allergic or anaphylactic reaction.
   a. Skin.
      i. Flushing.
      ii. Urticaria (hives).
      iii. Swelling of face (especially eyes and lips), hands, feet, neck.
      iv. Swelling of mouth, tongue, airway (angioedema).
   b. Respiratory.
      i. Tightness in throat and chest.
      ii. Cough.
      iii. Rapid, labored noisy breathing.
      iv. Stridor (harsh, high pitched sound during inspiration).
      v. Wheezing (may be audible without a stethoscope).
   c. Cardiac.
      i. Increased heart rate.
      ii. Decreased blood pressure.
   d. Generalized feelings.
      i. Itchy, watery eyes.
      ii. Headache.
      iii. Runny nose.
      iv. Sense of impending doom.
3. Recognize the signs of anaphylactic shock.
   a. May have any of the above, but must have signs of respiratory distress or shock.
   b. Altered mental status.
   c. Signs of respiratory distress.
   d. Signs of shock.
4. Treat allergic reactions.
   
   **NOTE:**
   Take Body Substance Isolation (BSI) precautions.
   
   a. Perform initial assessment ABCs (treat any life-threatening conditions).
   b. Perform a focused history and physical exam.
   c. Assess baseline vital signs and SAMPLE history.
   d. Manage the patient's airway and breathing. If the patient has an epinephrine autoinjector and has symptoms of anaphylaxis, assist in the epinephrine administration.
5. Evacuate the patient to the nearest medical treatment facility (MTF).

**ANAPHYLACTIC EMERGENCY**

This condition, also called anaphylaxis or anaphylactic shock, is a severe allergic reaction to foreign material. The most frequent causes are probably penicillin and the toxin from bee stings, although foods, inhalants, and contact substances can also cause a reaction. Anaphylaxis can happen at any time, even to people who have taken penicillin many times before without experiencing any problems. This condition produces severe shock and cardiopulmonary failure of a very rapid onset. Because of the rapidity and severity of the onset of symptoms, immediate intervention is necessary. The general treatment for severe anaphylaxis is the subcutaneous injection of 0.3 cc of epinephrine and supportive care.

The most characteristic and serious symptoms of an anaphylactic reaction are loss of voice and difficulty breathing. Other typical signs are giant hives, coughing, and wheezing. As the condition progresses, signs and symptoms of shock develop, followed by respiratory failure. Emergency management consists of maintaining vital life functions. Summon the medical officer immediately.
ANAPHYLACTIC SHOCK ASSESSMENT

Scenario

The HM needs to treat a casualty for an anaphylactic shock.

Objective

Initiate treatment for anaphylactic shock, stabilize the casualty, and minimize the effects of anaphylaxis without causing further injury to the casualty.

Performance Steps

1. Check the casualty for signs and symptoms of anaphylactic shock.
   a. Skin.
      i. Flushed or ashen.
      ii. Burning or itching.
      iii. Edema (swelling), especially in the face, tongue, or airway.
      iv. Urticaria (hives) spreading over the body.
      v. Marked swelling of the lips and cyanosis about the lips.
   b. Respiratory.
      i. Tightness or pain in the chest.
      ii. Sneezing and coughing.
      iii. Wheezing, stridor, or difficulty in breathing (dyspnea).
      iv. Sputum (may be blood tinged).
   c. Circulatory.
      i. Weak, rapid pulse.
      ii. Falling blood pressure.
      iii. Hypotension.
      iv. Dizziness or fainting.
      v. Coma.

2. Open the airway, if necessary.

3. Administer high concentration oxygen.

4. Administer epinephrine.
   a. Administer 0.3 - 0.5 ml of epinephrine, 1:1000 solution, subcutaneously (SQ) or intramuscularly (IM).
   b. Additional epinephrine may be required if anaphylaxis progresses. Additional doses may be administered every 5 to 10 minutes if needed.

5. Initiate an intravenous (IV) infusion.

6. Provide supportive measures for the treatment of shock, respiratory failure, circulatory collapse, or cardiac arrest.
   a. Infuse additional IV fluid if blood pressure continues to drop.
   b. Position the casualty in the supine position with legs elevated if injuries permit.
   c. Perform rescue breathing, if necessary.
   d. Administer external chest compressions, if necessary.

7. Check the casualty's vital signs every 3 to 5 minutes until the casualty is stable.

8. Record the treatment given.
9. Evacuate the casualty, providing supportive measures en route.

POISONS/DRUG ABUSE/HAZARDOUS MATERIALS EMERGENCIES

HMs can encounter special situations that include poisoning, suspected drug abuse, or exposure to hazardous materials. Knowledge of these conditions along with the ability to assess and treat them is essential. These situations are discussed in detail in Chapter 22, "Poisoning and Drug Abuse."

POISONED CASUALTY ASSESSMENT

Scenario

The HM has a casualty that has been poisoned. All other more serious injuries have been assessed and treated. The HM has taken body substance isolation (BSI) precautions and has performed an initial assessment.

Objective

Determine the type of poisoning and provide treatment, minimizing the effects of the poisoning, without causing further injury to the casualty.

1. Determine the type of poisoning.

CAUTION:
If determination cannot be made to the type of poisoning, the casualty should be treated by the symptoms presented.

a. Ingested poisons.
   i. Altered mental status.
   ii. Nausea/vomiting.
   iii. Abdominal pain.
   iv. Diarrhea.
   v. Chemical burns around the mouth.
   vi. Unusual breath odors.

b. Inhaled poisons.
   i. Carbon monoxide.
      1. Headache.
      2. Dizziness.
      3. Dyspnea.
      4. Nausea/vomiting.
      5. Cyanosis.
      6. Coughing.
   ii. Smoke Inhalation.
      1. Dyspnea.
      2. Coughing.
      3. Breath that has a smoky smell or the odor of chemicals involved at the scene.
      4. Black residue in any sputum coughed up by the casualty.
      5. Nose-hairs singed from super-heated air.

c. Injected poisons.
   i. Sympathomimetics
      (Uppers- example: cocaine).
      1. Excitement.
      2. Tachycardia.
      3. Tachypnea.
      4. Dilated pupils.
      5. Sweating.
   ii. Sedative-Hypnotics
      (Downers - examples; Valium®, Xanax XR®).
      1. Sluggish.
      2. Sleepy typical coordination of body and speech.
      3. Pulse and breathing rates are low, often to the point of a true emergency.
iii. Hallucinogens (LSD).
   1. Tachycardia.
   2. Dilated pupils.
   3. Flushed face.
   4. Often sees or hears things, has very little concept of time.

iv. Narcotics (Morphine, heroin).
   1. Reduced rate of breathing.
   2. Dyspnea.
   3. Low skin temperature.
   5. Pinpoint pupils.
   6. Very sleepy.

d. Absorbed poisons.
   i. Liquid or powder on the casualty's skin.
   ii. Burns.
   iii. Itching.
   iv. Irritation.
   v. Redness.

2. Administer emergency care.
   a. Ingested poisons.
      i. Maintain the airway.
      ii. Gather all information about the type of ingested poisoning.
      iii. Initiate IV therapy.
      iv. Administer activated charcoal.

   CAUTION:
   Activated charcoal is contraindicated for patients that have an altered mental status that are suspected of swallowing acids or alkalis, or have an inability to swallow.

   NOTE:
   Be prepared to provide oral suctioning if the casualty starts to vomit. All vomitus must be saved.

   1. Adults and children: 1 gram of activated charcoal/kg of body weight.
   3. Usual pediatric dose: 12.5 - 25 grams.

   NOTE:
   Mix with soda for easier consumption.

   v. Give supplemental oxygen.
   vi. Record the name, dose, and time of administration of medication.
   vii. Transport to the nearest medical treatment facility.

   b. Inhaled poisons.
      i. Remove the casualty from the unsafe environment.
      ii. Maintain the airway.
      iii. Administer high concentrations of oxygen.

   NOTE:
   Oxygen therapy is the most important treatment for inhalation poisoning.

   iv. Transport to the nearest medical treatment facility.

   c. Absorbed poisons.
      i. Remove the casualty from the source.
      ii. Remove contaminated clothing.
      iii. Brush off any powders from the casualty's skin.
      iv. Flush the skin with large amounts of water for at least 20 minutes.
d. Injected poisons.
   i. Maintain the airway and be prepared to provide assisted ventilations.
   ii. Give supplemental oxygen.
   iii. Initiate IV therapy.
   iv. Look for gross soft tissue damage ("tracks").
   v. Protect the casualty from harming self and others.

**NOTE:**
Be prepared to use restraints.

vi. Transport to the nearest medical treatment facility.

3. Document procedures.

**DIABETIC EMERGENCIES**

Diabetes mellitus is an inherited condition in which the pancreas secretes an insufficient amount of the protein hormone insulin. Insulin regulates carbohydrate metabolism by enabling glucose to enter cells for use as an energy source.

**Diabetic Ketoacidosis**

Diabetic ketoacidosis most often results either from forgetting to take insulin or from taking too little insulin to maintain a balanced condition. Diabetics may suffer from rising levels of glucose in the blood stream (hyperglycemia). The rising levels of glucose result in osmotic diuresis, an increased renal excretion of urine. Serious dehydration (hypovolemia) may result.

Concurrently, the lack of glucose in the cells leads to an increase in metabolic acids in the blood (acidosis) as other substances, such as fats, are metabolized as energy sources. The result is gradual central nervous system depression, starting with symptoms of confusion and disorientation, and leading to stupor and coma. Blood pressure falls, and the pulse rate becomes rapid and weak.

Respirations are deep, and a sickly sweet acetone odor is present on the breath. The skin is warm and dry.

**NOTE:**
Diabetic casualties are often mistakenly treated as if intoxicated since the signs and symptoms presented are similar to those of alcohol intoxication.

The diabetic under treatment tries to balance the use of insulin against glucose intake to avoid the above problems. The casualty or the casualty’s family may be able to answer two key questions:

1. Has the casualty eaten today?
2. Has he taken the prescribed insulin?

If the answer is yes to the first and no to the second question, the casualty is probably in a diabetic coma.

Emergency first aid centers on ABC support, administration of oral or intravenous fluids to counter shock, and rapid evacuation to medical officer's supervision.

**Insulin Shock**

Insulin shock results from too little sugar in the blood (hypoglycemia). This type of shock develops when a diabetic exercises too much or eats too little after taking insulin. Insulin shock is a very serious condition because glucose is driven into the cells to be metabolized, leaving too little glucose in circulation to support the brain. Brain damage develops quickly. Signs and symptoms of insulin shock include:

- Pale, moist skin
- Dizziness and headache
- Strong, rapid pulse
- Fainting, seizures, and coma

Treatment is centered on getting glucose into the system quickly to prevent brain damage. Placing sugar cubes under the tongue or administering oral liquid glucose are the most beneficial treatments.
Hard candies are a good interim treatment as well. Transport the casualty to a medical treatment facility as soon as possible.

**NOTE:**
If the HM is in doubt as to whether the casualty is in insulin shock or a ketoacidotic state, give them sugar.

Brain damage develops very quickly in insulin shock and must be reversed immediately.

If the casualty turns out to be ketoacidotic, a condition that progresses slowly, the extra sugar will do no appreciable harm.

**DIABETIC EMERGENCY ASSESSMENT**

**Scenario**

The HM has a patient with a diabetic emergency.

**Objective**

Initiate treatment for hypoglycemia or hyperglycemia, stabilize the patient, and minimize the effects without causing further injury to the patient.

**NOTE:**
Take Body Substance Isolation (BSI) precautions.

1. Identify the signs and symptoms of a diabetic emergency.

   a. **Hypoglycemia** (Low blood sugar)

   **NOTE:**
   Hypoglycemia is the most common of all diabetic emergencies.

   i. Rapid onset of altered mental status.

   **NOTE:**
   This is especially so after missing a meal, vomiting, or an unusual amount of physical exertion.

   ii. Intoxicated appearance, staggering, slurred speech, or unconsciousness.

   iii. Elevated heart rate.

   iv. Cold, clammy skin.

   v. Hunger.

   vi. Seizures.

   vii. Uncharacteristic behavior.

   viii. Anxiety.

   ix. Combativeness.

b. **Hyperglycemia** (High blood sugar)

   i. Slow onset.

   ii. Warm, red, dry skin.

   iii. Sweet, fruity breath odor (acetone).

   iv. Deep, rapid breathing.

   v. Dry mouth.

   vi. Intense thirst.

   vii. Abdominal pain.

   viii. Nausea and vomiting.

2. Administer the appropriate treatment.

   **NOTE:**
   If unsure whether the patient has hyperglycemia or hypoglycemia, it is safer to treat the patient for hypoglycemia.

a. **Hypoglycemia**

   i. If conscious, administer oral glucose IAW local protocol.

   **NOTE:**
   Give it only if the patient has a history of diabetes, the patient has an altered mental status and the patient is awake enough to swallow.

   1. Apply glucose to a tongue depressor and place it in the patient's mouth between the cheek and gum.

   2. Or if the patient is able, let the patient squeeze the glucose from the tube directly into his mouth.
ii. Monitor the patient for complications.

iii. Assess vital signs.

iv. If unconscious:

1. Secure the airway and administer oxygen.
2. Assess vital signs.
3. Start an intravenous IV at to keep vein open (TKO) rate.
4. Place the patient in the recovery position.

NOTE:
May be directed by the medical officer to give D50 (dextrose solution) intravenously to determine hyper- vs. hypoglycemia.

5. Transport to the nearest medical treatment facility.

b. Hyperglycemia.

i. Maintain an open airway and administer oxygen.

ii. Assess vital signs.

iii. Start an IV at TKO rate.

iv. Place the patient on a cardiac monitor, if available.

v. Transport to the nearest medical treatment facility.

3. Document all treatment given.

NOTE:
Document the patient's mental status using the alert, verbal, painful, and unresponsive (AVPU) scale and vital signs every 5 minutes.

A change in mental status may indicate an alteration in the patient's blood sugar level.

HEAD INJURIES

Head wounds must be treated with particular care, since there is always the possibility of brain damage. The general treatment for head wounds is the same as that for other fresh wounds. However, certain special precautions must be observed if the HM is giving first aid to a person who has suffered a head wound.

HEAD INJURY ASSESSMENT

Scenario

The HM needs to treat a casualty with an open or closed head injury. All other more serious injuries have been assessed and treated.

Objective

Treat the head injury and stabilize the casualty without causing additional injury.

Performance Steps

WARNING:
Treat casualties with any type of traumatic head injury or loss of consciousness as if they have a spinal injury.

NOTE:
Take Body Substance Isolation (BSI) precautions.

1. Check for the signs and symptoms of head injuries.

a. Closed head injury is caused by a direct blow to the head.

WARNING:
Brain injury, leading to a loss of function or death, often occurs without evidence of a skull fracture or scalp injury.

Because the skull cannot expand, swelling of the brain or a collection of fluid pressing on the brain can cause pressure.

This can compress and destroy the brain tissue.
i. Deformity of the head.
ii. Clear fluid or blood escaping from the nose and or ear(s).
iii. Periorbital discoloration (raccoon eyes).
iv. Bruising behind the ears, over the mastoid process (battle sign).
v. Lowered pulse rate if the casualty has not lost a significant amount of blood.
vi. Signs of increased intracranial pressure.
   1. Headache, nausea, and or vomiting.
   2. Possible unconsciousness.
   3. Change in pupil size or symmetry.
   4. Lateral loss of motor nerve function--one side of the body becomes paralyzed.

**NOTE:**
Lateral loss may not happen immediately but may occur later.

5. Change in the casualty's respiratory rate or pattern.
6. A steady rise in the systolic blood pressure if the casualty hasn't lost significant amounts of blood.
7. A rise in the pulse pressure (systolic pressure minus diastolic pressure).
8. Elevated body temperature.
9. Restlessness--indicates insufficient oxygenation of the brain.

b. **Concussion**--caused by a violent jar or shock.

**NOTE:**
A direct blow to the skull may bruise the brain.

i. Temporary unconsciousness followed by confusion.
ii. Temporary, usually short term, loss of some or all brain functions.

iii. The casualty has a headache or is seeing double.
iv. The casualty may or may not have a skull fracture.

c. **Contusion**--an internal bruise or injury. It is more serious than a concussion. The injured tissue may bleed or swell. Swelling may cause increased intracranial pressure that may result in a decreased level of consciousness and even death.

d. **Open head injury.**
   i. Penetrating wound--an entry wound with no exit wound.
   ii. Perforating wound--the wound has both entry and exit wounds.
   iii. Visibly deformed skull.
   iv. Exposed brain tissue.
   v. Possible unconsciousness.
   vi. Paralysis or disability on one side of the body.
   vii. Change in pupil size.
   viii. Lacerated scalp tissue may have extensive bleeding.

2. Direct manual stabilization of the casualty's head.
3. Check the casualty's vital signs.
4. Assess the casualty's level of consciousness using the AVPU scale.
   a. A--alert. The casualty responds spontaneously to stimuli and is able to answer questions in a clear manner.
   b. V--verbal. The casualty does not respond spontaneously but is responsive to verbal stimuli.
   c. P--pain. The casualty does not respond spontaneously or to verbal stimuli but is responsive to painful stimuli.
   d. U--unresponsive. The casualty is unresponsive to any stimuli.
5. Assess the casualty's pupil size.
   a. Observe the size of each pupil.

   **NOTE:**
   A variation of pupil size may indicate a brain injury.
   In a very small percentage of people, unequal pupil size is normal.

   b. Shine a light into each eye to observe the pupillary reaction to light.

   **NOTE:**
   The pupils should constrict promptly when exposed to bright light.
   Failure of the pupils to constrict may indicate brain injury.

6. Assess the casualty's motor function.
   a. Evaluate the casualty's strength, mobility, coordination, and sensation.
   b. Document any complaints, weakness, or numbness.

   **NOTE:**
   Progressive loss of strength or sensation is an important indicator of brain injury.

7. Treat the head injury.
   a. Treat a superficial head injury.
      i. Apply a dressing.
      ii. Observe for abnormal behavior or evidence of complications.
   b. Treat a head injury involving trauma.
      i. Maintain a patent airway using the jaw thrust maneuver.
      ii. If the casualty is unconscious, insert an oropharyngeal airway without hyper-extending the neck.
      iii. Administer high concentration oxygen by non-rebreather mask (NRB) and evaluate the need for artificial ventilations with supplemental oxygen.
      iv. Apply a cervical collar.
      v. Dress the head wound(s).
   vi. Control bleeding.

   **WARNING:**
   Do not apply pressure to or replace exposed brain tissue.

   vii. Treat for shock.
   viii. Monitor the casualty for convulsions or seizures.
   ix. Position the casualty with the head elevated 6 inches to assist with the drainage of blood from the brain.

   **CAUTION:**
   Do not give the casualty anything by mouth.

8. Continue to monitor the casualty and check and record the following at 5 minute intervals.
   a. Level of consciousness.
   b. Pupillary responsiveness and equality.
   c. Vital signs.
   d. Motor functions.

10. Evacuate the casualty.

**CHEST INJURIES**

Since chest injuries may cause severe breathing and bleeding problems, all chest injuries must be considered as serious conditions. Any casualty showing signs of difficulty in breathing without signs of airway obstruction must be inspected for chest injuries. The most serious chest injury that requires immediate first aid treatment is the sucking chest wound. This is a penetrating injury to the chest that produces a hole in the chest cavity. The chest hole causes the lung to collapse, preventing normal breathing functions. This is an extremely serious condition that will result in death if not treated quickly.
Casualties with open chest wounds gasp for breath, have difficulty breathing out, and may have a bluish skin color to their face. Frothy-looking blood may bubble from the wound during breathing. The proper treatment for a sucking chest wound is as follows:

**TREAT A CASUALTY WITH A CHEST INJURY**

**Scenario**

The HM has a casualty with a chest injury. All other more serious injuries have been assessed and treated.

**Objective**

Treat a chest wound without causing additional injury to the casualty.

**Performance Steps**

1. Perform an initial assessment of the casualty.
2. Check the casualty for signs and symptoms of chest injuries.
   a. Deformities, contusions, abrasions, punctures/penetrations (DCAP), bleeding, tenderness, lacerations, swelling (BTLS).
   b. Pleuritic pain that is increased by or occurs with respirations and is localized around the injury site.
   c. Labored or difficult breathing.
   d. Diminished or absent breath sounds.
   e. Cyanotic lips, fingertips, or fingernails.
   f. Rapid, weak pulse and low blood pressure.
   g. Coughing up blood or bloody sputum.
   h. Failure of one or both sides of the chest to expand normally upon inhalation.

   i. Paradoxical breathing - the motion of the injured segment of a flail chest, opposite to the normal motion of the chest wall.
   j. Enlarged neck veins.
   k. Coughing up blood or bloody sputum.
   l. Tracheal deviation - shift of the trachea from the midline toward the unaffected side due to pressure buildup on the injured side. THIS IS A LATE SIGN.

3. Check for an exit wound or injury.
4. Determine the type of injury.
   a. Open pneumothorax - air entering pleural space through defect in pleural wall.
      i. Signs and symptoms.
         1. Respiratory distress.
         2. Anxiousness.
         3. Tachypnea.
      ii. Treatment.
         1. Seal the wound(s), covering the larger wound first.

   NOTE:
   All penetrating chest wounds should be treated as if they were sucking chest wounds.

   2. Cut the dressing wrapper on one long and two short sides and remove the dressing.

   NOTE:
   In an emergency, any airtight material can be used. It must be large enough so it is not sucked into the chest cavity.

   3. Apply the inner surface of the wrapper to the wound when the casualty exhales.

   4. Ensure that the covering extends at least two inches beyond the edges of the wound.
5. If the HM does not have the ability to perform a needle chest decompression, seal by applying overlapping strips of tape to three sides of the plastic covering to provide a flutter-type valve.

6. If the HM has the ability to perform a needle chest decompression (NCD), ensure all four sides of the occlusive dressing are secured. (NCD procedures outlined later.)

7. Cover the exit wound in the same way, if applicable.

**NOTE:**
Assess the effectiveness of the flutter valve when the casualty breathes.

When the casualty inhales, the plastic should be sucked against the wound, preventing the entry of air.

When the casualty exhales, trapped air should be able to escape from the wound and out the untaped side of the dressing.

8. Supplement with oxygen if available.

**WARNING:**
Complication - if tension pneumothorax is suspected, perform a needle chest decompression (NCD).

b. **Rib fracture** - generally caused by a direct blow to the chest or compression of the chest. Severe coughing can also cause rib fracture.

i. Signs and symptoms.

1. Pain is aggravated by respirations and coughing.
2. Crepitus is present.
3. The casualty will guard to protect the injury.

ii. Complications.

1. Internal bleeding (hemothorax).
2. Shock.

iii. Treatment.

1. Use a sling and swathe to immobilize the affected side, i.e. immobilizing the arm as a means to support the rib cage.
2. Administer oxygen as necessary.

**NOTE:**
The broken rib may puncture the lung or the skin.

**WARNING:**
Do not tape, strap, or bind the chest, these interventions increase the development of pneumonia.

c. **Flail chest** - two or more ribs fractured in two or more places or a fractured sternum.

i. Signs and symptoms.

1. Severe pain at the site.
2. Rapid shallow breathing.
3. Paradoxical respirations.

ii. Complications.

1. Respiratory insufficiency.
2. Pneumothorax with hemothorax.

iii. Treatment.

1. Establish and maintain an airway.
2. Administer oxygen, if available.
3. Assist the casualty's respirations, if necessary.
4. Monitor the casualty for signs of hemothorax or tension pneumothorax, as necessary.
d. **Hemothorax** - bleeding from lacerated blood vessels in the chest cavity and or lungs. It results in the accumulation of blood in the chest cavity not outside the lungs.

i. Signs and symptoms.
   1. Hypotension due to blood loss.
   2. Shock.
   3. Cyanosis.
   4. Tightness in the chest.
   5. Mediastinal shift may produce deviated trachea away from the affected side. **LATE SIGN**
   6. Coughing up frothy red blood.

ii. Complications.
   1. Possibility of hypovolemic shock.
   2. Frequently accompanies a pneumothorax.

iii. Treatment.
   1. Establish and maintain an airway.
   2. Administer oxygen.
   3. Assist the casualty's breathing, as necessary

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**e. Tension pneumothorax.**

**NOTE:**
Condition in which air enters the chest cavity (pleural space) through a hole in the lung, expanding the space with every breath the casualty takes.

The air becomes trapped and cannot escape.

i. Signs and symptoms.
   2. Increased pressure in the chest causes the lung(s) to collapse.
   3. May result from the laceration of the lung by a broken rib or by spontaneous rupture of a bleb or lesion on the lung.


   ii. Treatment.
      1. Establish and maintain an airway.
      2. Perform NCD if indicated.
      3. Administer oxygen.
      4. Assist the casualty's respirations, as necessary.
      5. Monitor the casualty for progression of symptoms.

   5. Treat the injury.
   6. Treat the casualty for shock.
   7. Record the care provided.
   8. Evacuate the casualty.

   **NOTE:** Continue to assess the casualty.
The casualty should be evacuated by the most expedient means.

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**ABDOMINAL INJURIES**

A deep wound in the abdomen is likely to constitute a major emergency since there are many vital organs in this area. Abdominal wounds typically cause intense pain, nausea and vomiting, spasm of the abdominal muscles, and severe shock. Immediate surgical treatment is almost always required; therefore, the casualty must receive medical attention at once, or the chances of survival will be poor. The HM should give only the most essential first aid treatment, and concentrate efforts on getting the casualty to a medical treatment facility. The following first aid procedures may be of help to a person suffering from an abdominal wound.
ABDOMINAL INJURY ASSESSMENT

Scenario
The HM has a casualty with an open abdominal wound. All other more serious injuries have been assessed and treated.

Objective
Treat an open abdominal wound, minimize the effects of the injury, and stabilize the casualty without causing additional injury.

Performance Steps

1. Position the casualty.
   a. Place the casualty on his back (face up).
   b. Ensure the casualty has a patent airway.
   c. Flex the casualty's knees.
   d. Turn the casualty's head to the side and keep the airway clear if vomiting occurs.

2. Treat for shock. Initiate one large bore (18 gauge) IV if the casualty is exhibiting signs and symptoms of shock.

   WARNING:
   The most important concern in the initial management of abdominal injuries is shock.
   Shock may be present initially or develop later.
   Neither the presence nor absence of a wound, nor the size of the external wound are safe guidelines for judging the severity of the wound.

3. Expose the wound. Inspect for distention, contusions, penetration, eviscerations or obvious bleeding.

   CAUTION:
   Do not attempt to replace protruding internal organs or remove any protruding foreign objects.

4. Stabilize any protruding objects.

5. Apply a sterile abdominal dressing.

   NOTE:
   Protruding abdominal organs should be kept moist to prevent the tissue from drying out.
   A moist, sterile dressing should be applied if available.

   a. Using the sterile side of the dressing, or other clean material, place any protruding organs near the wound.
   b. Ensure that the dressing is large enough to cover the entire mass of protruding organs or area of the wound.
   c. If large enough to cover the affected area, place the sterile side of the plastic wrapper directly over the wound to provide an additional barrier layer to protect the organs from rupture and contamination. Open abdominal wounds can become infected quickly and lead to systemic infection, or sepsis.
   d. Place the dressing directly on top of the wound or plastic wrapper, if used.
   e. Tie the dressing tails loosely at the casualty's side.

   CAUTION:
   Do not apply pressure on the wound or expose internal parts.

   f. If two dressings are needed to cover a large wound, repeat steps 5a through 5e. Ensure that the ties of additional dressings are not tied over each other.
   g. If necessary, loosely cover the dressings with cravats. Tie them on the side of the casualty opposite that of the dressing ties.

6. Do not cause further injury to the casualty.
   a. Do not touch any exposed organs with bare hands.
   b. Do not try to push any exposed organs back into the body.
c. Do not tie the dressing tails tightly or directly over the dressing.

d. Do not give the casualty anything by mouth (NPO).

**NOTE:**
Continue to assess the casualty.

7. Prepare the casualty for evacuation.
   a. Place the casualty on his back (face up) with the knees flexed.
   b. If evacuation is delayed, check the casualty for signs of shock every 5 minutes.
   c. Consider pain management as necessary.

8. Record the treatment given.

9. Evacuate the patient.

**CHILDBIRTH EMERGENCIES**

Every HM must be prepared to handle the unexpected arrival of a new life into the world. If the HM is fortunate, a prepackaged sterile delivery pack will be available; unfortunately this is usually not the case. This pack will contain all the equipment needed for the normal delivery of a healthy baby. If the pack is not available the HM will require imaginative improvisation of clean alternatives.

When faced with an imminent childbirth, first determine whether there will be time to transport the expectant mother to a hospital. To help make this determination, the HM should try to find out:

- Which delivery will this be the woman (first vaginal deliveries normally take much longer than subsequent deliveries)
- Have there been any complications with this pregnancy (or previous pregnancies)
- Has her water broken or is there blood
- The time between contractions (if less than 3 minutes, delivery is approaching)
- If the mother senses that she has to move her bowels (if so, then the baby’s head is well advanced down the birth canal)
- If there is crowning of the baby’s head at the vaginal opening (crowning indicates that the baby is ready to present itself)
- How long will it take to get to the hospital

The HM must weigh the answers to these questions and decide if it will be safe to transport the patient to the hospital.

**Preparation**

Prior to childbirth, The HM must quickly "set the stage."

- Do not allow the mother to go to the bathroom since straining may precipitate delivery. However, do not try to inhibit the natural process of childbirth
- The mother should lie back on a sturdy table, bed, or stretcher with a folded sheet or blanket placed under her buttocks for absorption and comfort
- Ensure one side of the pelvis is elevated (place hip roll under right or left side; left side is more common) to ensure blood flow in the pelvic region and thus ensuring oxygenation of the fetus: the weight of the fetus and uterus can compress the abdominal aorta resulting in insufficient blood flow
- Remove all of the patient’s clothing below the waist, bend the knees, move the thighs apart (i.e. lithotomy position), and drape her lower extremities with clean towels or sheets
- Don sterile gloves, or, if these are not available, the HM must rewash his or her hands
Normal Vaginal Delivery (NVD)

In a normal delivery, the HM’s calm professional manner and sincere reassurance to the mother will reduce her anxiety and make the delivery easier for everyone. Help the woman rest and relax as much as possible between contractions.

During a contraction, deep, open-mouth breathing will relieve some pain and straining. As the child’s head reaches the area of the rectum, the mother will feel an urgent need to defecate. Reassurance that this is a natural feeling and a sign that the baby will be born soon will help alleviate her apprehension.

DELIVERY STEPS.—Watch for the presentation of the top of the baby’s head.

1. Once the head appears, the HM takes up station at the foot of the bed and gently supports the head (with the palms of the hand) to keep it from emerging too quickly. Allow the head to come out slowly.

2. Once the head presents, direct the mother to breathe and not to push while checking for the umbilical cord. As more of the head appears, visually check to be sure that the umbilical cord is not wrapped around the neck.

3. Cord around the baby’s neck: If it is, either gently try to untangle the cord or move one section over the baby’s shoulder. If neither of these actions is possible, clamp the cord in two places, 2 inches apart, and cut it between the clamps.

4. Once the baby’s chin emerges, direct the mother to breathe and not to push.

5. Support the baby’s head with one hand and use the bulb syringe from the pack to suction the mouth and then the nostrils. Before placing the bulb in the baby’s mouth or nose, compress it; otherwise, a forceful aspiration into the lungs will result.

NOTE:
Always suction the mouth first and then the nose.

This is critical in newborns who have had a bowel movement (meconium) within the womb and need the meconium cleared from the airway.

6. The baby will now start a natural rotation to the left or right, away from the face-down position.

NOTE:
Baby needs to be on his or her side to allow for manipulation and delivery of the shoulders.

7. As this rotation occurs, keep the baby’s head in alignment with his or her body.

NOTE:
From this point on, it is essential to remember that the baby is VERY slippery, and great care must be taken not to drop him or her. The surface beneath the mother should extend at least 2 feet out from her buttocks so that the baby will not be hurt if he or she does slip.

8. The shoulders appear next, usually one at a time. Deliver the top shoulder first using the flexibility of the posterior pelvic floor to move the shoulder under and out from the symphysis pubic bone. The bottom shoulder will typically deliver itself with a bit of force. Remember, the baby is VERY slippery.

9. Keep one hand beneath the baby’s head, and use the other hand to support its emerging body.
Infant Care Post-Delivery

Care immediately after delivery is critical for successful transition of the baby from inutero circulation and oxygenation (all provided by the mother) to extrautero circulation and oxygenation (all required of the baby). The following are steps to successfully transition the baby:

1. **Airway and Breathing.**
   a. Once the baby has been born, suction the nose and mouth again if breathing has not started.
   b. Wipe the baby’s face, nose, and mouth clean with sterile gauze.
   c. Vigorously rub the baby’s back and flick its feet to get the baby to cry and or to sustain a good healthy cry (if the cry is depressed). The reward is the baby’s hearty cry.

2. **Circulation.**
   a. Keep the baby level with the mother’s uterus until the cord is cut.
   b. Clamp the umbilical cord as the pulsations cease.
   c. Use two clamps from the prepackaged sterile delivery pack, 2 inches apart, with the first clamp 6 to 8 inches from the navel.
   d. Cut the cord between the clamps.
   e. For safety, use gauze tape to tie the cord 1 inch from the clamp toward the navel. Secure the tie with a square knot.

3. **Warmth.**
   a. Wrap the baby in a warm, sterile blanket, and log its time of arrival.
   b. If the baby has a low body temperature, place chest to chest with the mother (who must be stable) and place a blanket over the two of them to allow for heat transfer from the mother.

Mother Care Post-Delivery

This is a relatively dangerous period for the mother, as hemorrhage and shock may occur. Steps must be taken to ensure all infection control procedures are followed. Additionally, close hemodynamic monitoring is needed as the mother transitions from pregnancy to post-partum physiologic status. The following are steps to ensure a successful and safe transition:

1. The placenta (afterbirth) will deliver itself in 10 to 20 minutes. Massaging the mother’s lower abdomen can aid this delivery. Do not pull on the umbilical cord to hasten its delivery. Log the time of the placenta’s delivery, and wrap it up for hospital analysis.

   **NOTE:**
   If there are any concerns regarding delivery of the placenta or its presentation upon delivery, immediately contact a medical officer for guidance.

2. Place a small strip of tape (½-inch wide), folded and inscribed with the date, time of delivery, and mother’s name, around the baby’s wrist.

3. Place the same identification tape around the mother’s wrist so that the mother and baby can be matched later at the medical treatment facility.

4. Monitor vital signs every 5 minutes for the first 15 minutes, every 15 minutes for three recordings, every 30 minutes for 2 recordings, and every hour for 4 hours. Then resort to vital signs every 4 hours. If the patient is bleeding heavily or shock signs and symptoms are present, continue every 5 minute vital signs until the mother is stabilized.

5. Monitor for uterine hemorrhage.
   a. The uterus should be gently massaged to keep it hard.
   b. For first time mothers, the uterus will be at or slightly above the navel.
c. For experienced mothers, the uterus will be at or slightly below the navel.

NOTE:
If the uterus appears too high or is offset to the right or left the mother has a full bladder that must be emptied (either on her own or via urinary catheterization).

A full bladder will prevent the uterus from contracting and closing the vessels that are bleeding.

d. Have mother put infant to breast to aid with contractions which clamps down the uterine arteries and veins and decreases the bleeding.

6. Nutrition and restoration of resources.
   a. The mother will need nourishment and will wish to rest and watch her baby.

7. Care of the vaginal opening and canal.
   a. The mother should keep her hands away from the area surrounding the birth outlet.
   b. If uncontaminated water is available, she may wish to wash off her thighs. She may get up and go to the bathroom or seek better shelter.
   c. All care should be taken to avoid introducing infection into the birth canal.
   d. Educate the mother about the amount and color of vaginal discharge.
      i. She can expect some vaginal discharge for several days.
      ii. This is reddish for the first day or so but lightens and becomes less profuse within a few days.
      iii. May bleed longer than a typical period.
      iv. If bleeding increases, immediately assess the location and firmness of the uterus and ensure the mother has voided recently.

Final Notes

Stay with the mother until relieved by competent personnel. Almost all emergency births are normal. The babies typically thrive and the mothers recover quickly. It is very important when assisting with an emergency delivery that the HM continually reassures the mother and attempts to keep her calm.

COMPLICATIONS IN CHILDBIRTH

Unfortunately, not all deliveries go smoothly. The following sections cover various complications in childbirth.

Breech Delivery

A breech delivery occurs when the baby’s legs and or buttocks emerge first. Follow the steps for a normal delivery, and support the lower extremities with one hand. If the head does not emerge within 3 minutes, try to maintain an airway by gently pushing fingers into the vagina. Push the vagina away from the baby’s face and open his or her mouth with one finger. Get medical assistance immediately.

Prolapsed Cord

If the cord precedes the baby, protect it with moist, sterile wraps. If a physician cannot be reached quickly, place the mother in an extreme shock position. Give the mother oxygen, if available, and gently move a sterile gloved hand into the vagina to keep its walls and the baby from compressing the cord. The HM will provide support until the baby is delivered. The HM cannot remove his or her hand until told to do so by a medical officer. Get medical assistance immediately.

Excessive Bleeding

If the mother experiences severe bleeding, treat her for shock and give her oxygen, if available. Place sanitary napkins over the vaginal entrance and rush her to a hospital.
If hemorrhaging does occur, do the following:

1. The uterus should be gently massaged to keep it hard.
2. The woman should lie flat, and the bottom of the bed should be elevated.
3. Put a cold pack (such as a small towel dipped in cold water and wrung out) on the lower abdomen to irritate the uterus to contract.
4. Put pressure on the perineum with several sanitary napkins and the pressure of a hand.

Limb Presentation

If a single limb presents itself first, immediately get the mother to a hospital.

NON-TACTICAL TRAUMA ASSESSMENT

If there is no immediate danger to the HM or the surroundings are non-threatening, then the HM’s only limitations are the resources available and the nature of the injury. During these types of scenarios, it is quite reasonable to use the following patient assessment algorithm while assessing a trauma patient (Fig. 21-3).
Basic Trauma Life Support Assessment:

Scene Survey
- Is scene safe?
- Mechanism of Injury (MOI)
- Number of patient’s?
- Any HAZMAT?

Primary Assessment (Expose As You Go)
- Treat life threatening injuries as found.
- Control C-Spine
- Assess level of consciousness (AVPU)

A: Open and maintainable?
  - CONTROL C-Spine

B: Assess rate and quality
  - Access for deviated trachea and jugular vein distention
    - Expose and look and feel the chest
    - Is there equal rise and fall?
    - DCAP-BTLS, flat segments?

C: Evaluate skin color and temperature
  - Feel carotid and radial pulse
  - Evaluate pulse rate, strength, and quality

Head / Face - DCAP-BTLS
Neck - DCAP-BTLS
  - Step Off?
  - Apply C-collar

Shoulders - DCAP-BTLS
Abdomen - DCAP-BTLS
  - Tenderness, Rigidity, Distension (TRD)

Pelvis - DCAP-BTLS
  - Tenderness, Instability, Crepitations (TIC)?
  - Fracture (Eversion)?

Legs - DCAP-BTLS
  - PMS (Pulse Motor Sensory)

Arms - DCAP-BTLS
  - PMS (Pulse Motor Sensory)

Back - Log roll survivor if appropriate, if not, check for
  - DCAP-BTLS, Step-Offs

Secure to litter

En-route:
- Re-assess ABC’s and Interventions
- Detailed exam head, eyes, ears, nose
- Additional procedures and splinting as appropriate
- Give abbreviated report

Physical Exam Acronyms:

- A: Alert
- V: Verbal
- P: Painful
- U: Unresponsive

- D: Deformities
- C: Contusions
- A: Abrasions
- P: Punctures / Penetrations
- B: Burns
- T: Tenderness
- L: Lacerations
- S: Swelling
TCCC GUIDELINES FOR CARE

Basic Management Plan for Care Under Fire

1. Return fire/take cover.
2. Direct/expect casualty to remain engaged as a combatant, if appropriate.
3. Direct casualty to move to cover/apply self-aid if able.
4. Try to keep the casualty from sustaining additional wounds.
5. Airway management is best deferred until the Tactical Field Care Phase.
6. Stop LIFE-THREATENING external hemorrhage if tactically Feasible.
   a. Direct casualty to control hemorrhage by self-aid if able.
   b. Use a tourniquet for hemorrhage that is anatomically amendable to tourniquet application.
   c. For hemorrhage that cannot be controlled with a tourniquet, apply currently approved hemostatic dressing with pressure.

Basic Management Plan for Tactical Field Care

1. Casualties with an altered mental status should be disarmed immediately.
2. Airway Management.
   a. Unconscious casualty without airway obstruction.
      i. Chin lift or jaw thrust maneuver.
      ii. Nasopharyngeal airway.
      iii. Place casualty in the recovery position.
   b. Casualty with airway obstruction or impending airway obstruction.
      i. Chin lift or jaw thrust maneuver.
      ii. Nasopharyngeal airway.
      iii. Allow casualty to assume a position that best protects the airway, to include sitting up.
      iv. Place unconscious casualty in the recovery position.
      v. If previous measures unsuccessful: Surgical cricothyroidotomy (with lidocaine if conscious)
   a. In a casualty with progressive respiratory distress and known or suspected torso trauma, consider a tension pneumothorax and decompress the chest on the side of the injury with a 14-gauge, 3.25 inch needle/catheter unit inserted in the second intercostal space at the mid-clavicular line. Ensure that the needle entry into the chest is not medial to the nipple line and is not directed towards the heart.
   b. All open and or sucking chest wounds should be treated by immediately applying an occlusive material to cover the defect and securing it in place. Monitor the casualty for the potential development of a subsequent tension pneumothorax.
4. Bleeding.
   a. Assess for unrecognized hemorrhage and control all sources of bleeding. If not already done, use a CoTCCC-recommended tourniquet to control life-threatening external hemorrhage that is anatomically amenable to tourniquet application or for any traumatic amputation. Apply directly to the skin 2-3 inches above wound.
b. For compressible hemorrhage not amenable to tourniquet use or as an adjunct to tourniquet removal (if evacuation time is anticipated to be longer than two hours), use Combat Gauze as the hemostatic agent of choice. Combat Gauze should be applied with at least 3 minutes of direct pressure. Before releasing any tourniquet on a casualty who has been resuscitated for hemorrhagic shock, ensure a positive response to resuscitation efforts (i.e., a peripheral pulse normal in character and normal mentation if there is no traumatic brain injury (TBI)).

c. Reassess prior tourniquet application. Expose wound and determine if tourniquet is needed. If so, move tourniquet from over uniform and apply directly to skin 2-3 inches above wound. If a tourniquet is not needed, use other techniques to control bleeding.

d. When time and the tactical situation permit, a distal pulse check should be accomplished. If a distal pulse is still present, consider additional tightening of the tourniquet or the use of a second tourniquet, side by side and proximal to the first, to eliminate the distal pulse. Expose and clearly mark all tourniquet sites with the time of tourniquet application. Use an indelible marker.

5. Intravenous (IV) access:
   a. Start an 18-gauge IV or saline lock if indicated.
   b. If resuscitation is required and IV access is not obtainable, use the intraosseous (IO) route.

6. Fluid resuscitation:
   a. Assess for hemorrhagic shock; altered mental status (in the absence of head injury) and weak or absent peripheral pulses are the best field indicators of shock.
   b. If not in shock:
      i. No IV fluids necessary.
      ii. PO fluids permissible if conscious and can swallow.
   c. If in shock:
      i. Hextend®, 500-mL IV bolus.
      ii. Repeat once after 30 minutes if still in shock.
      iii. No more than 1000 mL of Hextend®.
   d. Continued efforts to resuscitate must be weighed against logistical and tactical considerations and the risk of incurring further casualties.
   e. If a casualty with TBI is unconscious and has no peripheral pulse, resuscitate to restore the radial pulse.

   a. Minimize casualty’s exposure to the elements. Keep protective gear on or with the casualty if feasible.
   b. Replace wet clothing with dry if possible.
   c. Apply Ready-Heat Blanket to torso.
   d. Wrap in Blizzard Rescue Blanket.
   e. Put Thermo-Lite Hypothermia Prevention System Cap on the casualty’s head, under the helmet.
   f. Apply additional interventions as needed and available.
   g. If mentioned gear is not available, use dry blankets, poncho liners, sleeping bags, body bags, or anything that will retain heat and keep the casualty dry.
8. Penetrating Eye Trauma.
   a. If a penetrating eye injury is noted or suspected.
      i. Perform a rapid field test of visual acuity.
   b. Cover the eye with a rigid eye shield (NOT a pressure patch).
   c. Ensure that the 400 mg moxifloxacin tablet in the combat pill pack is taken if possible and that IV/IM antibiotics are given as outlined below if oral moxifloxacin cannot be taken.

9. Monitoring:
   a. Pulse oximetry should be available as an adjunct to clinical monitoring.
   b. Readings may be misleading in the settings of shock or marked hypothermia.

10. Inspect and dress known wounds.

11. Check for additional wounds.

12. Provide analgesia as necessary.
   a. Able to fight:
      i. These medications should be carried by the combatant and self-administered as soon as possible after the wound is sustained.
         1. Mobic®, 15 mg PO once a day.
         2. Tylenol®, 650-mg bilayer caplet, 2 PO every 8 hours.
   b. Unable to fight:
      
      NOTE:
      Have naloxone readily available whenever administering opiates.

      i. Does not otherwise require IV/IO access.
      ii. Oral transmucosal fentanyl citrate (OTFC), 800 ug transbuccally.
      iii. Recommend taping lozenge-on-a-stick to casualty’s finger as an added safety measure.
      iv. Reassess in 15 minutes.

      v. Add second lozenge, in other cheek, as necessary to control severe pain.
      vi. Monitor for respiratory depression.
      vii. IV or IO access obtained:
           1. Morphine sulfate, 5 mg IV/IO.
           2. Reassess in 10 minutes.
           3. Repeat dose every 10 minutes as necessary to control severe pain.
           4. Monitor for respiratory depression.
      viii. Promethazine, 25 mg IV/IM/IO every 6 hours as needed for nausea or for synergistic analgesic effect.

13. Splint fractures and recheck pulse.

   a. If able to take PO:
      i. Moxifloxacin, 400 mg PO one a day.
   b. If unable to take PO (shock, unconsciousness):
      i. Cefotetan, 2 g IV (slow push over 3-5 minutes) or IM every 12 hours OR
      ii. Ertapenem, 1 g IV/IM once a day.

15. Communicate with the casualty if possible.
   a. Encourage; reassure.
   b. Explain care.
   c. Cardiopulmonary resuscitation (CPR) - Resuscitation on the battlefield for casualties of blast or penetrating trauma who have no pulse, no ventilations, and no other signs of life will not be successful and should not be attempted.
   d. Documentation of Care - Document clinical assessments, treatments rendered, and changes in the casualty’s status. Forward this information with the casualty to the next level of care.
Basic Management Plan for Tactical Evacuation Care

The new term “Tactical Evacuation” includes both Casualty Evacuation (CASEVAC) and Medical Evacuation (MEDEVAC) as defined in Joint Publication 4-02.

1. Airway Management.
   a. Unconscious casualty without airway obstruction:
      i. Chin lift or jaw thrust maneuver.
      ii. Nasopharyngeal airway.
      iii. Place casualty in the recovery position.
   b. Casualty with airway obstruction or impending airway obstruction:
      i. Chin lift or jaw thrust maneuver.
      ii. Nasopharyngeal airway.
      iii. Allow casualty to assume any position that best protects the airway, to include sitting up.
      iv. Place unconscious casualty in the recovery position.
      v. If above measures are unsuccessful:
         vi. Laryngeal Mask Airway (LMA)/incubating LMA OR
         vii. Combitube® OR
         viii. Endotracheal intubation OR
         ix. Surgical cricothyroidotomy (with lidocaine if conscious).
   c. Spinal immobilization is not necessary for casualties with penetrating trauma.

2. Breathing:
   a. In a casualty with progressive respiratory distress and known or suspected torso trauma, consider a tension pneumothorax and decompress the chest on the side of the injury with a 14-gauge, 3.25 inch needle/catheter unit inserted in the second intercostal space (over the top of the 3rd rib) at the mid-clavicular line. Ensure that the needle entry into the chest is not medial to the nipple line and is not directed towards the heart.
   b. Consider chest tube insertion if no improvement and or long transport is anticipated.
   c. Most combat casualties do not require supplemental oxygen, but administration of oxygen may be of benefit for the following types of casualties:
      i. Low oxygen saturation by pulse oximetry.
      ii. Injuries associated with impaired oxygenation.
      iii. Unconscious casualty.
      iv. Casualty with TBI (maintain oxygen saturation > 90%).
      v. Casualty in shock.
      vi. Casualty at altitude.
   d. All open and or sucking chest wounds should be treated by immediately applying an occlusive material to cover the defect and securing it in place. Monitor the casualty for the potential development of a subsequent tension pneumothorax.
3. Bleeding:
   a. Assess for unrecognized hemorrhage and control all sources of bleeding. If not already done, use a Council of TCCC (CoTCCC)-recommended tourniquet to control life-threatening external hemorrhage that is anatomically amenable to tourniquet application or for any traumatic amputation. Apply directly to the skin 2-3 inches above wound.
   b. For compressible hemorrhage not amenable to tourniquet use or as an adjunct to tourniquet removal (if evacuation time is anticipated to be longer than two hours), use Combat Gauze as the hemostatic agent of choice. Combat Gauze should be applied with at least 3 minutes of direct pressure. Before releasing any tourniquet on a casualty who has been resuscitated for hemorrhagic shock, ensure a positive response to resuscitation efforts (i.e., a peripheral pulse normal in character and normal mentation if there is no TBI).
   c. Reassess prior tourniquet application. Expose wound and determine if tourniquet is needed. If so, move tourniquet from over uniform and apply directly to skin 2-3 inches above wound. If a tourniquet is not needed, use other techniques to control bleeding.
   d. When time and the tactical situation permit, a distal pulse check should be accomplished. If a distal pulse is still present, consider additional tightening of the tourniquet or the use of a second tourniquet, side by side and proximal to the first, to eliminate the distal pulse.
   e. Expose and clearly mark all tourniquet sites with the time of tourniquet application. Use an indelible marker.

4. Intravenous (IV) access:
   a. Reassess need for IV access.
      i. If indicated, start an 18-gauge IV or saline lock.
      ii. If resuscitation is required and IV access is not obtainable, use intraosseous (IO) route.

5. Fluid resuscitation:
   a. Reassess for hemorrhagic shock: altered mental status in the absence of brain injury and or change in pulse character.
   b. If not in shock:
      i. No IV fluids necessary.
      ii. PO fluids permissible if conscious and can swallow.
   c. If in shock:
      i. Hextend® 500-mL IV bolus.
      ii. Repeat once after 30 minutes if still in shock.
      iii. No more than 1000 mL of Hextend®.
   d. Continue resuscitation with packed red blood cells (PRBCs), Hextend® (not to exceed 1000 ml), or Lactated Ringer’s solution (LR) as indicated.
   e. If a casualty with TBI is unconscious and has a weak or absent peripheral pulse, resuscitate as necessary to maintain a systolic blood pressure of 90 mmHg or above.

   a. Minimize casualty’s exposure to the elements. Keep protective gear on or with the casualty if feasible.
   c. Apply additional interventions as needed.
   d. Use the Thermal Angel or other portable fluid warmer on all IV sites, if possible.
   e. Protect the casualty from wind if doors must be kept open.
7. Penetrating Eye Trauma:
   a. If a penetrating eye injury is noted or suspected:
      i. Perform a rapid field test of visual acuity.
      ii. Cover the eye with a rigid eye shield (NOT a pressure patch).
      iii. Ensure that the 400 mg moxifloxacin tablet in the combat pill pack is taken if possible and that IV/IM antibiotics are given as outlined below if oral moxifloxacin cannot be taken.

8. Monitoring:
   a. Institute pulse oximetry and other electronic monitoring of vital signs, if indicated.

9. Inspect and dress known wounds if not already done.

10. Check for additional wounds.

11. Provide analgesia as necessary.
   a. Able to fight:
      i. Mobic®, 15 mg PO once a day.
      ii. Tylenol®, 650-mg bilayered caplet, 2 PO every 8 hours.
   b. Unable to fight:
      
      **NOTE:**
      Have naloxone readily available whenever administering opiates.
      
      i. Does not otherwise require IV/IO access:
         1. Oral transmucosal fentanyl citrate (OTFC) 800 micrograms transbuccally.
         2. Recommend taping lozenge-on-a-stick to casualty’s finger as an added safety measure.
         3. Reassess in 15 minutes.
         4. Add second lozenge, in other cheek, as necessary to control severe pain.
      
      ii. IV or IO access obtained:
         1. Morphine sulfate, 5 mg IV/IO.
         2. Reassess in 10 minutes.
         3. Repeat dose every 10 minutes as necessary to control severe pain.
         4. Monitor for respiratory depression.
      iii. Promethazine, 25 mg IV/IM/IO every 6 hours as needed for nausea or for synergistic analgesic effect.

12. Reassess fractures and recheck pulses.

13. Antibiotics: recommended for all open combat wounds.
   a. If able to take PO:
      i. Moxifloxacin, 400 mg PO once a day.
   b. If unable to take PO (shock, unconsciousness):
      i. Cefotetan, 2 g IV (slow push over 3-5 minutes) or IM every 12 hours OR
      ii. Ertapenem, 1 g IV/IM once a day.

14. The Pneumatic Anti-shock Garment (PASG) may be useful for stabilizing pelvic fractures and controlling pelvic and abdominal bleeding. Application and extended use must be carefully monitored. The PASG is contraindicated for casualties with thoracic or brain injuries.

15. Documentation of Care:
   a. Document clinical assessments, treatments rendered, and changes in casualty’s status on a TCCC Casualty Card.
   b. Forward this information with the casualty to the next level of care.
MORPHINE USE FOR PAIN RELIEF

LEARNING OBJECTIVE:

Explain morphine dosage, administration routes, indications, contraindications, and casualty marking procedures.

A HM may be issued morphine for the control of shock through the relief of severe pain. This controlled drug is issued under very strict accountability procedures. Possession of this drug is a medical responsibility that must not be taken lightly. Policies pertaining to morphine administration are outlined in BUMEDINST 6570.2 series, *Morphia Dosage and Casualty Marking*.

MORPHINE ADMINISTRATION

Morphine is the most effective of all pain-relieving drugs. It is most commonly available in pre-measured doses in syrettes or tubexes. Proper administration in selected patients relieves distressing pain and assists in preventing shock. The adult dose of morphine is 10 to 20 mg, which may be repeated, if necessary, in no less than 4 hours.

Morphine has several undesirable effects, however, and the HM must thoroughly understand these effects. Morphine:

- Is a severe respiratory depressant and must not be given to patients in moderate or severe shock or in respiratory distress
- Increases intracranial pressure and may induce vomiting. These effects may be disastrous in head injury cases
- Causes constriction of the pupils (pinpoint pupils). This effect prevents the use of the pupillary reactions for diagnosis in head injuries
- Is cardiotoxic and a peripheral vasodilator. Small doses of morphine may cause profound hypotension in a patient in shock
- Poisoning is always a danger. There is a narrow safety margin between the amounts of morphine that may be given therapeutically and the amounts that produce death
- Causes considerable mental confusion and interferes with the proper exercise of judgment. Therefore, morphine should not be given to ambulatory patients
- Is a highly addictive drug. Morphine should not be given trivially and must be rigidly accounted for. Only under emergency circumstances should morphine be administered

Rigidly control morphine administration to patients in shock or with extensive burns. Because of the reduced peripheral circulation, morphine administration by subcutaneous or intramuscular routes may not be absorbed into the bloodstream, and pain may persist. When pain persists, the uninformed often give additional doses, hoping to bring about relief. When resuscitation occurs and the peripheral circulation improves, the stored quantities of morphine are released into the system, and an extremely serious condition (morphine poisoning) results. When other pain-relieving drugs are not available and the patient in shock or with burns is in severe pain, 20 mg of morphine may be given intramuscularly (followed by massage of the injection site). Resist the temptation to give more, however. Unless otherwise ordered by a medical officer, doses should not be repeated more than twice and then at least 4 hours apart.

If the pain from a wound is severe, morphine may be given when examination of the patient reveals no:

- Head injury
- Chest injury, including sucking and non-sucking wounds
- Wounds of the throat, nasal passages, oral cavity, or jaws wherein blood might obstruct the airway
- Massive hemorrhage
• Respiratory impairment, including chemical burns of the respiratory tract (any casualty having fewer than 16 respirations per minute should not be given morphine)
• Evidence of severe or deepening shock
• Loss of consciousness

CASUALTY MARKING

Morphine overdose is always a danger. For this reason, plainly identify every casualty who has received morphine. Write the letter “M” and the hour of injection on the patient’s forehead (e.g., M0830) with a skin pencil or semi-permanent marking substitute. Attach the empty morphine syrette or tubex to the patient’s shirt collar or another conspicuous area of the clothing with a safety pin or by some other means. This action will alert others that the drug has been administered.

SOFTWARE TISSUE INJURIES

LEARNING OBJECTIVES:

Describe the different types of wounds.

Determine management and treatment procedures for open and internal soft-tissue injuries.

The most common injuries seen by HMs in a first aid setting are soft tissue injuries with the accompanying hemorrhage, shock, and danger of infection. Any injury that causes a break in the skin, underlying soft tissue structures, or body membranes is known as a wound. This section will discuss the classification of wounds, the general and specific treatment of soft tissue injuries, the use of dressings and bandages in treating wounds, and the special problems that arise because of the location of wounds.

CLASSIFICATION OF WOUNDS

Wounds may be classified according to their general condition, size, location, the manner in which the skin or tissue is broken, and the agent that caused the wound. It is necessary to consider these factors to determine what first aid treatment is appropriate for the wound.

General Condition of the Wound

If the wound is fresh, first aid treatment consists mainly of stopping the flow of blood, treating for shock, and reducing the risk of infection. If the wound is already infected, first aid consists of keeping the casualty quiet, elevating the injured part, and applying a warm wet dressing. If the wound contains foreign objects, first aid treatment may consist of removing the objects if they are not deeply embedded. DO NOT remove objects embedded in the eyes or the skull, and do not remove impaled objects. Stabilize the impaled object to prevent further injury and minimize bleeding. Impaled objects should be surgically removed.

LACERATIONS—These wounds are torn, rather than cut. They have ragged, irregular edges and masses of torn tissue underneath. These wounds are typically made by blunt (as opposed to sharp) objects. A wound made by a dull knife, for instance, is more likely to be a laceration than an incision. Bomb fragments often cause lacerations. Many of the wounds caused by accidents with machinery are lacerations; they are often complicated by crushing of the tissues as well. Lacerations are frequently contaminated with dirt, grease, or other material that is ground into the tissue. They are therefore very likely to become infected.

PUNCTURES—Punctures are caused by objects that penetrate into the tissues while leaving a small surface opening. Wounds made by nails, needles, wire, and bullets are typically punctures. As a rule, small puncture wounds do not bleed freely; however, large puncture wounds may cause severe internal bleeding.
The possibility of infection is great in all puncture wounds, especially if the penetrating object has tetanus bacteria on it.

**AVULSIONS**—An avulsion is the tearing away of tissue from a body part. Bleeding is normally heavy. In certain situations, the torn tissue may be surgically reattached. It can be saved for medical evaluation by wrapping it in a sterile dressing and placing it in a cool container, and rushing it along with the casualty to a medical facility. Do not allow the avulsed portion to freeze, and do not immerse it in water or saline.

**AMPUTATIONS**—A traumatic amputation is the non-surgical removal of the limb from the body. Bleeding is heavy and requires a tourniquet (which will be discussed later) to stop the flow. Shock is certain to develop in these cases. As with avulsed tissue, wrap the limb in a sterile dressing, place it in a cool container, and transport it to the hospital with the casualty. Do not allow the limb to be in direct contact with ice, and do not immerse it in water or saline. The limb can often be successfully reattached.

**Causes of Wounds (Kinematics of Trauma)**

Although it is not always necessary to know what agent or object has caused the wound, it is helpful. Knowing what has caused the wound may give the HM some idea of the probable size of the wound, its general nature, the extent to which it is likely to become contaminated with foreign matter, and what special dangers must be guarded against. Of special concern in wartime setting is the velocity of wound-causing missiles (bullets or shrapnel). A low-velocity missile damages only the tissues with which it comes into contact. On the other hand, a high-velocity missile can do enormous damage by forcing the tissues and body parts away from the track of the missile with a velocity only slightly less than that of the missile itself. These tissues, especially bone, may become damage-causing missiles themselves, thus accentuating the destructive effects of the missile.

Having classified the wound into one or more of the general categories listed, the HM will have a good idea of the nature and extent of the injury, along with any special complications that may exist. This information will aid in the treatment of the casualty.

**MANAGEMENT OF OPEN SOFT-TISSUE INJURIES**

There are three basic rules to be followed in the treatment of practically all open soft tissue injuries: to control hemorrhage, to treat the casualty for shock, and to prevent infection. These will be discussed, along with the proper application of first aid materials and other specific first aid techniques.

**Hemorrhage**

Hemorrhage is the escape of significant amounts of blood from the vessels of the circulatory system. The average adult body contains about 5-6 liters of blood. Five hundred milliliters of blood, the amount given by blood donors, can normally be lost without any harmful effect. The loss of 1 liter of blood usually causes shock, but shock may develop if small amounts of blood are lost rapidly, since the circulatory system does not have enough time to compensate adequately. The degree of shock progressively increases as greater amounts of blood escape. Young children, sick people, or the elderly may be especially susceptible to the loss of even small amounts of blood since their internal systems are in such delicate balance. Capillary blood is normally dark brick red in color. If capillaries are cut, the blood oozes out slowly. Blood from the veins is dark red. Venous bleeding is characterized by a steady, even flow. If an artery near the surface is cut, the blood, which is bright red in color, will gush out in spurts that are synchronized with the heartbeats. If the severed artery is deeply buried, however, the bleeding will appear to be a steady stream.
In actual practice, it can be difficult to decide whether bleeding is venous or arterial, but the distinction is not important. The important thing to know is that all bleeding must be controlled as quickly as possible.

External hemorrhage is of greatest importance because it is the most frequently encountered and the easiest to control. It is characterized by a break in the skin and visible bleeding. Internal hemorrhage (which will be discussed later) is far more difficult to recognize and to control.

Control of Hemorrhage and the use of Tourniquets

In the past, emphasis has been placed on elevation of an extremity and compression on a pressure point (proximal to the bleeding site) as intermediate steps in hemorrhage control. No research has been published on whether or not elevation of an extremity slows hemorrhage. If the extremity is fractured, this maneuver could potentially result in converting a closed fracture to an open one or in causing increased internal hemorrhage. Similarly, the use of pressure points for hemorrhage control has not been studied. Thus, in the absence of compelling data, these interventions can no longer be recommended for situations where direct pressure or a pressure dressing has failed to control hemorrhage.

If external bleeding from an extremity cannot be controlled by pressure, application of a tourniquet is the reasonable next step in hemorrhage control.

APPLY A TOURNIQUET TO CONTROL BLEEDING

Scenario

The HM has encountered a casualty who is bleeding profusely from an extremity and needs a tourniquet to control the bleeding. All other more serious injuries have been assessed and treated.

Objective

Control the bleeding from the extremity without causing further harm to the casualty.

Performance Steps

1. Determine if the bleeding is life-threatening.
2. Apply a tourniquet if direct pressure and the emergency bandage fail to control the bleeding.

CAUTION:
Under combat conditions, while under effective enemy fire, a temporary tourniquet may often be the primary means to control bleeding.

A properly applied tourniquet will quickly control life-threatening hemorrhage until the casualty can be moved away from the effective fire.

a. Improvised tourniquet.
   i. Don BSI
   ii. Apply pressure to pressure point above the wound.
   iii. Prepare equipment.
   iv. Expose the wound.
   v. Place the prepared cravat and windlass 2-3 inches above the wound (not over a joint) and secure the cravat tightly against the extremity with a full non-slip knot.
   vi. Twist the windlass until the bleeding stops.
   vii. While holding tension on the windlass, place the windlass inside the half knot of the second cravat proximal to the tourniquet (if possible).
viii. Tighten the second cravat around windlass and secure the second cravat to the extremity with a full non-slip knot.

ix. Assess for the absence of a distal pulse (not indicated for amputations).

x. Place a "T" and the time of application on the casualty.

xi. Secure the tourniquet in place with tape.

b. C-A-T®:
   i. Don BSI.
   ii. Apply pressure to pressure point above the wound.
   iii. Expose the wound enough to ensure the tourniquet is placed above the injury.
   iv. Place C-A-T® between the heart and the wound on the injured extremity, 2-3 inches above the wound.
   v. Pull the free end of the self adhering band through the buckle and route through the friction adapter buckle (it is not necessary to route through friction adapter on an arm wound).
   vi. Pull the self adhering band tight around the extremity and fasten it back on itself.
   vii. Twist the windlass until the bleeding stops.
   viii. Lock the windlass in place within the windlass clip.
   ix. Secure the windlass with the windlass strap.
   x. Assess for the absence of a distal pulse (not indicated for amputations).
   xi. Place a "T" and the time of application on the casualty.
   xii. Secure the C-A-T® in place with tape.

3. Record the treatment.

4. Reassess the injury to ensure bleeding has been controlled.

5. If the source of bleeding was due to a traumatic amputation.
   a. Wrap the amputated part in a clean cloth or sterile dressing (if available).
   b. Wrap or bag the amputated part in plastic.
   c. Label the plastic bag with the casualty's information.
   d. Transport the amputated part in a cool container (if available) with the casualty.

   CAUTION:
   Do not place the amputated part directly in contact with ice.
   Do not submerge the part directly in water.
   Do not allow the part to freeze.

6. Evacuate the casualty.

MANAGEMENT OF INTERNAL SOFT-TISSUE INJURIES

Internal soft-tissue injuries may result from deep wounds, blunt trauma, blast exposure, crushing accidents, bone fracture, poison, or sickness. They may range in seriousness from a simple contusion to life-threatening hemorrhage and shock.

Visible Indications

Visible indications of internal soft-tissue injury include the following:

- Hematemesis (vomiting bright red blood)
- Hemoptysis (coughing up bright red blood)
- Melena (excretion of tarry black stools)
- Hematochezia (excretion of bright red blood from the rectum)
- Hematuria (passing of blood in the urine)
- Nonmenstrual (vaginal bleeding)
- Epistaxis (nosebleed)
- Ecchymosis (pooling of the blood near the skin surface)

**Other Signs and Symptoms**

More often than not, however, there will be no visible signs of injury, and the HM will have to infer the probability of internal soft-tissue injury from other symptoms such as the following:

- Pale, moist, clammy skin
- Subnormal temperature
- Rapid, feeble pulse
- Falling blood pressure
- Dilated, slowly reacting pupils with impaired vision
- **Tinnitus**
- Syncope
- Dehydration and thirst
- Yawning and air hunger
- Anxiety, with a feeling of impending doom

**Immediate Treatment**

There is little that the HM can do to correct internal soft-tissue injuries since they are almost always surgical problems. The goal must be to obtain the greatest benefit from the casualty’s remaining blood supply.

**INITIATE TREATMENT FOR HYPOVOLEMIC SHOCK**

**Objective**

Initiate treatment for hypovolemic shock, stabilize the casualty, minimize the effect of shock, and prepare for immediate evacuation without further injury to the casualty.

**Performance Steps**

<table>
<thead>
<tr>
<th>NOTE:</th>
<th>Take Body Substance Isolation (BSI) precautions.</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Take Body Substance Isolation (BSI) precautions.</td>
</tr>
<tr>
<td>1.</td>
<td>Control bleeding.</td>
</tr>
<tr>
<td>2.</td>
<td>Maintain the airway.</td>
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<tr>
<td></td>
<td>Administer oxygen, if available.</td>
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<tr>
<td>3.</td>
<td>Reassure the casualty to reduce anxiety.</td>
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<tr>
<td></td>
<td>Anxiety increases the heart rate, which worsens the casualty's condition. Anyone who has just been shot or who has experienced detonation of explosives nearby will have tachycardia.</td>
</tr>
<tr>
<td>4.</td>
<td>Initiate one large bore (18 gauge) IV.</td>
</tr>
<tr>
<td>5.</td>
<td>Maintain the IV flow with Hextend®.</td>
</tr>
<tr>
<td>a.</td>
<td>Continue the flow until the systolic blood pressure stabilizes at greater than 80mm Hg.</td>
</tr>
<tr>
<td>i.</td>
<td>The usual amount is 500 ml; repeat the dose of 500 ml one time. A total of 1000 ml maximum amount of Hextend® can be used for hypovolemia.</td>
</tr>
<tr>
<td>ii.</td>
<td>A palpable radial pulse typically indicates that the casualty has a systolic blood pressure of 80 mm Hg.</td>
</tr>
</tbody>
</table>

**Scenario**

The HM in the field is assessing a casualty who is suffering from significant blood loss.
6. Elevate the casualty’s legs.
   a. Elevate the casualty's legs above chest level, without lowering the head below chest level.

   **NOTE:**
   Splint leg or ankle fractures before elevating the legs, if necessary.

   b. If the casualty is on a litter, elevate the foot of the litter.

7. Maintain normal body temperature.
   Aggressively treat for hypothermia in a trauma patient.

8. Monitor the casualty.

   **NOTE:**
   Give nothing by mouth. Moisten the casualty's lips with a wet cloth.

   a. Check vital signs every 5 minutes until they return to normal, and then check every 15 minutes.

   b. Check the casualty's level of consciousness.

   **NOTE:**
   If the blood pressure is unstable or drops, the pneumatic anti-shock garment (PASG) should be applied by qualified personnel.

9. Record the procedure.

10. Evacuate the casualty.

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**WOUND CLOSURE**

**LEARNING OBJECTIVES:**

Discuss the different types of suture material and their uses.

Explain topical, local infiltration and nerve-block anesthetic administration procedures.

Explain the steps in wound suturing and suture removal.

The care of the wound is largely controlled by the tactical situation, facilities available, and the length of time before proper medical care may be available. Normally, the advice to HMs regarding the suturing of wounds is DO NOT ATTEMPT IT. However, if days are expected to elapse before the patient can be seen by a surgeon, he or she should know how to use the various suture procedures and materials, and how to select the most appropriate of both.

Before discussing the methods of coaptation (bringing together), some of the contraindications to wound closing should be described.

- If there is reddening and edema of the wound margins, infection manifested by the discharge of pus, and persistent fever or toxemia, DO NOT CLOSE THE WOUND
  - If these signs are minimal, the wound should be allowed to "clean up"
  - The process may be hastened by warm, moist dressings, and irrigations with sterile saline
  - This aids in the liquefaction of necrotic wound materials and the removal of thick exudates and dead tissues
• If the wound is a puncture wound, a large gaping wound of the soft tissue, or an animal bite, leave it un-sutured. Even under the care of a surgeon, it is the rule not to close wounds of this nature until after the fourth day.
  o This is called "delayed primary closure" and is performed upon the indication of a healthy appearance of the wound.
  o Healthy muscle tissue that is viable is evident by its color, consistency, blood supply, and contractility.
  o Muscle that is dead or dying is comparatively dark and mushy; it does not contract when pinched, nor does it bleed when cut. If this type of tissue is evident, do not close the wound.
• If the wound is deep, consider the support of the surrounding tissue; if there is not enough support to bring the deep fascia together, do not suture because dead (hollow) spaces will be created.
  o In this generally gaping type of wound, muscles, tendons, and nerves are typically involved.
  o Only a surgeon should attempt to close this type of wound.

If the wound is small, clean, and free from foreign bodies and signs of infection, steps should be taken to close it. All instruments should be checked, cleaned, and thoroughly sterilized. Use a good light and position the patient on the table so that access to the wound will be unhindered.

The area around the wound should be cleansed and then prepared with an antiseptic. The wound area should be draped, whenever possible, to maintain a sterile field in which the HM will work. The HM should wear a cap and mask, scrub hands and forearms, and wear sterile gloves.

SUTURE MATERIALS

In modern surgery, many kinds of ligature and suture materials are used. All can be grouped into two classes: non-absorbable sutures and absorbable sutures.

Non-Absorbable Sutures

These are sutures that cannot be absorbed by the body cells and fluids in which they are embedded during the healing process. When used as buried sutures, these sutures become surrounded or encapsulated in fibrous tissue and remain as innocuous foreign bodies. When used as skin sutures, they are removed after the skin has healed. The most commonly used sutures of this type and the characteristics associated with each are listed below.

• Silk frequently reacts with tissue and can be "spit" from the wound.
• Cotton loses tensile strength with each autoclaving.
• Linen is better than silk or cotton but is more expensive and not as readily available.
• Synthetic materials (e.g., nylon, dermalon) are excellent, particularly for surface use. They cause very little tissue reaction; however, there is a tendency for the knots to come untied. Because of this tendency, most surgeons tie 3 to 4 square knots in each such suture. Nylon is preferred over silk for face and lip areas because silk too often causes tissue reactions.
• Rust-proof metal (usually stainless steel wire) has the least tissue reaction of all suture materials and is by far the strongest. The primary problems associated with it are that it is more difficult to use because it kinks and that it must be cut with wire cutters.
Absorbable Sutures

These are sutures that are absorbed or digested during and after the healing processes by the body cells and tissue fluids in which they are embedded. It is this characteristic that enhances their use beneath the skin surfaces and on mucous membranes.

Surgical gut fulfills the requirements for the perfect suture ease of manufacture, tensile strength, and variety available more often than any other material.

- Manufacture of catgut: Though it is referred to as "catgut," surgical gut is derived from the submucosal connective tissue of the first one-third (about 8 yards) of the small intestine of healthy government-inspected sheep. The intestine of the sheep has certain characteristics that make it especially adaptable for surgical use. Among these characteristics are its uniformly fine-grained tissue structure and its great tensile strength and elasticity.

- Tensile strength of catgut: This suture material is available in sizes of 6-0 to 0 and 1 to 4, with 6-0 being the smallest diameter and 4 being the largest. The tensile strength increases with the diameter of the suture.

- Varieties of catgut: Surgical gut varies from plain catgut (the raw gut that has been gauzed, polished, sterilized, and packaged) to chromic catgut (that has undergone various intensities of tanning with one of the salts of chromic acid to delay tissue absorption time). Some examples of these variations and their absorption times follow in Table 21-4.

<table>
<thead>
<tr>
<th>Type Gut</th>
<th>Absorption Time</th>
</tr>
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<tbody>
<tr>
<td>A: Plain</td>
<td>10 days</td>
</tr>
<tr>
<td>B: Mild</td>
<td>20 days</td>
</tr>
<tr>
<td>C: Medium</td>
<td>30 days</td>
</tr>
<tr>
<td>D: Extra</td>
<td>40 days</td>
</tr>
</tbody>
</table>

Table 21-4.—Absorption Times of Various Types of Surgical Gut

SUTURE NEEDLES

Suture needles may be straight or curved, and they may have either a tapered round point or a cutting edge point. They vary in length, curvature, and diameter for various types of suturing. Specific characteristics of suture needles are listed below.

- **Size:** Suture needles are sized by diameter and are available in many sizes
- **Taper point:** Most often used in deep tissues, this type needle causes minimal amounts of tissue damage
- **Cutting edge point:** This type needle is preferred for suturing the skin because of the needle's ability to penetrate the skin's toughness
- **Atraumatic (atraloc, wedged):** These needles may either have a cutting edge or a taper point. Additionally, the suture may be fixed on the end of the needle by the manufacturer to cause the least tissue trauma

PREPARATION OF CASUALTY

Before suturing the wound(s) of any casualty, the following steps should be taken to prepare the casualty.

1. Examine the casualty carefully to determine what materials are needed to properly close the wound.
   a. Select and prepare sterile instruments, needles, and suture materials.
   b. Position the patient securely so that access to the wound and suture tray is optimal. It is normally not necessary to restrain patients for suturing.
   c. Make sure a good light is available.

2. Strictly observe **aseptic** wound preparation. Use mask, cap, and gloves. Thorough cleaning and proper draping are essential.
3. Select an anesthetic with care. Consider the patient’s tolerance to pain, time of injury, medications the patient is taking or has been given, and the possible distortion of the tissue when the anesthetic are infiltrated.

Selection of Anesthesia

The most common local anesthetic used is Xylocaine, which comes in various strengths (0.5%, 1%, and 2%) and with or without epinephrine. Injectables containing epinephrine must never be used on the fingers, toes, ears, nose, or any other appendage with small vessels because of the vasoconstricting effect of the epinephrine which would eliminate blood flow causing tissue death in these areas. Epinephrine is also contraindicated in patients with hypertension, diabetes, or heart disease.

The three methods of anesthesia administration are topical, local infiltration, and nerve block. Topical anesthetics are generally reserved for ophthalmic or plastic surgery and nerve blocks are generally accomplished by an anesthesiologist or nurse anesthetist for the surgical patient. For HMs, topical anesthesia is limited to the instillation of eye drops for mild corneal abrasions after all foreign bodies have been removed. DO NOT attempt to remove embedded foreign bodies. Nerve blocks are limited to digital blocks wherein the nerve trunks that enervate the fingers or toes are anesthetized. The most common method of anesthesia used by HMs is the infiltration of the anesthetizing agent around a wound or minor surgical site.

Administration of Anesthesia

Performing a digital block is a fairly simple procedure, but it should not be attempted except under the supervision of a medical officer or after a great deal of practice. The first step is cleansing the injection site with an antiseptic solution.

The anesthetizing agent is then infiltrated into the lateral and medial aspects at the base of the digit with a small bore needle (25- or 26-gauge), taking care not to inject into the veins or arteries. Proper placement of the anesthesia should result in a loss of sensitivity in a few minutes. This is tested by asking if the patient can distinguish a sharp sensation or pain when a sharp object is gently applied to the skin.

Administering local anesthesia is similar except the HM is anesthetizing nerves immediately adjacent to where the work will be done instead of nerve trunks. There are two generally accepted methods of infiltrating the anesthesia. One is through the skin surrounding the margin of the wound and the other is through the wound into the surrounding tissue. In either case, sufficient quantities must be infiltrated to affect anesthesia approximately ½ inch around the wound, taking care not to inject into a vein or artery.

CAUTION: The maximum recommended amount of Xylocaine to be used is 50 ml for a 1% solution or the equivalent.

GENERAL PRINCIPLES OF WOUND SUTURING

Wounds are closed either primarily or secondarily. A primary closure takes place within a short time of when the wound occurs, and it requires minimal cleaning and preparation. A secondary closure, on the other hand, occurs when there is a delay of the closure for up to several days after the wound's occurrence. A secondary closure requires a more complex procedure. Wounds 6 to 14 hours old may be closed primarily if they are not grossly contaminated and are meticulously cleaned. Wounds 14 to 24 hours old should not be closed primarily. When reddening and edema of the wound margins, discharge of pus, persistent fever, or toxemia are present, do not close the wound.
Do not use a primary closure for a large, gaping, soft-tissue wound. This type of wound will require warm dressings and irrigations, along with aseptic care for 3 to 7 days to clear up the wound. Then a secondary wound closure may be performed.

The steps to perform a delayed wound closure are outlined below:

1. Debride the wound area and convert circular wounds to elliptical ones before suturing. Circular wounds cannot be closed with satisfactory cosmetic results.

2. Try to convert a jagged laceration to one with smooth edges before suturing it. Make sure that not too much skin is trimmed off; that would make the wound difficult to approximate.

3. Use the correct technique for placing sutures. The needle holder is applied at approximately one-quarter of the distance from the blunt end of the needle. Suturing with a curved needle is done toward the person doing the suturing. Insert the needle into the skin at a 90° angle, and sweep it through in an arc-like motion, following the general arc of the needle.

4. Carefully avoid bruising the skin edges being sutured. Use Adson forceps and very lightly grasp the skin edges. It is unsafe to use dressing forceps while suturing. Since there are no teeth on the grasping edges of the dressing forceps, the force required to hold the skin firmly may be enough to cause necrosis.

5. Do not put sutures in too tightly. Gentle approximation of the skin is all that is necessary. Remember that postoperative edema will occur in and about the wound, making sutures tighter. Figure 21-4 illustrates proper wound-closure techniques.

6. If there is a significant chance that the sutured wound may become infected (e.g., bites, delayed closure, gross contamination), place an iodoform (anti-infective) wick in the wound. Or place a small rubber drain in the wound, and remove the drain in 48 hours.

7. When suturing, the best cosmetic effect is obtained by using numerous interrupted simple sutures placed 1/8 inch apart. Where cosmetic result is not a consideration, sutures may be slightly farther apart. Generally, the distance of the needle bite from the wound edges should be equal to the distance between sutures.

8. When subcutaneous sutures are needed, it is proper to use 4-0 chromic catgut.

9. When deciding the type of material to use on skin, use the finest diameter that will satisfactorily hold the tissues. Table 21-5 provides guidance as to the best suture to use in selected circumstances.
10. When cutting sutures, subcutaneous catgut should have a 1/16-inch tail. Silk skin sutures should be cut as short as is practical for removal on the face and lip. Elsewhere, skin sutures may have longer tails for convenience. A tail over ¼-inch is unnecessary, however, and tends to collect exudate.

11. The following general rules can be used in deciding when to remove sutures:

a. Face: As a general rule, 4 or 5 days. Better cosmetic results are obtained by removing every other suture and any suture with redness around it on the third day and the remainder on the fifth day.

b. Body and scalp: 7 days.

c. Soles, palms, back, or over joints: 10 days, unless excess tissue reaction is apparent around the suture, in which case they should come out sooner.

d. Any suture with pus or infection around it should be removed immediately, since the suture's presence will make the infection worse.

e. When wire is used, it may be left in safely for 10 to 14 days.

Table 21-5.—Suture Size by Location

<table>
<thead>
<tr>
<th>Suture Size</th>
<th>Suture Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-0</td>
<td>Can be used to suture in G-Tube or Chest Tube</td>
</tr>
<tr>
<td>3-0</td>
<td>Skin: Foot&lt;br&gt;Deep: Chest, Abdomen, Back</td>
</tr>
<tr>
<td>4-0</td>
<td>Skin: Scalp, Chest, Abdomen, Foot, Extremity&lt;br&gt;Deep: Scalp, Extremity, Foot</td>
</tr>
<tr>
<td>5-0</td>
<td>Skin: Scalp, Brow, Oral, Chest, Abdomen, Hand, Penis</td>
</tr>
<tr>
<td>6-0</td>
<td>Skin: Ear, Lid, Brow, Nose, Lip, Face, Penis</td>
</tr>
<tr>
<td>7-0</td>
<td>Skin: Eyelid, Lip, Face</td>
</tr>
</tbody>
</table>

MANAGEMENT OF MUSCULOSKELETAL INJURIES

LEARNING OBJECTIVE:

Select the appropriate stabilization and treatment procedure for the management of bone injuries.

BONE INJURIES

A break in the bone is known as a fracture. There are two main kinds of fractures. A closed fracture is one in which the injury is entirely internal; the bone is broken but there is no break in the skin. An open fracture is one in which there is an open wound in the tissues and the skin. Sometimes the open wound is made when a sharp end of the broken bone pushes out through the flesh; sometimes it is made by an object such as a bullet that penetrates from the outside.

Open fractures are more serious than closed fractures. They typically involve extensive damage to the tissues and are quite likely to become infected. Closed fractures are sometimes turned into open fractures by rough or careless handling of the casualty.

It is not always easy to recognize a fracture. All fractures, whether closed or open, are likely to cause severe pain and shock; but the other symptoms may vary considerably. A broken bone sometimes causes the injured part to be deformed or to assume an unnatural position. Pain, discoloration, and swelling may be localized at the fracture site, and there may be wobbly movements if the bone is broken clear through.

It may be difficult or impossible for the casualty to move the injured part; if able to move it, there may be a grating sensation (crepitus) as the ends of the broken bone rub against each other. However, if a bone is cracked rather than broken through, the casualty may be able to move the injured part without much difficulty.
An open fracture is easy to recognize if an end of the broken bone protrudes through the flesh. If the bone does not protrude, however, the HM might see the external wound but fail to recognize the broken bone.

**General Guidelines**

If required to give first aid to a person who has suffered a fracture, follow these general guidelines:

- If there is any possibility that a fracture has been sustained, treat the injury as a fracture until an X-ray can be made.
- Get the casualty to a definitive care facility at the first possible opportunity. All fractures require medical treatment.
- Do not move the casualty until the injured part has been immobilized by splinting (unless the move is necessary to save life or to prevent further injury).
- Treat for shock.
- Do not attempt to locate a fracture by grating the ends of the bone together.
- Do not attempt to set a broken bone unless a medical officer will not be available for many days.
- When a long bone in the arm or leg is fractured, the limb should be carefully straightened so that splints can be applied, unless it appears that further damage will be caused by such a maneuver.
  - Never attempt to straighten the limb by applying force or traction with any improvised device.
  - Pulling gently along the long axis of the limb is permissible and may be all that is necessary to get the limb back into position.
- Apply splints.
  - If the casualty is to be transported only a short distance, or if treatment by a medical officer will not be delayed, it is best to leave the clothing on and place emergency splinting over it.
  - If the casualty must be transported for some distance, or if a considerable period of time will elapse before treatment by a medical officer, it may be better to remove enough clothing to apply well padded splints directly to the injured part.
    - To remove clothing over the injured part, cut the clothing or rip it along the seams.
    - In any case, be careful! Rough handling of the casualty may convert a closed fracture into an open fracture, increase the severity of shock, or cause extensive damage to the blood vessels, nerves, muscles, and other tissues around the broken bone.
- If the fracture is open.
  - Take care of the wound before dealing with the fracture.
  - Bleeding from the wound may be profuse, but most bleeding can be stopped by direct pressure on the wound.
  - Other supplemental methods of hemorrhage control were discussed in the section on wounds of this chapter. Use a tourniquet as a last resort.
  - After the bleeding has been stopped, treat the fracture.

Now that the general rules for treating fractures have been reviewed, please read on regarding the symptoms and emergency treatment of specific fracture sites.

**Forearm Fracture**

There are two long bones in the forearm, the radius and the ulna. When both are broken, the arm may appear to be deformed. When only one is broken, the other acts as a splint and the arm retains a more or less natural appearance. Any fracture of the forearm is likely to result in pain, tenderness, inability to use the forearm, and a kind of wobbly motion at the point of injury. If the fracture is open, a bone will show through.
If the fracture is open, stop the bleeding and treat the wound. Apply a sterile dressing over the wound. Carefully straighten the forearm. Remember that rough handling of a closed fracture may turn it into an open fracture. Apply a pneumatic splint if available; if not, apply two well-padded splints to the forearm, one on the top and one on the bottom. Be sure that the splints are long enough to extend from the elbow to the wrist. Use bandages to hold the splints in place. Put the forearm across the chest. The palm of the hand should be turned in, with the thumb pointing upward. Support the forearm in this position by means of a wide sling and a cravat bandage, as shown in Figure 21-5. The hand should be raised about 4 inches above the level of the elbow. Treat the casualty for shock and evacuate as soon as possible.

NOTE:
Treatment of the fracture depends partly upon the location of the break.

If the fracture is in the upper part of the arm near the shoulder, place a pad or folded towel in the armpit, bandage the arm securely to the body, and support the forearm in a narrow sling (Fig. 21-6).

Upper Arm Fracture

The signs of fracture of the upper arm include pain, tenderness, swelling, and a wobbly motion at the point of fracture. If the fracture is near the elbow, the arm is likely to be straight with no bend at the elbow.

If the fracture is open, stop the bleeding and treat the wound before attempting to treat the fracture.
If the fracture is at or near the elbow, the arm may be either bent or straight. No matter in what position the arm is found, DO NOT ATTEMPT TO STRAIGHTEN IT OR MOVE IT IN ANY WAY. Splint the arm as carefully as possible in the position in which found. This will prevent further nerve and blood vessel damage. The only exception to this is if there is no pulse distal to the fracture, in which case gentle traction is applied and then the arm is splinted. Treat the casualty for shock and get him under the care of a medical officer as soon as possible.

Femur Fracture

The femur is the long bone of the upper part of the leg between the kneecap and the pelvis. When the femur is fractured through, any attempt to move the limb results in a spasm of the muscles and causes excruciating pain. The leg has a wobbly motion, and there is complete loss of control below the fracture. The limb may assume an unnatural position, with the toes pointing outward. By actual measurement, the fractured leg is shorter than the uninjured one because of contraction of the powerful thigh muscles. Serious damage to blood vessels and nerves often results from a fracture of the femur, and shock is likely to be severe.

If the fracture is open, stop the bleeding and treat the wound before attempting to treat the fracture itself. Serious bleeding is a special danger in this type of injury, since the broken bone may tear or cut the large femoral artery in the thigh.

Carefully straighten the leg. Apply two splints, one on the outside of the injured leg and one on the inside. The outside splint should reach from the armpit to the foot. The inside splint should reach from the crotch to the foot. The splints should be fastened in five places: (1) around the ankle; (2) over the knee; (3) just below the hip; (4) around the pelvis; and (5) just below the armpit. The legs can then be tied together to support the injured leg as firmly as possible.

It is essential that a fractured thigh be splinted before the casualty is moved. Manufactured splints, such as the Hare or the Thomas half-ring traction splints are best, but improvised splints may be used. Remember, DO NOT MOVE THE CASUALTY UNTIL THE INJURED LEG HAS BEEN IMMOBILIZED. Treat the casualty for shock, and evacuate at the earliest possible opportunity.

Lower Leg Fracture

When both bones of the lower leg are broken, the usual signs of fracture are likely to be present. When only one bone is broken, the other one acts as a splint and, to some extent, prevents deformity of the leg. However, tenderness, swelling, and pain at the point fracture are almost always present. A fracture just above the ankle is often mistaken for a sprain. If both bones of the lower leg are broken, an open fracture is very likely to result.

If the fracture is open, stop the bleeding and treat the wound. Carefully straighten the injured leg. Apply a pneumatic splint if available; if not, apply three splints, one on each side of the leg and one underneath (Fig. 21-7). Be sure that the splints are well padded, particularly under the knee and at the bones on each side of the ankle.

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A pillow and two side splints work very well for treatment of a fractured lower leg. Place the pillow beside the injured leg, then carefully lift the leg and place it in the middle of the pillow. Bring the edges of the pillow around to the front of the leg and pin them together. Then place one splint on each side of the leg (over the pillow), and fasten them in place with strips of bandage or adhesive tape. Treat the casualty for shock and evacuate as soon as possible. When available, use the Hare or Thomas half-ring traction splints.

Kneecap Fracture

Carefully straighten the injured limb. Immobilize the fracture by placing a padded board under the injured limb. The board should be at least 4 inches wide and should reach from the buttock to the heel. Place extra padding under the knee and just above the heel. Use strips of bandage to fasten the leg to the board in four places: (1) just below the knee; (2) just above the knee; (3) at the ankle; and (4) at the thigh. Do not cover the knee itself. Swelling is likely to occur very rapidly, and any bandage or tie fastened over the knee would quickly become too tight. Treat the casualty for shock and evacuate as soon as possible.

Clavicle Fracture

A person with a fractured clavicle shows definite symptoms. When the casualty stands, the injured shoulder is lower than the uninjured one. The casualty is usually unable to raise the arm above the level of the shoulder and may attempt to support the injured shoulder by holding the elbow of that side in the other hand. This is the characteristic position of a person with a broken clavicle. Since the clavicle lies immediately under the skin, it may be possible to detect the point of fracture by the deformity and localized pain and tenderness.

If the fracture is open, stop the flow of blood and treat the wound before attempting to treat the fracture. Then apply a sling and swathe splint as described below. Bend the casualty’s arm on the injured side, and place the forearm across the chest. The palm of the hand should be turned in, with the thumb pointed up. The hand should be raised about 4 inches above the level of the elbow. Support the forearm in this position by means of a wide sling. A wide roller bandage (or any wide strip of cloth) may be used to secure the casualty’s arm to the body. A figure-eight bandage may also be used for a fractured clavicle. Treat the casualty for shock and evacuate to a definitive care facility as soon as possible.

Rib Fracture

If a rib is broken, make the casualty comfortable and quiet so that the greatest danger the possibility of further damage to the lungs, heart, or chest wall by the broken ends is minimized.

The common finding in all casualties with fractured ribs is pain localized at the site of the fracture. By asking the patient to point out the exact area of the pain, the location of the injury can be determined. There may or may not be a rib deformity, chest wall contusion, or laceration of the area. Deep breathing, coughing, or movement is painful. The patient generally wishes to remain still and may often lean toward the injured side, with a hand over the fractured area to immobilize the chest and to ease the pain.

Ordinarly, rib fractures are not bound, strapped, or taped if the casualty is reasonably comfortable. However, they may be splinted by the use of external support. If the patient is considerably more comfortable with the chest immobilized, the best method is to use a swathe in which the arm on the injured side is strapped to the chest to limit motion. Place the arm on the injured side against the chest, with the palm flat, thumb up, and the forearm raised to a 45° angle. Immobilize the chest, using wide strips of bandage to secure the arm to the chest.

Do not use wide strips of adhesive plaster applied directly to the skin of the chest for immobilization since the adhesive tends to limit
the ability of the chest to expand (interfering with proper breathing). Treat the casualty for shock and evacuate as soon as possible.

**Nose Fracture**

A fracture of the nose causes localized pain and swelling, a noticeable deformity of the nose, and extensive nosebleed.

Stop the nosebleed. Have the casualty sit quietly, with the head tipped slightly backward. Tell the casualty to breathe through the mouth and not to blow the nose. If the bleeding does not stop within a few minutes, apply a cold compress or an ice bag over the nose.

Treat the casualty for shock. Ensure the casualty receives a medical officer’s attention as soon as possible. Permanent deformity of the nose may result if the fracture is not treated promptly.

**Jaw Fracture**

A person who has a fractured jaw may suffer serious interference with breathing. There is likely to be great difficulty in talking, chewing, or swallowing. Any movement of the jaw causes pain. The teeth may be out of line, and there may be bleeding from the gums. Considerable swelling may develop.

One of the most important phases of emergency care is to clear the upper respiratory passage of any obstruction. If the fractured jaw interferes with breathing, pull the lower jaw and the tongue well forward and keep them in that position, jaw thrust position.

Apply a four-tailed bandage (also known as a Barton bandage). Be sure that the bandage pulls the lower jaw forward. Never apply a bandage that forces the jaw backward, since this might seriously interfere with breathing. The bandage must be firm so that it will support and immobilize the injured jaw, but it must not press against the casualty’s throat.

Be sure that the casualty has scissors or a knife to cut the bandage in case of vomiting. Treat the casualty for shock and evacuate as soon as possible.

**Skull Fracture**

When a person suffers a head injury, the greatest danger is that the brain may be severely damaged; whether or not the skull is fractured is a matter of secondary importance. In some cases, injuries that fracture the skull do not cause serious brain damage; but brain damage can and frequently does result from apparently slight injuries that do not cause damage to the skull itself.

It is often difficult to determine whether an injury has affected the brain because the symptoms of brain damage vary greatly. A person suffering from a head injury must be handled very carefully and given immediate medical attention.

Some of the symptoms that may indicate brain damage are listed below. Remember that all of these symptoms are not always present in any one case and that the symptoms that do occur may be greatly delayed.

- Bruises or wounds of the scalp may indicate that the casualty has sustained a blow to the head. Sometimes the skull is depressed (caved in) at the point of impact. If the fracture is open, there may be glass, shrapnel, or other objects penetrating the skull
- The casualty may be conscious or unconscious. If conscious, the casualty may feel dizzy and weak, as though about to faint
- Severe headache sometimes (but not always) accompanies head injuries
- The pupils of the eyes may be unequal in size and may not react normally to light
- There may be bleeding or cerebrospinal fluid (CSF) leakage from the ears, nose, or mouth
- The casualty may vomit
The casualty may be restless and perhaps confused and disoriented

The arms, legs, face, or other parts of the body may be partially paralyzed

The casualty’s face may be very pale, or it may be unusually flushed

The casualty is likely to be suffering from shock, but the symptoms of shock may be disguised by other symptoms

It is not necessary to determine if the skull is fractured when giving first aid to a person who has suffered a head injury. The treatment is the same in either case, and the primary intent is to prevent further damage to the brain.

Keep the casualty lying down. If the face is flushed, raise the head and shoulders slightly. If the face is pale, have the casualty lie so that the head is level with, or slightly lower than, the body. Watch carefully for vomiting. If the casualty begins to vomit, position the head to prevent choking on the vomitus.

If there is serious bleeding from the wounds, try to control that bleeding by the application of direct pressure, using caution to avoid further injury to the skull or brain. Use a donut-shaped bandage to gently surround protruding objects. Never manipulate those objects.

Be very careful about moving or handling the casualty. Move the casualty no more than is necessary. If transportation is necessary, keep the casualty lying down

In any significant head or facial injury, assume injury to the cervical spine. Immobilization of the cervical spine is indicated

Be sure that the casualty is kept comfortably warm, but not too warm

Do not give the casualty anything to drink. DO NOT GIVE ANY MEDICATIONS. See that the casualty receives a medical officer’s attention as soon as possible

**Spinal Fractures**

If the spine is fractured at any point, the spinal cord may be crushed, cut, or otherwise damaged so severely that death or paralysis will result. However, if the fracture occurs in such a way that the spinal cord is not seriously damaged, there is a very good chance of complete recovery, provided that the casualty is properly cared for. Any twisting or bending of the neck or back whether due to the original injury or carelessness from handling later is likely to cause irreparable damage to the spinal cord.

The primary symptoms of a fractured spine are pain, shock, and paralysis. Pain is likely to be acute at the point of fracture. It may radiate to other parts of the body. Shock is normally severe, but (as in all injuries) the symptoms may be delayed for some time. Paralysis occurs if the spinal cord is seriously damaged. If the casualty cannot move the legs, feet, or toes, the fracture is probably in the back; if the fingers will not move, the neck is probably broken. Remember that a spinal fracture does not always injure the spinal cord, so the casualty is not always paralyzed. Any person who has an acute pain in the back or the neck following an injury should be treated as though there is a fractured spine, even if there are no other symptoms.

Emergency treatment for all spinal fractures, whether of the neck or of the back, has two primary purposes: (1) to minimize shock, and (2) to prevent further injury to the spinal cord. Keep the casualty comfortably warm. Do not attempt to keep the casualty in the position ordinarily used for the treatment of shock, because it might cause further damage to the spinal cord. Just keep the casualty lying flat and do NOT attempt to lower the head.
To avoid further damage to the spinal cord, DO NOT MOVE THE CASUALTY UNLESS IT IS ABSOLUTELY ESSENTIAL! If the casualty’s life is threatened in the present location or transportation is necessary to receive medical attention, then, of course, the HM must move the casualty. However, if movement is necessary, be sure that the HMs do it in a way that will cause the least possible damage.

- **DO NOT BEND OR twist THE CASUALTY S BODY**
- **DO NOT MOVE THE HEAD FORWARD, BACKWARD, OR SIDEWAYS**
- **DO NOT UNDER ANY CIRCUMSTANCES ALLOW THE CASUALTY TO SIT UP**

If it is necessary to transport a person who has suffered a spinal fracture, has a suspected spinal fracture, or the MOI indicates a high IOS of spinal fracture follow these general rules:

- Assume that the patient has a cervical fracture which has the most potential for negative outcomes (i.e. quadriplegic on a ventilator)
- Transport patient lying on the back, face up
- Place pillows or sandbags beside the head so that it cannot turn to either side. DO NOT put pillows or padding under the neck or head
- No matter where the spine is broken, use a firm support in transporting the casualty; use a rigid stretcher, or a door, shutter, wide board, etc.
- Pad the support carefully, and put blankets both under and over the casualty
- Use cravat bandages or strips of cloth to secure the casualty firmly to the support

- When placing the casualty on a spine board, one of two acceptable methods may be used
  - **DO NOT ATTEMPT TO LIFT/ROLL THE CASUALTY UNLESS ADEQUATE ASSISTANCE IS AVAILABLE**
  - Remember: Any bending or twisting of the body is almost sure to cause serious damage to the spinal cord
  - One person lifts and supports the head while two other persons each lift at the shoulders and hips, respectively
  - A fourth person aligns the spine board next to the patient
  - The casualty is log rolled as a single unit towards the rescuers. It is critical that the head is kept aligned with the neck and the rest of the body
  - The spine board is positioned, the casualty is rolled back onto the spine board and both are lowered gently to the ground, and then the patient is secured in place
  - If there are at least four (preferably six) people present to help lift/roll the casualty, they can accomplish the job without too much movement of the casualty’s body
  - **NEVER** attempt to lift/roll the casualty, however, with fewer than four people

- Evacuate the casualty very carefully

**Pelvic Fracture**

Fractures in the pelvic region often result from falls, heavy blows, and accidents that involve crushing. The great danger in a pelvic fracture is that the organs enclosed and protected by the pelvis may be seriously damaged when the bony structure is fractured. In particular, there is danger that the bladder will be ruptured. There is also danger of severe internal bleeding; the large blood vessels in the pelvic region may be torn or cut by fragments of the broken bone.
The primary symptoms of a fractured pelvis are severe pain, shock, and loss of ability to use the lower part of the body. The casualty is unable to sit or stand. If the casualty is conscious, there may be a sensation of "coming apart.” If the bladder is injured, the casualty’s urine may be bloody.

**Do not move the casualty unless ABSOLUTELY necessary.** The casualty should be treated for shock and kept warm but should not be moved into the position ordinarily used for the treatment of shock.

If the HM must transport the casualty to another place, do it with the utmost care. Use a rigid stretcher, a padded door, or a wide board. Keep the casualty supine. In some cases, the casualty will be more comfortable if the legs are straight, while in other cases the casualty will be more comfortable with the knees bent and the legs drawn up.

When the casualty is in the most comfortable position, immobilization should be accomplished. Fractures of the hip are best treated with traction splints. Adequate immobilization can also be obtained by placing pillows or folded blankets between the legs and using cravats, roller bandages, or straps to hold the legs together, or through the use of MAST garments. Then, fasten the casualty securely to the stretcher or improvised support, and evacuate very carefully.

**JOINT AND MUSCLE INJURIES**

Injuries to joints and muscles often occur together, and it is sometimes difficult to tell whether the primary injury is to a joint or to the muscles, tendons, blood vessels, or nerves near the joint. Sometimes it is difficult to distinguish joint or muscle injuries from fractures. In case of doubt, always treat any injury to a bone, joint, or muscle as though it were a fracture.

In general, joint and muscle injuries may be classified under four headings:

- **Dislocations**
- **Sprains**
- **Strains**
- **Contusions (bruises)**

**Dislocations**

When a bone is forcibly displaced from its joint, the injury is known as a **dislocation**. In some cases, the bone slips back quickly into its normal position, but at other times it becomes locked in the new position and remains dislocated until it is put back into place. Dislocations are typically caused by falls or blows but occasionally by violent muscular exertion. The most frequently dislocated joints are those of the shoulder, hip, fingers, and jaw.

A dislocation is likely to bruise or tear the muscles, ligaments, blood vessels, tendons, and nerves near a joint. Rapid swelling and discoloration, loss of ability to use the joint, severe pain and muscle spasms, possible numbness and loss of pulse below the joint, and shock are characteristic symptoms of dislocations. The fact that the injured part is stiff and immobile, with marked deformation at the joint, will help to distinguish a dislocation from a fracture. In a fracture, there is deformity between joints rather than at joints, and there is generally a wobbly motion of the broken bone at the point of fracture.

As a general rule do not attempt to reduce a dislocation, to put a dislocated bone back into place, unless it is known that a medical officer cannot be reached within 8 hours. Unskilled attempts at reduction may cause great damage to nerves and blood vessels or actually fracture the bone. Therefore, except in great emergencies, HMs should leave this treatment to specially trained medical personnel and concentrate their efforts on making the casualty as comfortable as possible under the circumstances.
The following emergency measures will be helpful:

1. Loosen the clothing around the injured part.
2. Place the casualty in the most comfortable position possible.
3. Support the injured part by means of a sling, pillows, bandages, splints, or any other device that will make the casualty comfortable.
4. Treat the casualty for shock.
5. Get medical help as soon as possible.

HMs should NEVER attempt to reduce the more serious dislocations, such as those of the hip. However, if it is probable that the casualty cannot be treated by a medical officer within a reasonable time, the HM should make a careful effort to reduce certain dislocations (such as those of the jaw, finger, or shoulder) if there is no arterial or nerve involvement (pulse will be palpable and there will be no numbness below the joint). Treat all other dislocations as fractures, and evacuate the casualty to a definitive care facility.

**DISLOCATION OF THE JAW.**—When the lower jaw is dislocated, the casualty cannot speak or close the mouth. Dislocation of the jaw is typically caused by a blow to the mouth; sometimes it is caused by yawning or laughing. This type of dislocation is not always easy to reduce, and there is considerable danger that the operator’s thumbs will be bitten in the process.

For protection, wrap the thumbs with a handkerchief or bandage. While facing the casualty, the HM should press the thumbs down just behind the last lower molars and, at the same time, lift the chin up with the fingers. The jaw should snap into place at once. The HM will have to remove the thumbs quickly to avoid being bitten. No further treatment is required, but warn the casualty to keep the mouth closed as much as possible during the next few hours.

**DISLOCATION OF THE FINGER.**—The joints of the finger are particularly susceptible to injury, and even minor injuries may result in prolonged loss of function. Great care must be used in treating any injury of the finger.

To reduce a dislocation of the finger, grasp the finger firmly and apply a steady pull in the same line as the deformity. If it does not slip into position, try it again, but if it does not go into position on the third attempt, DO NOT TRY AGAIN. In any case, and whether or not the dislocation is reduced, the finger should be strapped, slightly flexed, with an aluminum splint or with a roller gauze bandage over a tongue blade. A dislocated finger can be immobilized by strapping it to a flat, wooden stick, such as a tongue depressor.

**DISLOCATION OF THE SHOULDER.**—Before reduction, place the casualty in a supine position. After putting the heel of a foot in the casualty’s armpit, grasp the wrist and apply steady traction by pulling gently and increasing resistance gradually. Pull the arm in the same line as it is found. After several minutes of steady pull, flex the casualty’s elbow slightly. Grasp the arm below the elbow, apply traction from the point of the elbow, and gently rotate the arm into the external or outward position. If three reduction attempts fail, carry the forearm across the chest and apply a sling and swathe.

An alternate method involves having the patient lie face down on an examining table with the injured arm hanging over the side. Apply prolonged, firm, gentle traction at the wrist with gentle external rotation. A water bucket with a padded handle placed in the crook of the patient’s elbow may be substituted. Gradually add sand or water to the bucket to increase traction. Grasping the wrist and using the elbow as a pivot point, gently rotate the arm into the external position.
Sprains

Sprains are injuries to the ligaments and soft tissues that support a joint. A sprain is caused by the violent wrenching or twisting of the joint beyond its normal limits of movement and involves a momentary dislocation, with the bone slipping back into place of its own accord. Although any joint may be sprained, sprains of the ankle, wrist, knee, and finger are most common.

Symptoms of a sprain include pain or pressure at the joint, pain upon movement, swelling and tenderness, possible loss of movement, and discoloration. Treat all sprains as fractures until ruled out by X-rays.

Emergency care for a sprain includes application of cold packs for the first 24 to 48 hours to reduce swelling and to control internal hemorrhage; elevation and rest of the affected area; application of a snug, smooth, figure-eight bandage to control swelling and to provide immobilization (basket weave adhesive bandages can be used on the ankle); a follow-up examination by a medical officer; and X-rays to rule out the presence of a fracture.

NOTE:
Check bandaged areas regularly for swelling that might cause circulation impairment and loosen bandages if necessary.

After the swelling stops (24 to 48 hours), moist heat can be applied for short periods (15 to 30 minutes) to promote healing and reduce swelling. Moist heat can be warm, wet compresses, warm whirlpool baths, etc.

CAUTION:
Heat should not be applied until 24 hours after the last cold pack.

Strains

Injuries caused by the forcible overstretching or tearing of muscles or tendons are known as strains. Strains may be caused by lifting excessively heavy loads, sudden or violent movements, or any other action that pulls the muscles beyond their normal limits.

The chief symptoms of a strain are pain, lameness or stiffness (sometimes involving knotting of the muscles), moderate swelling at the place of injury, discoloration due to the escape of blood from injured blood vessels into the tissues, possible loss of power, and a distinct gap felt at the site.

Keep the affected area elevated and at rest. Apply cold packs for the first 24 to 48 hours to control hemorrhage and swelling. After the swelling stops, apply mild heat to increase circulation and aid in healing. As in sprains, heat should not be applied until 24 hours after the last cold pack. Muscle relaxants, adhesive straps, and complete immobilization of the area may be indicated. Evacuate the casualty to a medical facility where X-rays can be taken to rule out the presence of a fracture.

Contusions

Contusions, commonly called bruises, are responsible for the discoloration that almost always accompanies injuries to bones, joints, and muscles. Contusions are caused by blows that damage bones, muscles, tendons, blood vessels, nerves, and other body tissues. They do not necessarily break the skin.

The symptoms of a contusion or bruise are familiar to everyone. There is immediate pain when the blow is received. Swelling occurs because blood from the broken vessels leaks into the soft tissue under the skin. At first the injured place is reddened due to local skin irritation from the blow. Later the characteristic "black and blue" marks appear. Perhaps several days later, the skin turns yellowish or greenish before normal coloration returns. The bruised area may be very tender.

21-82
As a rule, slight bruises do not require treatment. However, if the casualty has severe bruises, treat for shock. Immobilize the injured part, keep it at rest, and protect it from further injury. Sometimes the casualty will be more comfortable if the bruised area is bandaged firmly with an elastic or gauze bandage. If possible, elevate the injured part. A sling may be used for a bruised arm or hand. Pillows or folded blankets may be used to elevate a bruised leg.

SPECIAL WOUNDS AND THEIR TREATMENT

LEARNING OBJECTIVE:

Describe medical precautions and wound-treatment procedures for the following list of wounds: eye wounds, head wounds, chest wounds, abdominal wounds, crushing injuries, animal bites, and the removal of foreign objects.

The HM should find most general wounds very easy to diagnose and treat. There are other wounds, however, that require special consideration and treatment. They are discussed below.

TREAT FOREIGN BODIES OF THE EYE

Scenario

The HM has a casualty with a foreign body in the eye. All other more serious injuries have been assessed and treated.

Objective

Treat foreign bodies of the eye, minimizing the effects of the injury, without causing additional injury to the eye.

Performance Steps

NOTE: Take Body Substance Isolation (BSI) precautions.

1. Perform visual acuity testing.
2. Assess eyes: pupils, equal and round, regular in size, and react to light (PEARRL).
3. Locate the foreign body.
   a. Method one.
      i. Pull the lower lid down.
      ii. Tell the casualty to look up and to both sides and check for foreign bodies.
      iii. Pull the upper lid up.
      iv. Tell the casualty to look down and to both sides and check for foreign bodies.
   b. Method two.
      i. Tell the casualty to look down.
      ii. Grasp the casualty's upper eyelashes and gently pull the eyelid away from the eyeball.
      iii. Place a cotton-tipped swab horizontally along the outer surface of the upper lid and fold the lid back over the swab.
      iv. Look for the foreign bodies or damage on the globe.

CAUTION: If the foreign bodies cannot be located, bandage both eyes and seek further medical aid immediately.
4. Remove the foreign body.

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<th>CAUTION:</th>
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<td>Do not put pressure on the globe.</td>
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a. Small foreign body on an anterior surface.
   i. Hold the casualty’s eye open.
   ii. Irrigate the eye.

b. Foreign body stuck to the cornea or lying under the upper or lower eyelid.
   i. For a foreign body under the lower eyelid, pull the lower lid down.
   ii. For a foreign body under the upper eyelid, pull the upper lid up.
   iii. Remove the foreign body with a moistened, sterile cotton-tipped swab.

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<th>CAUTION:</th>
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<tr>
<td>Bandage both eyes if foreign bodies are not easily removed by these methods or if there is pain or loss of vision in the eye. Seek further medical aid immediately.</td>
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<td>In hazardous conditions, leave the good eye uncovered long enough to ensure the casualty's safety.</td>
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</table>

c. Foreign body stuck or impaled in the eye.

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<tr>
<td>Do not attempt to remove a foreign body stuck to or sticking into the eyeball. A medical officer must remove such objects.</td>
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</table>

i. Apply dry sterile dressings to build around and support the object.

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<tr>
<td>This will help prevent further contamination and minimize movement of the object.</td>
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ii. Cover the injured eye with a paper cup or cardboard cone.

iii. Cover the uninjured eye with a dry dressing or eye patch.

iv. Reassure the casualty by explaining why both eyes are being covered.

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<th>NOTE:</th>
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<tr>
<td>The eyes move together. If the casualty uses (moves) the uninjured eye, the injured eye will move as well. Covering both eyes will keep them still and will prevent undue movement on the injured side. In hazardous conditions, leave the good eye uncovered long enough to ensure the casualty's safety.</td>
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</table>

d. Seek further medical aid immediately.

5. Obtain details about the injury.
   a. Source and type of the foreign bodies.
   b. Whether the foreign bodies were wind-blown or high velocity.
   c. Time of onset and length of discomfort.
   d. Any previous injuries to the eye.

6. Record the procedure

7. Do not cause additional injury to the eye.
   a. Do not probe for foreign bodies.
   b. Do not put pressure on the globe.
   c. Do not remove an impaled object.

8. Evacuate the casualty, as required.
CRUSH SYNDROME

When a casualty is crushed or trapped with compression on the extremities for a prolonged time, there is the possibility for crush syndrome (CS), characterized by ischemia and muscle damage (rhabdomyolysis). With rhabdomyolysis there is an efflux of potassium, nephrotoxic metabolites, myoglobin, purines, and phosphorous into the circulation, resulting in cardiac and renal dysfunction.

1. Recognition.
   a. History.
      i. Suspect in patients in whom there is a history of being trapped (e.g., urban operations, mountain operations, earthquakes, or bombings) for a prolonged period (from hours to days).
      ii. Clear history is not always available in combat, and the syndrome may appear insidiously in patients who initially appear well.
   b. Physical findings.
      i. A thorough examination must be done with attention to extremities, trunk, and buttocks. The physical findings depend on the duration of entrapment, treatment rendered, and time since the casualty’s release.
      ii. Extremities.
         1. May initially appear normal just after extrication.
         2. Edema develops and the extremity becomes swollen, cool, and tense.
         3. May have severe pain out of proportion to examination.
         4. Anesthesia and paralysis of the extremities, which can mimic a spinal cord injury with flaccid paralysis, but there will be normal bowel and bladder function.
      iii. Trunk/buttocks: may have severe pain out of proportion to examination.

THERAPY.—On scene while still trapped. The primary goal of therapy is to prevent acute renal failure in crush syndrome. Suspect, recognize, and treat rhabdomyolysis early in casualties of entrapment. Therapy should be initiated as soon as possible, preferably in the field, while the casualty is still trapped. Ideally it is recommended to establish IV access in a free arm or leg vein.

REMOVING FOREIGN OBJECTS

Many wounds contain foreign objects. Wood or glass splinters, bullets, metal fragments, bits of wire, fishhooks, nails, tacks, cinders, and small particles from grinding wheels are examples of the variety of objects or materials that are sometimes found in wounds. When such objects are near the surface and exposed, first aid treatment includes their removal.

However, first aid treatment does not include the removal of deeply embedded objects, powdered glass, or any widely scattered material of this nature. HMs should never attempt to remove bullets, but they should try to find out whether the bullet remains in the casualty. Look for both entrance and exit wounds. The general rule to remember is this:

NOTE:
Remove foreign objects from a wound when it can be done easily and without causing further damage; but NEVER HUNT FOR OR ATTEMPT TO REMOVE DEEPLY BURIED OR WIDELY SCATTERED OBJECTS OR MATERIALS, except in a definitive care environment.
The following procedure may be used to remove a small object from the skin or tissues if the object is near the surface and clearly visible:

1. Cleanse the skin around the object with soap and water and paint with any available skin antiseptic solution.

2. If necessary, pierce the skin with a sharp instrument; a needle, razor, or sharp knife that has been sterilized by passing it through a flame three or four times.

3. Grasping the object at the end, remove it. Tweezers, small pincers, or forceps may be used for this purpose. (Whatever instrument used should first be sterilized by boiling if at all possible.)

4. If the wound is superficial, apply gentle pressure to encourage bleeding.

5. Cover the wound with a dry, sterile dressing.

If the foreign object is under a fingernail or toenail, HMs may have to cut a V-shaped notch in the nail so that the object can be grasped by the forceps. Do not try to dig the object out from under the nail with a knife or similar instrument.

A curved or barbed object (such as a fishhook) may present special problems. Figure 21-8 shows one method of removing a fishhook that has become embedded in the flesh. As illustrated in Figure 21-8A, the barb on the hook prevents its direct removal. However, if the HM pushes the hook forward through the skin, as shown in Figure 21-8B, then the HM can clip off the barb with a wire cutter or similar tool, as shown in Figure 21-8C. The remainder of the fishhook can then be withdrawn in the manner indicated in Figure 21-8D.

**Figure 21-8.—Removing a Fishhook**

**ANIMAL BITES**

A special kind of infection that must be guarded against in case of animal bites is rabies (sometimes called "hydrophobia"). This disease is caused by a virus that is present in the saliva of infected animals. The disease occurs most commonly in wild animals, but it has been found in domestic animals and household pets. In fact, it is probable that all mammals are susceptible to it. The virus that causes rabies is ordinarily transmitted by a bite, but it can be transmitted by the saliva of an infected animal coming in contact with a fresh wound or with the thin mucous membrane of the lips or nose. The virus does not penetrate normal unbroken skin. If the skin is broken, DO NOT attempt wound closure.

If rabies develops in man, it is normally fatal. A preventive treatment is available and it is very effective, but only if it is started shortly after the bite. This treatment is outlined in BUMEDINST 6220.8 series, *Streptococcal Infection Control Program.*
Since the vaccine can be obtained only at a medical treatment facility or a major ship, any person bitten by an animal must be transferred quickly to the nearest treatment facility for evaluation, along with a complete report of the circumstances surrounding the incident. Remember, prevention is of utmost importance.

Immediate local treatment of the wound should be given. Wash the wound and the surrounding area carefully, using sterile gauze, soap, and sterile water. Use sterile gauze to dry the wound, and then cover the wound with a sterile dressing. DO NOT use any chemical disinfectant. Do not attempt to cauterize the wound in any way. All of the animal’s saliva must be removed from the casualty’s skin to prevent further contamination of the wound.

**CAUTION:**
DO NOT allow the animal’s saliva to come in contact with open sores or cuts on any exposed skin while providing patient care.

When a person has been bitten by an animal, every effort must be made to catch the animal and to keep it confined for a minimum of 8 to 10 days. DO NOT kill it if there is any possible chance of catching it alive. The symptoms of rabies are not always present in the animal at the time the bite occurs, but the saliva may nevertheless contain the rabies virus. It is essential; therefore, that the animal is kept under observation until a diagnosis can be made.

The rabies treatment is given if the animal develops any definite symptoms, if it dies during the observation period, or if for any reason the animal cannot be kept under observation. Remember that any animal bite is dangerous and MUST be evaluated at a treatment facility.

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**ENVIRONMENTAL INJURIES**

**LEARNING OBJECTIVES:**

*Explain the classification and evaluation process for burns.*

*Determine the appropriate treatment for each type of burn.*

Under the broad category of environmental injuries, HM’s will consider a number of emergency problems. Exposure to extremes of temperature, whether heat or cold, causes injury to skin, tissues, blood vessels, vital organs, and, in some cases, the whole body. In addition, contact with the sun’s rays, electrical current, or certain chemicals causes injuries similar in character to burns.

**THERMAL BURNS**

True burns are generated by exposure to extreme heat that overwhelms the body’s defensive mechanisms. Burns and scalds are essentially the same injury: Burns are caused by dry heat, and scalds are caused by moist heat. The seriousness of the injury can be estimated by the depth, extent, and location of the burn, the age and health of the casualty, and other medical complications.

**Classification of Severity**

Burns are classified according to their depth as first-, second-, and third-degree burns (Fig. 21-9).
FIRST-DEGREE BURN.—With a first-degree burn, the epidermal layer is irritated, reddened, and tingling. The skin is sensitive to touch and blanches with pressure. Pain is mild to severe, edema is minimal, and healing occurs naturally within a week.

SECOND-DEGREE BURN.—A second-degree burn is characterized by epidermal blisters, mottled appearance, and a red base. Damage extends into but not through the dermis. Recovery takes 2 to 3 weeks, with some scarring and depigmentation. This condition is painful. Body fluids may be drawn into the injured tissue, causing edema and possibly a "weeping" fluid (plasma) loss at the surface.

THIRD-DEGREE BURN.—A third-degree burn is a full-thickness injury penetrating into muscle and fatty connective tissues, or even down to the bone. Tissues and nerves are destroyed. Shock, with blood in the urine, is likely to be present. Pain will be absent at the burn site if all the area nerve endings are destroyed, and the surrounding tissue (which is less damaged) will be painful.

Tissue color will range from white (scalds) to black (charing burns). Although the wound is typically dry, body fluids will collect in the underlying tissue. If the area has not been completely cauterized, significant amounts of fluids will be lost by plasma "weeping" or by hemorrhage, thus reducing circulation volume. There is considerable scarring and possible loss of function. Skin grafts may be necessary.

Rule of Nines

Of greater importance than the depth of the burn in evaluating the seriousness of the condition is the extent of the burned area. A first-degree burn over 50 percent of the body surface area (BSA) may be more serious than a third-degree burn over 3 percent. The Rule of Nines is used to give a rough estimate of the surface area affected. Figure 21-10 shows how the rule is applied to adults.
**CHART FOR ESTIMATING SEVERITY OF BURN WOUND**

- **NAME**
- **WARD**
- **NUMBER**
- **DATE**
- **AGE**
- **ADMISSION WEIGHT**

**LUND AND BROWDER CHARTS**

- **REGION**
  - HEAD
  - NECK
  - ANT.TRUNK
  - POST.TRUNK
  - RIGHT ARM
  - LEFT ARM
  - BUTTOCKS
  - GENITALIA
  - RIGHT LEG
  - LEFT LEG
  - TOTAL BURN

**RELATIVE PERCENTAGE OF BODY SURFACE AREA AFFECTED BY GROWTH**

<table>
<thead>
<tr>
<th>AREA</th>
<th>AGE 0</th>
<th>1</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>ADULT</th>
</tr>
</thead>
<tbody>
<tr>
<td>A = 1/2 OF HEAD</td>
<td>9½</td>
<td>8½</td>
<td>6½</td>
<td>5½</td>
<td>4½</td>
<td>3½</td>
</tr>
<tr>
<td>B = 1/2 OF ONE THIGH</td>
<td>2½</td>
<td>3½</td>
<td>4</td>
<td>4½</td>
<td>4½</td>
<td>4½</td>
</tr>
<tr>
<td>C = 1/2 OF ONE LEG</td>
<td>2½</td>
<td>2½</td>
<td>2½</td>
<td>3</td>
<td>3½</td>
<td>3½</td>
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</tbody>
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The Lund and Browder chart for accurate assessment of the % BSA

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Figure 21-10.—Rule of Nines
Other Factors

A third factor in burn evaluation is the location of the burn. Serious burns of the head, hands, feet, or genitals will require hospitalization.

The fourth factor is the presence of any other complications, especially respiratory tract injuries or other major injuries or factors. The HM must take all these factors into consideration when evaluating the condition of the burn casualty, especially in a triage situation.

First Aid

1. After the casualty has been removed from the source of the thermal injury, first aid should be kept to a minimum.
2. Maintain an open airway.
3. Control hemorrhage, and treat for shock.
4. Remove constricting jewelry and articles of clothing.
5. Protect the burn area from contamination by covering it with clean sheets or dry dressings. DO NOT remove clothing adhering to a wound.
6. Splint fractures.
7. For all serious and extensive burns (over 20 percent BSA), and in the presence of shock, start intravenous therapy with an electrolyte solution (Ringer’s lactate) in an unburned area.
8. Maintain intravenous treatment during transportation.
   a. Pain resulting from small burns may be relieved with an anesthetic ointment if the skin is not broken.
   b. Relieve mild pain (as with first degree burns) with aspirin. Relieve moderate pain with cool, wet compresses or ice water immersion (for burns of less than 20 percent BSA).
   c. Severe pain may be relieved with morphine or Demerol® injections.

Aid Station Care

Once the casualty has arrived at the aid station, observe the following procedures.

1. Continue to monitor for airway patency, hemorrhage, and shock.
2. Continue intravenous therapy that is in place, or start a new one under a medical officer’s supervision to control shock and replace fluid loss.
3. Monitor urine output (UOP); at least 30cc/kg/hr is minimal output.
   a. Shave body hair well back from the burned area.
   b. Cleanse the area gently with disinfectant soap and warm water.
   c. Remove dirt, grease, and nonviable tissue.
   d. Apply a sterile dressing of dry gauze.
   e. Place bulky dressings around the burned parts to absorb serous exudates.
5. All major burn casualties should be given a booster dose of tetanus toxoid to guard against infection. Administration of antibiotics may be directed by a medical officer or an Independent Duty Corpsman.
6. If evacuation to a definitive care facility will be delayed for 2 to 3 days, start topical antibiotic therapy after the patient stabilizes and following debridement and wound care.
   a. Gently spread a 1/16-inch thickness of or Silvadene Cream® over the burn area.
   b. Repeat the application after 12 hours, and then after daily debridement.
   c. Treat minor skin reactions with antihistamines.

**SUNBURN**

Sunburn results from prolonged exposure to the ultraviolet rays of the sun. First- and second-degree burns similar to thermal burns result. Treatment is essentially the same as that outlined for thermal burns. Unless a major percentage of the body surface is affected, the casualty will not require more than first aid attention. Commercially prepared sunburn lotions and ointments may be used. Prevention through education and the proper use of sun screens is the best way to avoid this condition.

**ELECTRICAL BURNS**

Electrical burns may be far more serious than a preliminary examination may indicate. The entrance and exit wounds may be small, but as electricity penetrates the skin it burns a large area below the surface (Fig. 21-11).

Before treatment is started, ensure that the casualty is no longer in contact with a live electrical source. Shut the power off or use a non-conducting rope or stick to move the casualty away from the line or the line away from the casualty.

HMs can do little for these casualties other than monitoring the basic life functions; delivering CPR; treating for shock; covering the entrance and exit wounds with a dry, sterile dressing; and transporting the casualty to a medical treatment facility. Due to the nature of the injury, the patient may require defibrillation with an AED or cardiac defibrillator in order to re-set the electric circuits in the heart so that a normal cardiac rhythm can return. AEDs are the device of choice for HMs; follow the manufacturer’s directions for use.

**CHEMICAL BURNS**

When acids, alkalis, or other chemicals come in contact with the skin or other body membranes, they may cause injuries that are generally referred to as chemical burns. For the most part, these injuries are not caused by heat but by direct chemical destruction of body tissues. Areas most often affected are the extremities, mouth, and eyes. Alkali burns are more serious than acid burns because alkalis penetrate deeper and burn longer.

*Figure 21-11.—Electrical Burns*

*Photograph provided by HMCS (SS/SW) Christopher Santee of Naval Medical Manpower Personnel Education and Training Command, Bethesda, MD.*
When such burns occur, the following emergency procedures must be carried out immediately:

1. Quickly flush the area with large amounts of water, using a shower or hose, if available.
   a. Do not apply water too forcefully.
   b. Flood the area while the clothing (including shoes and socks) is being removed and continue flushing the skin after removal of all clothing.

   **NOTE:**

   There are two exceptions to the above:

   In alkali burns caused by dry lime, the mixing of water and lime creates a very corrosive substance. Dry lime should be brushed away from the skin and clothing, unless large amounts of water are available for rapid and complete flushing.

   In acid burns caused by phenol (carbolic acid), wash the affected area with alcohol because phenol is not water soluble; then wash with water. If alcohol is not available, flushing with water is better than no treatment at all.

2. After thorough washing, neutralize any chemical remaining on the affected area.

   **CAUTION:**

   Never use any chemical antidotes such as baking soda or alcohol in treating burns of the eye, and do not try to neutralize chemical agents.

   After thorough irrigation, loosely cover both eyes with a clean dressing. This prevents further damage by decreasing eye movement.

   The aftercare for all chemical burns is similar to that for thermal burns: Cover the affected area and get the casualty to a medical treatment facility as soon as possible.

3. Flush the area again with water and gently pat dry with sterile gauze. Do not rub the area.

4. Transport the casualty to a medical treatment facility.

When treating chemical burns to the eye, the one and only emergency treatment is to flush the eye(s) immediately with large amounts of water or sterile saline solution. Irrigate acid burns to the eyes for at least 5 to 10 minutes with at least 2000 ml of water. Irrigate alkali burns to the eyes for at least 20 minutes. Because of the intense pain, the casualty may be unable to open the eyes. If this occurs, hold the eyelids apart so that water can flow across the eye.

   A drinking fountain or field "water buffalo" may be used to supply a steady stream of water. Hold the casualty’s head in a position that allows water to flow from the inside corner of the eye toward the outside. Do not allow the water to fall directly on the eye, and do not use greater force than is necessary to keep the water flowing across the eye.

   **CAUTION:**

   Never use any chemical antidotes such as baking soda or alcohol in treating burns of the eye, and do not try to neutralize chemical agents.

   After thorough irrigation, loosely cover both eyes with a clean dressing. This prevents further damage by decreasing eye movement.

   The aftercare for all chemical burns is similar to that for thermal burns: Cover the affected area and get the casualty to a medical treatment facility as soon as possible.

**WHITE PHOSPHORUS BURNS**

A special category of burns that may affect military personnel in a wartime or training situation is that caused by exposure of white phosphorus (WP or Willy Peter). First aid for this type of burn is complicated by the fact that white phosphorus particles ignite upon contact with air.
Superficial burns caused by simple skin contact or burning clothes should be flushed with water and treated like thermal burns. Partially embedded white phosphorus particles must be continuously flushed with water while the first aid provider removes them with whatever tools are available (i.e., tweezers, pliers, forceps). Do this quickly, but gently.

Firmly or deeply embedded particles that cannot be removed by the first aid provider must be covered with a saline-soaked dressing, and this dressing must be kept wet until the casualty reaches a medical treatment facility. The wounds containing embedded phosphorus particles may then be rinsed with a dilute, freshly mixed 1% solution of copper sulfate. This solution combines with phosphorus on the surface of the particles to form a blue-black cupric phosphate covering, which both impedes further oxidation and facilitates identification of retained particles. Under no circumstances should the copper sulfate solution be applied as a wet dressing.

Wounds must be flushed thoroughly with a saline solution following the copper sulfate rinse to prevent absorption of excessive amounts of copper. (Copper has been associated with extensive intravascular hemolysis.) An adjunct to the management of phosphorus burn injuries is the identification of the retained phosphorescent particles in a darkened room during debridement.

NOTE:
Combustion of white phosphorus results in the formation of a severe pulmonary irritant.

The ignition of phosphorus in a closed space (such as the BAS tent or sickbay) may result in the development of irritant concentrations sufficient to cause acute inflammatory changes in the tracheobronchial tree.

The effects of this gas, especially during debridement, can be minimized by placing a moist cloth over the nose and mouth to inactivate the gas and by ventilating the tent.

HEAT EXPOSURE INJURIES

LEARNING OBJECTIVE:
Describe the signs, symptoms, and emergency treatment of heat cramps, heat exhaustion, and heat stroke.

Excessive heat affects the body in a variety of ways. When a person exercises or works in a hot environment, heat builds up inside the body. The body automatically reacts to get rid of this heat through the sweating mechanism. This depletes water and electrolytes from the circulating volume. If they are not adequately replaced, body functions are affected, and, initially, heat cramps and heat exhaustion develop. If the body becomes too overheated or water or electrolytes too depleted, the sweat-control mechanism of the body malfunctions and shuts down. The result is heat stroke (sunstroke). Heat exposure injuries are a threat in any hot environment, but especially in desert or tropical areas and in the boiler rooms of ships. Under normal conditions, it is a preventable injury. Individual and command awareness of the causes of heat stress problems should help eliminate heat exposure injuries.

HEAT CRAMPS

Excessive sweating may result in painful cramps in the muscles of the abdomen, legs, and arms. Heat cramps may also result from drinking ice water or other cold drinks either too quickly or in too large a quantity after exercise. Muscle cramps are often an early sign of approaching heat exhaustion.

To provide first aid treatment for heat cramps, move the casualty to a cool place. Since heat cramps are caused by loss of salt and water, give the casualty plenty of cool (not cold) water to drink, adding about one teaspoon of salt to a liter or quart of water. Apply manual pressure to the cramped muscle, or gently massage it to relieve the spasm. If there are indications of anything more serious, transport the casualty immediately to a medical treatment facility.
HEAT EXHAUSTION

Heat exhaustion (heat prostration or heat collapse) is the most common condition caused by working or exercising in hot environments. In heat exhaustion, there is a serious disturbance of blood flow to the brain, heart, and lungs. This causes the casualty to experience weakness, dizziness, headache, nausea, and loss of appetite. The casualty may faint but will probably regain consciousness as the head is lowered, which improves the blood supply to the brain. Signs and symptoms of heat exhaustion are similar to those of shock; the casualty will appear ashen gray, the skin cool, moist, and clammy and the pupils may be dilated. The vital signs usually are normal; however, the casualty may have a weak pulse, together with rapid and shallow breathing. Body temperature may be below normal.

Treat heat exhaustion as if the casualty were in shock. Move the casualty to a cool or air-conditioned area. Loosen the clothing, apply cool wet cloths to the head, maxilla, groin, and ankles, and fan the casualty. Do not allow the casualty to become chilled. (If this does occur, cover with a light blanket and move into a warmer area.) If the casualty is conscious, give a solution of 1 teaspoon of salt dissolved in a liter of cool water. If the casualty vomits, do not give any more fluids. Transport the casualty to a medical treatment facility as soon as possible. Intravenous fluid infusion may be necessary for effective fluid and electrolyte replacement to combat shock.

HEAT STROKE

Sunstroke is more accurately called heat stroke since it is not necessary to be exposed to the sun for this condition to develop. It is a less common but far more serious condition than heat exhaustion, since it carries a 20 percent mortality rate. The most important feature of heat stroke is the extremely high body temperature (105°F, 41°C or higher) accompanying it.

In heat stroke, the casualty suffers a breakdown of the sweating mechanism and is unable to eliminate excessive body heat buildup while exercising. If the body temperature raises too high, the brain, kidneys, and liver may be permanently damaged.

Sometimes the casualty may have preliminary symptoms such as headache, nausea, dizziness, or weakness. Breathing will be deep and rapid at first, later shallow and almost absent. The casualty will be flushed, very dry, and very hot. The pupils will be constricted (pinpoint) and the pulse fast and strong. Compare these symptoms with those of heat exhaustion. When providing first aid for heat stroke, remember that this is a true life-and-death emergency. The longer the casualty remains overheated, the more likely irreversible brain damage or death will occur. First aid is designed to reduce body heat fast.

Reduce heat immediately by dousing the body with cold water or by applying wet, cold towels to the whole body. Move the casualty to the coolest place available and remove as much clothing as possible. Maintain an open airway. Place the casualty on his back, with the head and shoulders slightly raised. If cold packs are available, place them under the arms, around the neck, at the ankles, and in the groin. Expose the casualty to a fan or air conditioner, since drafts will promote cooling. Immersing the casualty in a cold water bath is also very effective. If the casualty is conscious, give cool water to drink. Do not give any hot drinks or stimulants. Discontinue cooling when the rectal temperature reaches 102°F; watch for recurrence of temperature rise by checking every 10 minutes. Repeat cooling if temperature reaches 103°F rectally.

Get the casualty to a medical facility as soon as possible. Cooling measures must be continued while the casualty is being transported. Intravenous fluid infusion may be necessary for effective fluid and electrolyte replacement to combat shock.
PREVENTION OF HEAT EXPOSURE INJURIES

LEARNING OBJECTIVE:

Determine the steps needed to prevent heat exposure injuries.

The prevention of heat exposure injuries is a command responsibility, but the medical department plays a role in it by educating all hands about the medical dangers, monitoring environmental health, and advising the commanding officer.

On the individual level, prevention centers on water and salt replacement. Sweat must be replaced ounce for ounce; in a hot environment, water consumption must be drastically increased. Salt should be replaced by eating well-balanced meals, three times a day, salted to taste. In the field, "C" rations contain enough salt to sustain a person in most situations. DO NOT use salt tablets unless specified by a physician. DO NOT consume alcoholic beverages.

At the command level, prevention centers on an awareness of the environment. The Wet Bulb Globe Temperature (WBGT) must be monitored regularly, and the results interpreted with the Physiological Heat Exposure Limit (PHEL) chart before work assignments are made. In addition, unnecessary heat sources, especially steam leaks, must be eliminated, and vents and exhaust blowers must be checked for adequate circulation. The results will be a happier, healthier, and more productive crew.

COLD EXPOSURE INJURIES

LEARNING OBJECTIVE:

Describe the signs, symptoms, and emergency treatment of each type of cold exposure injury.

When the body is subjected to extremely cold temperatures, blood vessels constrict, and body heat is gradually lost. As the body temperature drops, tissues are easily damaged or destroyed.

The cold injuries resulting from inadequate response to the cold in military situations have spelled disaster for many armies such as those of Napoleon and Hitler in their Russian campaigns. The weather (i.e. temperature, humidity, precipitation, and wind) is the predominant influence in the development of cold injuries. Falling temperature interacting with high humidity, a wet environment, and rising wind accelerates the loss of body heat.

Other factors that influence the development of cold injuries are the individual's level of dehydration, the presence of other injuries (especially those causing a reduction in circulatory flow), and a previous cold injury which increases susceptibility by lowering resistance. In addition, the use of any drug (including alcohol) that modifies autonomic nervous system response or alters judgment ability can drastically reduce an individual’s chance for survival in a cold environment.

Like heat exposure injuries, cold exposure injuries are preventable. Acclimatization, the availability of warm, layered clothing, and maintenance of good discipline and training standards are important factors. These are command not medical responsibilities, but the HM plays a crucial role as a monitor of nutritional intake and personal hygiene (with emphasis on foot care) and as an advisor to the commanding officer. The HM is also responsible for acquainting the troops with the dangers of cold exposure and with preventive measures.
Two major points must be stressed in the management of all cold injuries: Rapid rewarming is of primary importance, and all unnecessary manipulations of affected areas must be avoided. More will be said about these points later.

In military operations the treatment of cold injuries is influenced by the tactical situation, the facilities available for the evacuation of casualties, and the fact that most cold injuries are encountered in large numbers during periods of intense combat when many other wounded casualties appear. Highly individualized treatment under these circumstances may be impossible because examination and treatment of more life-endangering wounds must be given priority. In a high-casualty situation, shelter cold-injury casualties, and try to protect them from further injury until there is sufficient time to treat them.

All cold injuries are similar, varying only in the degree of tissue damage. Although the effects of cold can, in general, be divided into two types general cooling of the entire body and local cooling of parts of the body cold injuries are seldom strictly of one type or the other; rather, these injuries tend to be a combination of both types. Each type of cooling, however, will be discussed separately in the sections that follow.

GENERAL COOLING (HYPOTHERMIA)

General cooling of the whole body is caused by continued exposure to low or rapidly falling temperatures, cold moisture, snow, or ice. Those exposed to low temperatures for extended periods may suffer ill effects, even if they are well protected by clothing, because cold affects the body systems slowly, almost without notice.

As the body cools, there are several stages of progressive discomfort and disability. The first symptom is shivering, which is an attempt to generate heat by repeated contractions of surface muscles. This is followed by a feeling of listlessness, indifference, and drowsiness. Unconsciousness can follow quickly.

Shock becomes evident as the casualty’s eyes assume a glassy stare, respiration becomes slow and shallow, and the pulse is weak or absent. As the body temperature drops even lower, peripheral circulation decreases and the extremities become susceptible to freezing. Finally, death results as the core temperature of the body approaches 80°F.

The steps for treatment of hypothermia are as follows:

1. Carefully observe respiratory effort and heart beat; CPR may be required while the warming process is underway.
2. Re-warm the casualty as soon as possible.
   a. It may be necessary to treat other injuries before the casualty can be moved to a warmer place.
   b. Severe bleeding must be controlled and fractures splinted over clothing before the casualty is moved.
3. Replace wet or frozen clothing and remove anything that constricts the casualty’s arms, legs, or fingers, interfering with circulation.
4. If the casualty is inside a warm place and is conscious, the most effective method of warming is immersion in a tub of warm (100 to 105 °F or 38 to 41 °C) water.
   a. The water should be warm to the elbow never hot.
   b. Observe closely for signs of respiratory failure and cardiac arrest (re-warming shock).
   c. Re-warming shock can be minimized by warming the body trunk before the limbs to prevent vasodilatation in the extremities with subsequent shock due to blood volume shifts.
5. If a tub is not available, apply external heat to both sides of the casualty.
   a. Natural body heat (skin to skin) from two rescuers is the best method. This is called "buddy warming."
   b. If this is not practical, use hot water bottles or an electric re-warming blanket.
      i. Do not place the blanket or bottles next to bare skin.
      ii. Monitor the temperature of the artificial heat source, since the casualty is very susceptible to burn injury.
   c. Because the casualty is unable to generate adequate body heat, placement under a blanket or in a sleeping bag is not sufficient treatment.

6. If the casualty is conscious, give warm liquids to drink. Never give alcoholic beverages or allow the casualty to smoke.

7. Dry the casualty thoroughly if water is used for re-warming.

8. As soon as possible, transfer the casualty to a definitive care facility. Be alert for the signs of respiratory and cardiac arrest during transfer, and keep the casualty warm.

**LOCAL COOLING**

Local cooling injuries, affecting individual parts of the body, fall into two categories: freezing and nonfreezing injuries. In the order of increasing seriousness, they include chilblain, immersion foot, superficial frostbite, and deep frostbite. The areas most commonly affected are the face and extremities.

**Chilblain**

*Chilblain* is a mild cold injury caused by prolonged and repeated exposure for several hours to air temperatures from above freezing 32°F (0°C) to as high as 60°F (16°C). Chilblain is characterized by redness, swelling, tingling, and pain to the affected skin area.

Injuries of this nature require no specific treatment except warming of the affected part (if possible use water bath of 90°F to 105°F), keeping it dry, and preventing further exposure.

**Immersion Foot**

*Immersion foot*, which also may occur in the hands, results from prolonged exposure to wet cold at temperatures ranging from just above freezing to 50°F (10°C). Immersion foot is typically seen in connection with limited motion of the extremities and water-soaked protective clothing.

Signs and symptoms of immersion foot are tingling and numbness of the affected areas; swelling of the legs, feet, or hands; bluish discoloration of the skin; and painful blisters. Gangrene may occur. General treatment for immersion foot is as follows:

1. Get the casualty off his or her feet as soon as possible.
2. Remove wet shoes, socks, and gloves to improve circulation.
3. Expose the affected area to warm, dry air.
4. Keep the casualty warm.
5. Do not rupture blisters or apply salves and ointments.
6. If the skin is not broken or loose, the injured part may be left exposed; however, if it is necessary to transport the casualty, cover the injured area with loosely wrapped fluff bandages of sterile gauze.
7. If the skin is broken, place a sterile sheet under the extremity and gently wrap it to protect the sensitive tissue from pressure and additional injury.
8. Transport the casualty as soon as possible to a medical treatment facility as a litter patient.
Frostbite occurs when ice crystals form in the skin or deeper tissues after exposure to a temperature of 32°F (0°C) or lower. Depending upon the temperature, altitude, and wind speed, the exposure time necessary to produce frostbite varies from a few minutes to several hours. The areas most commonly affected are the face and extremities.

The symptoms of frostbite are progressive. Casualties generally incur this injury without being acutely aware of it. Initially, the affected skin reddens and there is an uncomfortable coldness. With continued heat loss, there is a numbness of the affected area due to reduced circulation. As ice crystals form, the frozen extremity appears white, yellow-white, or mottled blue-white, and is cold, hard, and insensitive to touch or pressure. Frostbite is classified as superficial or deep, depending on the extent of tissue involvement.

SUPERFICIAL FROSTBITE.—In superficial frostbite the surface of the skin will feel hard, but the underlying tissue will be soft, allowing it to move over bony ridges. This is evidence that only the skin and the region just below it are involved. General treatment for superficial frostbite is as follows:

1. Take the casualty indoors.
2. Re-warm hands by placing them under the armpits, against the abdomen, or between the legs.
3. Re-warm feet by placing them in the armpit or against the abdomen of the buddy.
4. Gradually re-warm the affected area by warm water immersion, skin-to-skin contact, or hot water bottles.
5. Never rub a frostbite area.

DEEP FROSTBITE.—In deep frostbite, the freezing reaches into the deep tissue layers. There are ice crystals in the entire thickness of the extremity. The skin will not move over bony ridges and will feel hard and solid.

The objectives of treatment are to protect the frozen areas from further injury, to rapidly thaw the affected area, and to be prepared to respond to circulatory or respiratory difficulties.

1. Carefully assess and treat any other injuries first. Constantly monitor the casualty’s pulse and breathing since respiratory and heart problems can develop rapidly. Be prepared to administer CPR if necessary.
2. Do not attempt to thaw the frostbitten area if there is a possibility of refreezing. It is better to leave the part frozen until the casualty arrives at a medical treatment facility equipped for long-term care. Refreezing of a thawed extremity causes severe and disabling damage.
3. Treat all casualties with injuries to the feet or legs as litter patients. When this is not possible, the casualty may walk on the frozen limb, since it has been proven that walking will not lessen the chances of successful treatment as long as the limb has not thawed out.
4. When adequate protection from further cold exposure is available, prepare the casualty for re-warming by removing all constricting clothing such as gloves, boots, and socks. Boots and clothing frozen on the body should be thawed by warm-water immersion before removal.
5. Rapidly re-warm frozen areas by immersion in water at 100°F to 105°F (38°C to 41°C). Keep the water warm by adding fresh hot water, but do not pour the water directly on the injured area. Ensure that the frozen area is completely surrounded by water; do not let it rest on the side or bottom of the tub.
6. After re-warming has been completed, pat the area dry with a soft towel. Later it will swell, sting, and burn.
   a. Blisters may develop. These should be protected from breaking.
   b. Avoid pressure, rubbing, or constriction of the injured area.
   c. Keep the skin dry with sterile dressings and place cotton between the toes and fingers to prevent their sticking together.

7. Protect the tissue from additional injury and keep it as clean as possible (use sterile dressings and linen).

8. Try to improve the general morale and comfort of the casualty by giving hot, stimulating fluids such as tea or coffee. Do not allow the casualty to smoke or use alcoholic beverages while being treated.

Transfer to a medical treatment facility as soon as possible. During transportation, slightly elevate the frostbitten area and keep the casualty and the injured area warm. Do not allow the injured area to be exposed to the cold.

LATER MANAGEMENT OF COLD INJURIES

LEARNING OBJECTIVE:

Determine the steps needed for the later management of cold-exposure injuries.

When the patient reaches a hospital or a facility for definitive care, the following treatment should be employed:

1. Maintain continued vigilance to avoid further damage to the injured tissue. In general, this is accomplished by keeping the patient at bed rest with the injured part elevated (on surgically clean sheets) and with sterile pieces of cotton separating the toes or fingers.
   a. Expose all lesions to the air at normal room temperature.
   b. Weight bearing on injured tissue must be avoided.

2. Whirlpool baths, twice daily at 98.6°F (37°C) with surgical soap added, assist in superficial debridement, reduce superficial bacterial contamination, and make range of motion exercises more tolerable.

3. Analgesics may be required in the early post-thaw days but will soon become unnecessary in uncomplicated cases.

4. Encourage the patient to take a nutritious diet with adequate fluid intake to maintain hydration.

5. Perform superficial debridement of ruptured blebs, and remove supplicative scabs and partially detached nails.

DIVING RELATED DISORDERS

LEARNING OBJECTIVES:

Explain the basic laws associated with diving related disorders.

Identify signs and symptoms of common diving related disorders.

Identify treatment methods for common diving related disorders.

Introduction

A general approach to the medical aspects of diving and altitude injuries would be to say it is literally “medicine under pressure.” The physiological insult is by definition “pressure related.” The solution to most dive and altitude related injuries is to reintroduce the patient to pressure. Additionally, the vague and often misleading presentation a diving patient presents adds its own unique pressure in medicine.

“Caissons Disease”

The word caisson is a French word meaning “big boxes” Caissons were developed to allow workers a dry environment in which they could work on the bottom. They used these boxes to excavate bridge footings and build tunnels under water.
As the use of caissons increased, a new and unexplained illness began to affect the workers. Upon returning to the surface the workers often experienced dizziness, difficulty breathing and sharp pains in their joints and abdomen. The workers usually recovered but not always completely. The caisson workers often noted that they felt better while on the bottom in the caissons. The malady was logically called, caisson disease. However, workers on the Brooklyn bridge project in New York gave the malady a more descriptive name “the bends.” The “bends” is a slang term used for Decompression Sickness (DCS).

This demonstrates the importance that all medical personnel have a basic understanding of the effects of pressure on the human body. Whether stationed at a diving command or a high mountain airstrip; understanding pressure related emergencies can make the difference by knowing the mechanisms of injury and the presentation with an elevated index of suspicion. Injuries specific to diving are the result of exposure to increased pressure over and above what bodies are normally exposed to at the earth’s surface. The three principle categories for injuries are barotraumas, toxicities, and decompression sickness.

**Pressure**

Pressure is defined as force acting upon a particular area of matter. While diving there are two factors to consider: the weight of the water over the diver and the weight of the atmosphere above the water. In the field of aviation the effects of pressure must be considered, due to the weight of the atmosphere. The weight of the atmosphere (from sea-level up to the ozone layer) exerts 14.7 psi on the human body. This pressure of the “atmosphere” is constantly exerted on our bodies. Due to the atmosphere being made up of gases and gases having the characteristic of compressing, if people travel to a higher altitude they find air is less dense, therefore weighs less per square inch. Inversely as they descend through the water, more weight is applied causing the gas to be denser.

1 atmosphere = 14.7
1 foot sea water = 0.445 psi
33 feet sea water = 14.7 psi

Measuring pressure while descending the water column (going deeper) there will be an increase of 0.445 psi for every foot of seawater descended into. This is known as “hydrostatic pressure.” At 33 feet of seawater (fsw) the amount of pressure on the diver’s body doubles from the surface. This increase remains 0.445psi/fsw no matter how deep because water does not compress (Fig. 21-12). The deeper a diver descends the more water that is over the diver, the more weight that is acting on the diver.

![Figure 21-12.—Atmosphere and Pressure Relationship](image)

33 fsw = 14.7 psi = 1 atm

*1 square inch of air 20-30 miles high = 1 square inch of water 33 feet high.*

Pressure increases linearly, gas volume changes exponentially.

21-100
Barotrauma (Boyles Gas Law)

Boyles Law (Fig. 21-13) – For any gas at a constant temperature, pressure, and volume are inversely related. Boyles Law predicts gas changes in volume. As a bubble descends the water column, increasing pressure will act on it causing it to compress and shrink in size. Inversely, as it ascends the water column, pressure decreases thereby allowing it to expand/enlarge.

Barotrauma is defined as damage to tissues caused by a change in ambient pressure. The human body has gas filled, semi rigid cavities that are subject to changes in volume due to changes in pressure – lungs, sinuses, and middle ear for example. A diver must equalize for this volume change otherwise barotrauma will occur. This is also known as a squeeze on descent and reverse squeeze on ascent.

The most common type of squeeze, “middle ear squeeze,” can be experienced by simply jumping in a swimming pool and swimming to the bottom – pressure increases, the volume of gas in the middle ear decreases resulting in pain. If not corrected/equalized by forcing more gas into the middle ear (valsalva), barotrauma will occur. The space inside the middle ear is enclosed. As a diver descends in the water, pressure is increasing and compressing that space, if the diver does not valsalva and equalize the pressure inside the middle ear to match the pressure being applied outside, damage will occur.

General Treatment for middle ear squeeze: Upon surfacing after a middle ear squeeze, the diver may complain of pain, fullness in the ear, hearing loss, or even mild vertigo. Occasionally, the diver may have a bloody nose, the result of blood being forced out of the middle ear space and into the nasal cavity through the eustachian tube.

![Figure 21-13.—Diving Laws and Associated Complications](image-url)
Treatment consists of decongestants, NSAID’s for pain and inflammation as needed, and discontinue diving until healed. Three days to several weeks depending on severity. If the eardrum is ruptured antibiotics may be prescribed as well. Never administer medication directly into the external ear canal if a ruptured eardrum is suspected or confirmed without consulting an ear, nose, and throat (ENT) specialist.

General Types of Squeezes/Barotrauma – Outer Ear, Middle Ear, Inner Ear, Sinus, Tooth, Dry Suit, Mask, POIS, etc. As noted above, that which affects the middle ear affects other gas-filled, semi-rigid areas as well. Of particular concern are the pulmanary over inflation syndrome (POIS) injuries which are discussed below.

Pulmonary Over Inflation Syndrome (POIS) is barotrauma of the lung. Expanding gas if trapped in the lung(s) and not allowed to escape can result in tearing at the alveolar sacs. This can result in one or several types of POIS - Mediastinal Emphysema, Subcutaneous Emphysema, Pneumothorax, and Arterial Gas Embolism.

Mediastinal Emphysema is the tearing of the lung with air leaking out and remaining inside the chest cavity. Symptoms are mild with a substernal burning sensation or pain on deep inspiration. This is enough air to cause discomfort yet not enough to cause the lung to collapse.

Subcutaneous Emphysema tearing of the lung with air leaking out of the lung then migrating up and out of the chest cavity and stopping at the base of the neck. Air bubbles can be felt beneath the skin.

Pneumothorax is the tearing of the lung with air leaking out and collapsing the lung.

Arterial Gas Embolism (AGE) capillaries on the alveolar sacs at the location of a tear in the lung draw gas into the blood stream. These gas bubbles will follow the circulatory system traveling from the lung to the heart then out to the body via arterial flow. The bubble continues until it becomes lodged ultimately resulting in decreased blood flow and hypoxia downstream from its location, acting like a blood clot.

Severity of symptoms depends on the location of the bubble. The brain and heart are the two most serious locations for AGE to occur with stroke and heart attack symptoms presenting respectively. Due to the obstruction occurring on the arterial side of the circulatory system, symptoms present rapidly. The general rule is “Any neurological deficit within 10 minutes of a diver reaching the surface is considered AGE." 

Given the mechanism of injury for POIS it is entirely possible to have all 4 types of injury at the same time. Any time a diver presents with any POIS symptoms, a neurological exam must be completed to rule out AGE.

Toxicities: Dalton’s Law – increasing partial pressure

As a gas descends in the water column it is exposed to increased pressure and becomes more concentrated (Fig. 21-13). The ratio or percentage of gas (21% oxygen/79% nitrogen in air for example) remains the same, but because gasses compress, the number of molecules that fit in a given volume increases. Take human lungs for instance. Tidal Volume at rest is 500ml. At a depth of 33 fsw the body still requires 500ml of Tidal Volume, however, because gases compress twice the amount of nitrogen and oxygen is received in a single breath compared to what is normally received at surface. This is what’s known as “partial pressure”, gas becomes “concentrated” under pressure. This “concentration” relative to atmospheres increases linearly: 33fsw x 2, 66fsw x 3, and 99fsw x 4. At 99fsw the diver is at 4 atmospheres absolute (3 water + 1 surface).
Higher partial pressures/concentrations of gasses have adverse and toxic effects on the body.

**Nitrogen Narcosis** at depths greater than 99 fsw, Nitrogen exerts a progressive depression of the central nervous system (CNS). Nitrogen Narcosis doesn’t cause damage but, its greatest hazard is gross lack of judgment which can cause a diver to make life threatening mistakes at depth.

**CNS Oxygen Toxicity** at partial pressures greater than 1.3, oxygen has a toxic effect on the CNS. Prolonged exposure to oxygen can irritate the tissues of the respiratory tract and lungs resulting in a burning sensation, also called Pulmonary Oxygen Toxicity.

**Carbon Dioxide Toxicity** build up is the waste product of respiration. Hyperbaric environment (increased pp) not required but due to the nature of work diving and ventilation limitations of diving apparatus make this the most common toxicity encountered in diving.

**Carbon Monoxide Toxicity** Carbon Monoxide binds to hemoglobin 200 times faster than oxygen, thereby causing a state of hypoxia. Breathing medium (tanks) contaminated by exhaust from internal combustion engines is the main cause for this toxicity. Hyperbaric environment not required, but increased pp exacerbates effects of carbon monoxide.

**Decompression Sickness: Henry’s Law – absorption/saturation**

The amount of gas which will dissolve in a liquid is proportional to the partial pressure of that gas above the liquid (Fig. 21-13). Take a closed container half filled with water, half with air, increase the pressure inside the chamber by adding more air – air is going to dissolve into the water. Now rapidly open the container reducing the pressure – the air will come back out of the liquid in the form of bubbles. This is the same action as shaking a carbonated beverage prior to opening, it explodes when opened because the pressure is decreased and the gas is forced out of the liquid.

Our bodies are 85% water and on the surface the body is at equilibrium (balance) with the inert gases in breathing air. Tissues are “saturated” to the 14.7 psi of 1 atmosphere of pressure.

Air is 79% Nitrogen, 21% Oxygen. There is about 1% of other trace elements, but not in high enough concentration to have an effect. Our bodies metabolize the oxygen. When the ppO\(^2\) falls below the surface equivalent of 16% signs of decreased mental status and function present themselves. Nitrogen is not necessary for anything, it is not metabolized. It is an “inert gas.” It basically provides a buffer or vehicle for oxygen. During a dive, pressure increases due to the weight of water over the diver causing the inert gas to become more concentrated. Thus at depth, because the pressure on the diver has increased, the amount of inert gas dissolved in the diver’s tissue also increases.

Then what happens to this gas on ascent to the surface? The external ambient pressure reduces on ascent, so the partial pressure of inert gas in the breathing mix decreases. Correspondingly, per Henry’s Law, the amount of inert gas dissolved in tissues drops.

When a diver maintains a normal ascent rate from the bottom to the surface, the inert gases have time to “off gas” or come out of solution at a controlled rate where the body can naturally dispose of the gas through the normal process of respiration. If ascent is too rapid the diver’s body exceeds the capacity for dissolved inert gas in its tissues, then the excess gas dissolved in tissues has nowhere else to go except to form bubbles in the body.

Essentially, DCS (decompression sickness) is the formation of bubbles in tissues. Where these bubbles form determines the type and severity of DCS. By following rules for decompression, such as a controlled rate of ascent and limiting time at depth will prevent significant bubble formation and reduce the risk of DCS.
Decompression Sickness Type I

Pain – Dull aching pain localized to a joint, normally not made worse with movement. It can progress from a dull ache to a deep ache and typically results from bubble formation in joint tissue. This is the most common manifestation of DCS Type I.

Marbling – When a bubble forms “in” the skin, the dermis and or epidermis, it results in a condition known as Cutis Marmorata. This is a mottling or marbling of the skin or a popular or plaque like violet colored rash. This is often accompanied by an itching or burning sensation. On rare occasions, skin has an orange-peel appearance. This condition is often called “skin bends.” This is not to be confused with Subcutaneous Emphysema; they are two different disease processes.

Swelling – When a bubble forms in the lymphatic system it will cause swelling of the affected lymph nodes. The most commonly involved lymph nodes are in the inguinal and axillary areas. The affected nodes are usually painful and swollen.

Decompression Sickness Type II

Central Nervous System (CNS) – When a bubble forms within the CNS it will produce a neurological deficit. Some examples include weakness, decreased sensation, paralysis, confusion, memory loss, visual disturbances, or extreme fatigue. The onset of symptoms takes place 10 minutes after surfacing from a dive up to 48 hours post dive. Any neurological symptom within the first 10 minutes after surfacing from a dive is considered an Arterial Gas Embolism.

Pain – This is a different type of pain from that of Type I DCS. If the pain is radiating such as radicular truck pain, pain that follows a dermatome, is an indication of Type 2 DCS.

Lungs – When a bubble forms in the lungs it results in Pulmonary DCS (the chokes). This is characterized by burning, substernal discomfort on inspiration, non-productive coughing that can become paroxysmal, and severe respiratory distress. Symptoms can start up to 12 hours after a dive and persist for 12 to 48 hours.

Inner Ears – When a bubble forms within the inner ears, it results in Inner Ear DCS (staggers). It is characterized by tinnitus (ringing in the ears), hearing loss, vertigo, dizziness, nausea, and vomiting. The affected person will have difficulty walking, hence the name staggers.

Aviation Bends

DCS caused by rapid decompression of an aircraft cabin or a rapid vertical climb; typically seen in fighter jets, either of them can produce similar mechanics of surfacing too rapidly in the water. Symptoms will present as Type I or II DCS and are treated accordingly.

General rules

DCS Types I and II, and AGE can progress to permanent or life threatening conditions. Recompression in a hyperbaric chamber is the only definitive treatment for DCS and AGE.

Pain alone is not AGE. A Neurological deficit would need to be present for it to be true AGE and present within the first 10 minutes.

Other POIS may be present. Recompression therapy is not indicated for pneumothorax or mediastinal and subcutaneous emphysema unless considered severe.
Treatment

ABCs.

- 100% O2 by mask
- Obtain dive history
  - Depth of dive
  - Time spent on dive
  - Time the diver reached the surface
  - What are the symptoms
  - When did they start
  - Have they improved or worsened
  - Does anything make them better or worse
  - Were any other dives prior to last dive, if so depth and time of dive and time spent on surface between dives
  - Are there any prior diving related injuries
- If diving related injury is suspected contact closest recompression facility, Dive Medical Technician(DMT), and or dive medical officer (DMO)
- Upon recommendation transport patient flat on O2 – do not elevate feet or head. If aircraft used maintain cabin pressure / altitude < 1000 feet above sea level
- Start a large bore IV (16 or 18 gauge) at 75cc/hr or KVO as indicated

CAUTION:
Do NOT give medications as they will mask the symptoms.

Differences between AGE and DCS

AGE can occur in as shallow as a few feet of water. DCS requires depth with improper off gassing, excessive time at depth, or both. Get a thorough history!

SUMMARY

A medical emergency can occur at anytime. HM’s must be prepared to act expeditiously and confidently, whether in a combat situation, on board a naval vessel, or at the Navy Exchange. This chapter covers the preliminary steps that should be followed when managing sick or injured patients. The preliminary emergency steps include triage, patient assessment, and, when needed, basic life support. Other related topics covered in this chapter are breathing aids, shock, diagnosis and emergency treatment procedures for medical conditions and injuries, and other emergencies.
A Hospital Corpsman (HM) may encounter patients who have poisoning or drug overdose incidents. Patients may initially present with no symptoms or with varying degrees of overt intoxication. The asymptomatic patient may have been exposed to or ingested a lethal dose of a substance but not exhibit any manifestations of toxicity. A patient with mild symptoms may deteriorate rapidly requiring close observation.

Potentially significant exposures should be observed in a medical treatment facility whenever possible. HMs are not always in a treatment facility environment and must be prepared to deal with a medical situation should one present itself.

This chapter will outline the assessment and treatment for ingested, inhaled, absorbed, and injected poisons.

**NOTE:**
Prior to deployments and operational commitments, commands are strongly recommended to contact the area Environmental Preventive Medicine Unit (EPMU) for current, specific, medical intelligence, and surveillance data. With this information at hand, the local preventive medicine authority can identify, prevent, and treat conditions not common to the homeport area.

The cognizant Environmental Preventive Medicine Unit will provide data through the Medical, Environmental, Diagnosis, Intelligence and Counter-measure (MEDIC) CD-ROM which is a comprehensive management tool. It is an invaluable aid for identifying at-risk communicable diseases, immunization requirements, local pests and environmental dangers.

**LEARNING OBJECTIVE:**

Explain assessment and treatment procedures for ingested, inhaled, absorbed, and injected poisons.

A poison is a substance that, when introduced into the body, produces a harmful effect on normal body structures or functions. They come in solid, liquid, and gaseous forms; and may be ingested, inhaled, absorbed, or injected into the body.

The effects of poisons may be local, remote, or a combination of both effects. A local effect is produced when a poison only affects the area in which it is applied, i.e. poison ivy reaction. A remote effect is produced when a poison affects parts of the body that are remote to the site of application or point of introduction, i.e. allergic reaction to a bee sting resulting in cardiopulmonary arrest. Poisons do not always show an effect until several doses have been taken. Then, an effect is produced that is nearly equal to the effect produced by taking the whole amount at one time and is known as a cumulative effect.

Toxicology is the science of poisons, their actions, their detection, and the treatment of the conditions produced by them. Every chemical in a sufficient dose can cause toxic effects in a human or other organism. The amount or concentration of a chemical and the duration of exposure to it are what determine the chemical's dose and toxicity. A 16th century quotation from Paracelsus states, "The dose makes the poison . . . . All substances are poisons; there is none which is not a poison. The right dose differentiates a poison and a remedy."
A poisoning is defined as the presence of signs or symptoms associated with exposure or contact with a substance. If there are no clinical manifestations or toxic effects, the incident is simply an "exposure" or a contact with a potentially poisonous substance. Just being exposed to a chemical does not mean that a poisoning has or will occur. It is a matter of dose and a few other variables (e.g., age, sex, individual resistance, and state of health) that determine if, or what, toxic effects will occur.

ASSESSMENT AND TREATMENT OF PATIENT

In most cases, ASSESSMENT AND TREATMENT OF THE PATIENT IS MORE IMPORTANT THAN EFFORT TO IDENTIFY AND TREAT A SPECIFIC POISON. Supportive therapy managing the ABCs (Airway, Breathing, and Circulation) of basic life support and treating the signs and symptoms are safe and effective in the vast majority of poisonings. Extraordinary means to enhance elimination of the poison (hemodialysis and hemoperfusion) are seldom needed. Except for agents with a delayed onset of toxicity (such as acetaminophen), most ingested poisons produce signs and symptoms in less than four hours. Most efforts to decontaminate the stomach through gastric lavage or activated charcoal to remove an ingested poison have little value more than one hour after ingestion.

In acute poisonings, prompt treatment is indicated. After the patient has been evaluated and stabilized, general poison management can be initiated.

There are six steps in the initial evaluation and follow-on poison management:

1. **Stabilization:** consists of a brief evaluation and assessment directed toward identifying the measures required to maintain life and prevent further deterioration of the patient.
   a. Observe the ABC + D & E.
      i. Airway, Breath, and Circulation.
      ii. Drug-induced central nervous system (CNS) depression.
      iii. Expose (undress/uncover) the patient for disabilities/injuries to ensure areas of contact or exposure to a chemical can be properly visualized and assessed.
   b. Complete basic neurologic exam; be sure to check the pupils for size and reactivity to light.
   c. Administer oxygen as needed.
   d. Start an IV.
   e. Watch for signs and symptoms of anaphylaxis.

2. **Evaluation:** must be performed once the patient is stabilized.
   a. Include a full history, physical exam, and ordering of appropriate tests (i.e. labs, EKG, x-rays) directed toward identification of toxic agent(s), evaluating the severity of toxic effects, and searching for trauma and complications.
   b. Periodically reassess the patient. Look for changes. Monitor vital signs, urine output (UOP), and cardiac rhythm.
   c. Record the findings (including time) and respond to important changes appropriately.

3. **Prevention or limitation of absorption:** through skin decontamination, flushing of eyes, ventilation, stomach emptying, and administration of charcoal and cathartics.
4. **Elimination enhancement:** through serially administered activated charcoal, ion-trapping (pH adjustment of the urine to promote excretion of certain poisons), hemodialysis, and hemoperfusion (similar to hemodialysis, but used for larger size molecules).

5. **Administration of specific antidotes:** Less than 5 percent of poisons have specific antidotes. All patients who present should receive glucose, thiamine, and naloxone. Consider supplemental oxygen.

6. **Continuing care and disposition:** including a period of observation and education (i.e. poison prevention) or psychiatric counseling. Establish follow-up.

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**THE DIAGNOSIS OF POISONING**

In many situations, the treatment of a poisoning victim will be under the direction of a medical officer. However, the HM must be ready to treat the victim.

Poisoning should be suspected in all cases of sudden, severe, and unexpected illness. The HM should investigate by ascertaining, as quickly and thoroughly as possible, the answers to the following questions:

- What are the signs and symptoms of the illness?
- What was happening before the illness occurred? (There may have been a chronic exposure over time with the signs and symptoms just becoming apparent.)
- What substance(s) is/were in use?
- Is there a container of the suspected substance?
  - If so, how much was there initially, and how much is there now?
  - If possible, have the container brought to the treatment facility. The label will often identify the contents and the recommended precautions and treatment. The label may also list a contact number for emergency advice.
- Other people including the HM may become contaminated through contact with the container. Handle it carefully.
  - When did the exposure happen?
  - What was the duration of exposure?
  - What is the location of the bite or injury (if applicable)?
  - Has this happened before?
  - Are there other people involved?
  - Does the patient have a significant past medical history?
  - Is the patient’s condition improving or deteriorating?

The presence of a toxic syndrome or toxidrome can help establish that a poison has been involved by suggesting the class of poison(s) to which the patient may have been exposed. Table 22-1 provides a list of commonly encountered toxidromes, their sources and symptoms.
Once poisoning has been established, the general rule is to quickly remove as much of the toxic substance from the victim as possible. The method of removal of the poison varies depending upon how the poison was introduced:

- **Ingested poisons**: There is a choice between **emetics** and **gastric lavage**, followed by **absorption** and cathartics
- **Inhaled poisons**: Oxygen ventilation is the method of choice
- **Absorbed poisons**: Removal of the poison is primarily attained by cleansing the skin
- **Injected poisons**: Antidotal medications are recommended

### Ingested Poisons

Ingested poisons are those poisons which have been consumed, whether accidentally or intentionally, by the victim. Ingestion is the most common route of exposure.

<table>
<thead>
<tr>
<th>Syndrome</th>
<th>Sources</th>
<th>Signs &amp; Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narcotic</td>
<td>opiates, benzodiazepines, barbiturates</td>
<td>“beady eyes,” sunglasses, decreased blood pressure, CNS and respiratory depression</td>
</tr>
<tr>
<td>Withdrawal</td>
<td>alcohol, barbiturates, benzodiazepines, narcotics, sedative-hypnotics</td>
<td>diarrhea, dilated pupils, goose bumps, increased heart rate, tearing, yawning, stomach cramps, hallucinations</td>
</tr>
<tr>
<td>Sympathomimetic</td>
<td>theophylline, caffeine, LSD, PCP, amphetamine, cocaine, decongestants</td>
<td>CNS excitation (confusion, in-coordination, agitation, hallucination, delirium, seizures), increased blood pressure and heart rate</td>
</tr>
<tr>
<td>Anticholinergic</td>
<td>antihistamines, atropine, scopolamine, antidepressants, anti-Parkinson L, antipsychotics, antispasmodics, mushrooms, hallucinogens, antidepressants</td>
<td>dry skin, increased heart rate, dilated pupils, fever, urinary retention, decreased bowel sounds, CNS excitation</td>
</tr>
<tr>
<td>Cholinergic</td>
<td>organophosphates, carbamates, physostigmine, neostigmine, endrophonium</td>
<td>“SLUDGE,” increased salivaion, lacrimation, urination, defecation, GI cramping, emesis; CNS (headache, restless, anxiety, confusion, coma, seizures); muscle weakness and fasciculation</td>
</tr>
</tbody>
</table>

Table 22-1.—Commonly Encountered Toxidromes

**GENERAL TREATMENT**

Once poisoning has been established, the general rule is to quickly remove as much of the toxic substance from the victim as possible. The method of removal of the poison varies depending upon how the poison was introduced:

- **Ingested poisons**: There is a choice between esmetics and gastric lavage, followed by absorption and cathartics
- **Inhaled poisons**: Oxygen ventilation is the method of choice
- **Absorbed poisons**: Removal of the poison is primarily attained by cleansing the skin
- **Injected poisons**: Antidotal medications are recommended

Ingestion of substances that do not produce local effects can be divided into two types:

- Nontoxic substances (latex paint, dirt, silica gel, spider plant)
- Potentially toxic substances (poisonous fish, medications, heavy metals (lead, mercury), pesticides, and personal care products)

Episodes involving the ingestion of non-toxic substances do not require decontamination of the stomach. Swallowing a non-toxic foreign body, like a coin or button battery in a child, may result in choking and require prompt medical intervention.
The toxicity range of absorbed poisons extends from non-toxic to extremely toxic. Ingestion substances with a low order of toxicity may result in the production of only minor systemic effects that are mild, self-limiting, and do not require significant medical intervention including nausea, vomiting, and or diarrhea.

**NOTE:**
Do not induce unnecessary vomiting to discourage a patient from repeating a voluntary ingestion.

**Noncorrosives**

Many noncorrosive substances have the common characteristic of irritating the stomach. They produce nausea, vomiting, convulsions, and severe abdominal pain. The victim may complain of a strange taste, and the lips, tongue, and mouth may look different than normal. Shock may occur. Examples of noncorrosives are listed in Table 22-2.

First aid for most forms of noncorrosive poisoning centers on quickly emptying the stomach of the irritating substance(s). The following steps are suggested:

1. Maintain an open airway. Be prepared to give artificial ventilation.
2. Dilute the poison by having the conscious victim drink one to two glasses of water or milk.
3. Empty the stomach using an emetic, gastric lavage, adsorbent, and or cathartic.

a. Giving an emetic is a preferred method for emptying the contents of the stomach. It is quick and (except in cases of caustic or petroleum distillate poisoning, or when an antiemetic has been ingested) can be used in almost every situation when the victim is conscious.

i. Ipecac syrup is the most commonly used substance to which an HM will have access.

   1. This emetic acts locally by irritating the gastric mucosa and centrally by stimulating the medullary vomiting center in the brain.

   2. The usual adult dose is 15-30 ml, and the dose for a child (age 1 to 12 years) is 15 ml.

   ii. The dosage should be followed immediately by a glass of water. Most people will vomit within 30 minutes.

   iii. The amount of stomach contents (and poison) recovered will vary.

   iv. In an emergency room, the medical officer can rapidly induce vomiting by the injection of various medications.

   v. As a last resort, tickle the back of the victim’s throat with a finger or a blunt object. This procedure should induce vomiting.

### Table 22-2.—Common Stomach Irritants and Possible Sources of Contact

<table>
<thead>
<tr>
<th>Irritant</th>
<th>Sources of Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenic</td>
<td>Dyes, insecticides, paint, printer sink, wood preservatives</td>
</tr>
<tr>
<td>Copper</td>
<td>Antifouling paint, batteries, canvas preservative, copper plating, electroplating, fungicides, insecticides, soldering, wood preservatives</td>
</tr>
<tr>
<td>Iodine</td>
<td>Antiseptics</td>
</tr>
<tr>
<td>Mercury</td>
<td>Bactericides, batteries, dental supplies and appliances, disinfectants, dyes, fungicides, ink, insecticides, laboratories, photography, wood preservatives</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>Incendiaries, matches, pesticides, rat poison</td>
</tr>
<tr>
<td>Silver nitrate</td>
<td>Batteries, cleaning solutions, ink, photographic film, silver polish, soldering</td>
</tr>
<tr>
<td>Zinc</td>
<td>Disinfectants, electroplating, fungicides, galvanizing, ink, insecticides, matches, metal plating and cutting, paint, soldering, wood preservatives</td>
</tr>
</tbody>
</table>

22-5
b. Trained personnel may use gastric lavage by itself or after two doses of Ipecac syrup has failed to induce vomiting.
   i. After passing a large caliber nasogastric tube, aspirate the stomach contents.
   ii. Instill 100 ml of normal saline into the stomach.
   iii. Aspirate it out again.
   iv. Continue this flushing cycle until the returning fluid is clear. Gastric lavage is preferred when the victim is unconscious or as in the case of strychnine poisoning is subject to seizures.

c. Activated charcoal (AC) adsorbs many substances in the stomach and prevents absorption into the body.
   i. After the substance is adsorbed to the AC, the bound substance moves through the stomach and is eliminated with the production of a charcoal-black bowel movement.
   ii. AC may be administered after emesis or lavage, or it may be used alone.

d. A cathartic (magnesium sulfate or sorbitol) may be used to “speed” the movement of the bound substance and minimize absorption.

4. Collect the vomitus for laboratory analysis.
5. Soothe the stomach with milk or milk of magnesia.
6. Transport the victim to a definitive care facility if symptoms persist.

**Corrosives**

Acids and alkalis (bases) produce actual chemical burning and corrosion of the tissues of the lips, mouth, throat, and stomach. Acids do most of their damage in the acidic stomach environment, while alkalis primarily destroy tissues in the mouth, throat, and esophagus. Stains and burns around the mouth, and the presence of characteristic odors provide clues as to an acid or base ingestion. Swallowing and breathing may be difficult, especially if any corrosive was aspirated into the lungs. Stridor, a high-pitched sound coming from the upper airway, may be heard. The abdomen may be tender and swollen with gas and perforation of the esophagus or stomach may occur.

**NEVER ATTEMPT TO TREAT AN ACID OR BASE INGESTION BY ADMINISTERING A NEUTRALIZING SOLUTION BY MOUTH. GIVE WATER ONLY, UNLESS DIRECTED BY A POISON CONTROL CENTER (PCC) OR MEDICAL OFFICER.** Monitor the ABC+D&Es, and watch for signs of shock. Examples of corrosive agents and sources of contact are listed in Table 22-3.
When providing treatment for the above poisons, DO NOT INDUCE VOMITING. The damage to the mouth and esophagus will be compounded. In addition, the threat of aspiration during vomiting is too great. *Gastric lavage* could cause perforation of the esophagus or stomach. Therefore, use it only on a doctor’s order. First aid consists of diluting the corrosive and keeping alert for a patent airway and shock. If spontaneous vomiting occurs, administer an antiemetic.

### Irritants

Substances such as automatic dishwasher detergent, diluted ammonia, and chlorine bleach can produce local irritation to the mucous membranes and potentially cause mild chemical burns. The pH of irritants may be slightly acidic or basic. If a patient has ingested an irritant, direct the patient to spit the product out and rinse the mouth repeatedly with water. Spit the rinse water out also. Do NOT administer anything other than water unless directed by a PCC or physician.

### Petroleum Distillates or Hydrocarbons

Volatile petroleum products (such as kerosene, gasoline, turpentine, and related petroleum products like red furniture polish) usually cause severe chemical pneumonia as well as other toxic effects in the body. Signs and symptoms include abdominal pain, choking, gasping, vomiting, and fever. These products may be identified by their characteristic odor. Mineral oil and motor oil are not as serious as they usually do nothing more than cause diarrhea.

When providing treatment for the ingestion of petroleum distillates, DO NOT INDUCE VOMITING unless told to do so by a PCC or physician. Vomiting may cause additional poison to enter the lungs. However, the quantity of poison swallowed or special petroleum additives may make gastric lavage or the use of cathartics advisable. If a physician or PCC cannot be reached, give the victim 30 to 60 ml of vegetable oil. Transport the victim immediately to a medical treatment facility.

<table>
<thead>
<tr>
<th>Agent</th>
<th>Sources of Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACIDS</td>
<td>Hydrochloric</td>
</tr>
<tr>
<td></td>
<td>Nitric</td>
</tr>
<tr>
<td></td>
<td>Oxalic</td>
</tr>
<tr>
<td></td>
<td>Sulfuric</td>
</tr>
<tr>
<td>ALKALIES</td>
<td>Ammonia</td>
</tr>
<tr>
<td></td>
<td>Lime</td>
</tr>
<tr>
<td></td>
<td>Lye</td>
</tr>
<tr>
<td></td>
<td>Carbolic</td>
</tr>
<tr>
<td>PHENOLS</td>
<td>Creosol</td>
</tr>
<tr>
<td></td>
<td>Creosote</td>
</tr>
</tbody>
</table>

Table 22-3.—Examples of Common Acids, Alkalies, and Phenols, with Possible Sources of Contact
Food Poisoning

Food poisoning can occur from ingesting animal or plant materials, or even from the chemicals that are used in raising, processing, or preserving crops and livestock. Most bacterial and viral food poisonings appear within eight hours of ingesting food. The signs and symptoms of poisoning include nausea, vomiting, diarrhea, muscle aches, and low-grade fever.

The general treatment is supportive and directed at preventing dehydration through the administration of fluids. If diarrhea persists more than 24 hours, or the patient is unable to keep fluids down, further definitive medical care is necessary. Food poisoning can also occur from ingestion of parasites.

INHALATION POISONS

In the Navy and in other industrial settings, inhalation is the more common route of exposure to toxic substances. The irritants and corrosives mentioned in Tables 22-2 and 22-3 are more often a source of poisoning by means of inhalation rather than by ingestion. An inhaled poison can act directly on the upper respiratory tract or lungs with immediate, delayed, or chronic effects or the substance can use the pulmonary system to gain entry into the body, be absorbed into the blood, and cause toxic effects (systemic toxicity) at a distant site of action.

The handling of large quantities of petroleum products (fuel oil and gasoline, in particular) constitutes a special hazard, since all of these products give off hazardous vapors. Other poisonous gases are by-products of certain operations or processes: exhaust fumes from internal combustion engines; fumes or vapors from materials used in casting, molding, welding, or plating; gases associated with bacterial decomposition in closed spaces; and gases that accumulate in voids, double bottoms, empty fuel tanks, and similar places. Some sources of inhalation chemical poisoning are listed in Table 22-4.

<table>
<thead>
<tr>
<th>Inhaled Substance</th>
<th>Source of Exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetone, isopropyl alcohol, amyl acetate</td>
<td>Nail polish remover</td>
</tr>
<tr>
<td>Aliphatic hydrocarbons</td>
<td>Fuels, Stoddard solvent, PD-680, mineral spirits, naphtha</td>
</tr>
<tr>
<td>Butane</td>
<td>Throw-away lighters</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>Fire suppression/fighting, evaporation of dry ice, wells and sewers</td>
</tr>
<tr>
<td>Carbon monoxide</td>
<td>Fires, lightning, heating and fuel exhausts</td>
</tr>
<tr>
<td>Chlorinated hydrocarbons</td>
<td>Shoe polish</td>
</tr>
<tr>
<td>Chlorine</td>
<td>Water purification, sewage treatment</td>
</tr>
<tr>
<td>Chlorofluorocarbons (CFCs)</td>
<td>Refrigerants, degreasers, propellants (old)</td>
</tr>
<tr>
<td>Hydrogen sulfide</td>
<td>Sewer, decaying materials, CHT system</td>
</tr>
<tr>
<td>Methylethylketone</td>
<td>Paint</td>
</tr>
<tr>
<td>Methylene chloride</td>
<td>Paint stripper, solvent, dyes</td>
</tr>
<tr>
<td>N-hexane</td>
<td>Rubber cement</td>
</tr>
<tr>
<td>Nitrous oxide</td>
<td>Aerosol can propellant</td>
</tr>
<tr>
<td>Tetrachloroethylene (perchloroethylene)</td>
<td>Dry cleaning</td>
</tr>
<tr>
<td>Toluene</td>
<td>Plastic adhesive, acrylic paint, shoe polish</td>
</tr>
<tr>
<td>Trichloroethane (methylchloroform)</td>
<td>Solvent, degreaser</td>
</tr>
</tbody>
</table>

Table 22-4.—Sources of Inhalation Poisoning
Carbon monoxide is the most common agent of gas poisoning. It is present in exhaust gases of internal combustion engines as well as in sewer gas, lanterns, charcoal grills, and in manufactured gas used for heating and cooking. It gives no warning of its presence as it is completely odorless and tasteless. The victim may lose consciousness and suffer respiratory distress with no warning other than slight dizziness, weakness, and headache. The lips and skin of a victim of carbon monoxide poisoning are characteristically cherry red. Death may occur within a few minutes.

Most inhalation poisoning causes shortness of breath and coughing. The victim's skin will turn blue. If the respiratory problem is not corrected, cardiac arrest will follow due to hypoxia.

Inhaling fine metal fumes can cause a special type of acute or delayed poisoning. These metal fumes are generated from heating metal to boiling and evaporation during hot metal work in such operations as metal cutting or welding. The resulting illness is called metal fume fever (MFF). In the Navy, the most common cause of MFF is the inhalation of vaporized zinc found in the galvanized covering of iron and steel. Proper local and general ventilation and or the use of respiratory protection are necessary to prevent this illness. The first stage of treatment for an inhalation poisoning is to remove the victim from the toxic atmosphere immediately.

If trained rescuers are not immediately available and the HM can reach and rescue the victim; this can be accomplished by taking a deep breath, holding it, entering the area, and pulling the victim out.

Immediately after pulling the victim out, follow the steps below:

1. Start basic life support (the ABC+D&Es).
2. Remove clothing to expose the victim (if chemical warfare agents or volatile fuels were the cause).
3. Keep the victim calm, detect and treat for life-threatening conditions to include administering oxygen.
4. Perform focused history and physical exam.
5. Transport the victim to a treatment facility for further treatment with all containers, bottles and labels of substance if available.

**ABSORBED POISONS**

Some substances cause tissue irritation or destruction by contact with the skin, eyes, and lining of the nose, mouth, and throat. These substances include acids, alkalis, phenols, and some chemical warfare agents. Direct contact with these substances will cause inflammation or chemical burns in the affected areas. Consult the “Chemical Burns "and “Chemical Agents " sections of Chapter 23 of this manual for treatment guidelines.

**INJECTED POISONS AND ENVENOMATIONS**

Injection of venom by stings and bites from various insects and arthropods, while not normally life-threatening, can cause an acute allergic reaction that can be fatal. Poisons may also be injected by snakes and marine animals.

**Bee, Wasp, and Fire Ant Stings**

Stings from bees, wasps, and ants account for more poisonings than stings from any other insect group. Fortunately, they rarely result in death.
The vast majority of stings cause a minor local reaction at the injection site, with pain, redness, itching, and swelling. These symptoms usually fade after a short time. A small percentage of these stings can cause an allergic victim severe anaphylactic reactions, presenting with itching, swelling, weakness, headache, difficulty breathing, and abdominal cramps. Shock may follow quickly, and death may occur.

The following first aid measures are recommended for all but minor, local reactions to bites or stings:

1. Closely monitor vital signs.
2. Due to edema of soft tissue, remove all rings, bracelets, and watches.
3. Remove stingers without squeezing additional venom (remaining in poison sacs attached to stingers) into the victim. To do this, scrape along the skin with a dull knife (as if shaving the patient). The dull blade will catch the stinger and pull it out.
4. Place an ice cube or analgesic-corticosteroid cream or lotion over the wound site to relieve pain.
5. For severe allergic reactions (generalized itching or swelling, breathing difficulty, feeling faint or clammy, unstable pulse or blood pressure), immediately give the victim a subcutaneous injection of 1:1000 aqueous solution of epinephrine. Dosage is 0.5 ml for adults and ranges from 0.1 to 0.3 ml for children.

**NOTE:**

Patients with a documented history of severe allergic reactions will commonly have an auto-injector syringe with epinephrine in it. If convenient, locate and use it.

Scorpion Stings

About 40 species of scorpions (Fig. 22-1) exist in America. *Centruroides exilicauda*, also called "bark scorpion," is the scorpion found in Mexico and the southwest region of United States and may cause severe effects.

![Figure 22-1.—Scorpion](image)

Most dangerous species are found from North Africa to India. Scorpion stings vary in severity, depending on the species of the scorpion and the amount of poison actually injected. They cause severe pain in the affected area. Mild reactions may include local swelling, skin discoloration, swollen lymph nodes near the sting area, itching, paresthesias ("pins and needles," numbness), and even nausea and vomiting. The duration of symptoms is less than 24 hours. The following first aid treatment should be given for scorpion stings:

1. Place ice over the sting site (cool the area for up to 2 hours). Do NOT use tobacco juice, saliva, or other concoctions.
2. Elevate the affected limb to approximately heart level to help reduce swelling.
4. Calcium gluconate, 10 ml of 10 percent solution, may be given intravenously to relieve muscle cramps.
5. Benzodiazepines (Valium and Midazolam) may be used to control excitability and convulsions.
6. Antivenom is available for severe stings by *Centruroides exilicauda*. It is available from the Good Samaritan Poison Center in Phoenix (602-253-3334) and Banner Poison Control Center Hotline at 1-800-222-1222.

**CAUTION:**
Morphine and meperidine hydrochloride may **worsen** the respiratory depression from the venom of *Centruroides exilicauda*.

### Spider Bites

Spiders in the United States are generally harmless, with several exceptions. The most notable are the black widow (*Latrodectus mactans*) and brown recluse (*Loxosceles recluse*, also found in South America) spiders. Their bites are serious but rarely fatal. Wandering spiders (*Phoneutria* species, found in South America), funnel web spiders (*Atrax* species, found in Australia), and more widely distributed spiders of the *Chiracanthium* species may also cause moderate to severe human reactions. Check the current MEDIC CD-ROM (available at Environmental Preventive Medicine Units) for management of specific situations and venues.

The female black widow spider is identified by the red hourglass-shaped spot on its belly (Fig. 22-2). Its bite causes a dull, numbing pain, which gradually spreads from the region of the bite to the muscles of the entire torso. The pain becomes severe, and a board-like rigidity of the abdominal muscles is common. Nausea, vomiting, headache, dizziness, dyspnea, edema, rash, hypertension, and anxiety are frequently present.

The bite site can be very hard to locate (there is little or no swelling at the site), and the victim may not be immediately aware of having been bitten. The buttocks and genitalia should be carefully examined for a bite site if the suspected victim has recently used an outside head.

The following first aid treatment steps are suggested:
1. Place ice over the bite to reduce pain.
2. Hospitalization for patients with respiratory distress; cardiovascular symptoms; protracted (deep) pain; pediatric and elderly patients, pregnant patients, or patients with cardiac history.
3. Be prepared to give antivenom in severe cases.

The brown recluse spider (Fig. 22-2) is identified by its violin-shaped marking. Its bite may initially go unnoticed, but after several hours, a bleb develops over the site, and rings of erythema begin to surround the bleb. Other symptoms include restlessness, fever, chills, nausea, vomiting, pain and shock.
A progressively enlarging necrotic ulcerating lesion eventually develops. Intravascular hemolysis is most often seen in children and may be fatal. Antivenom is not currently available.

Treatment for brown recluse spider bites includes the following:

1. Debridement of lesion, followed by peroxide cleansing and Aluminum Acetate solution soaks.
3. Treat with appropriate oral antibiotics as directed by the physician.

Snakebites

Poisonous snakes are found throughout the world, with the exception of certain islands and the Antarctic. There are five venomous families of snakes.

- **Viperidae**: Includes rattlesnakes, moccasins, South American lance-headed vipers and bushmasters, Asian pit vipers, African and Asian vipers and adders, European adders, and saw-scaled vipers (Middle-eastern). Death results mainly by coagulopathy (a blood clotting disorder) and shock.
- **Elapidae**: Includes cobras, kraits, mambas, and coral snakes. Death results from neurotoxic venom that causes respiratory failure, paralysis, and cardiac failure.
- **Hydrophidae**: Includes sea snakes and venomous snakes from the islands of the southern Pacific Ocean, including Australia, New Zealand, Guam, and New Guinea. Also kills from neurotoxic venom.
- **Colubridae**: Includes most of the common nonvenomous species, as well as the boomslang, and vine/twig/bird snake (Africa); Japanese yamakagashi; Southeast Asian red-necked callback. Venom method of toxic action varies according to type of snake.
- **Atractaspididae**: Includes the burrowing asps/mole vipers, stiletto snakes, and adders. Venom method of toxic action varies according to type of snake.

Within the United States, poisonous snakes are Crotalids (rattlesnakes, copperheads, and moccasins) and the Elapids (coral snakes).

**CROTALIDS**—are of the Viperidae (viper) family and are called "pit vipers" because of the small, deep pits between the nostrils and the eyes (Fig. 22-3). They have two long, hollow fangs. These fangs are normally folded against the roof of the mouth, but they can be extended when the snake strikes. Other identifying features include thick bodies; slit-like pupils of the eyes; and flat, triangular heads. The most identifying feature of a pit viper is the relative width of the snake head compared to the thickness of the body. The head will be **much wider** than the body, giving the appearance of an arrowhead. The difference in size is so obvious that identification of a snake as a pit viper can usually be made from a safe distance.

Figure 22-3.—American Pit Viper

Further identification can be made by examining the wound for signs of fang entry in the bite pattern. Pit viper bites leave two puncture marks (sometimes only one, and sometimes more). Nonvenomous snakes (for example, garter snakes) leave a series, often in a curve or semi-circle, of tiny scratches or punctures.
Individual identifying characteristics include rattles on the tails of most rattlesnakes, and the cotton-white interior of the mouths of moccasins.

**ELAPIDS.**—Coral snakes are of the family *Elipidae* and related to the cobra, kraits, and mamba snakes in other parts of the world (Fig. 22-4). Corals, which are found in the Southeastern United States, are comparatively thin snakes with small bands of red, black, and yellow (or almost white). Some nonpoisonous snakes have similar coloring.

Venom, which is stored in sacs in the snake’s head, is introduced into a victim through hollow or grooved fangs. An important point to remember, however, is that a bitten patient has not necessarily received a dose of venom. Snakes can control whether or not it will release the venom and how much it will inject. Baby snakes are unable to control the release of venom. Symptoms in a poisonous snakebite incident can be either severe, mild or not develop at all.

**Signs and Symptoms of Snakebites**

In a snakebite incident, every reasonable effort should be made to positively identify the snake; as the treatment of a nonpoisonous bite is far simpler and less dangerous to the victim than treatment of a poisonous bite. However, unless the snake can be **POSITIVELY** identified as nonpoisonous, **CONSIDER ALL SNAKEBITES AS POISONOUS! SEEK CONSULTATION FROM AN EXPERT SOURCE.**

Signs and symptoms of venomous snakebite include:

- A visible bite on the skin (possibly no more than a local discoloration)
- Pain and swelling in the bite area (may develop slowly, from 30 minutes to several hours)
- Continued bleeding from site of bite (often seen with viper bites)
- Rapid pulse
- Labored breathing
- Progressive weakness
- Dim or blurred vision
- Nausea and vomiting
- Drowsiness (or loss of consciousness)
Usually enough symptoms present themselves within an hour of a poisonous snakebite to erase any doubt as to the victim having been envenomated or not. The victim’s condition provides the best information as to the seriousness of the situation.

The aims of first aid for envenomated snakebites are to reduce - not stop - the circulation of blood through the bite area, delay absorption of venom, prevent aggravation of the local wound, maintain vital signs, and transport the victim as soon as possible to a treatment facility with minimum movement.

First Aid and Treatment

1. Try to identify the snake. Positive identification is important to selecting the correct antivenom for the treatment of the patient.

   **NOTE:**
   Do not risk further injury by trying to kill the snake.

2. GENTLY wash the wound with soap and water (it may remove some of the venom). Do NOT rub vigorously, as it may cause the venom to be absorbed more rapidly.

3. Certain suction extractors have benefit (for example, the Sawyer® Extractor™), especially if used within the first 3 minutes. If available immediately, use the extractor and leave it on for 30 minutes. The cups may fill up. Empty and re-use them as necessary.

4. Place the victim in a comfortable position.

5. Tell the patient to remove any jewelry (especially rings and bracelets, as these may impede blood flow if there is swelling of the extremities). Assist, if necessary.

6. Start an IV.

7. Monitor vital signs (including ABC + D&Es) closely, responding appropriately as necessary.

8. Until evacuation or treatment is possible, ensure the victim lies quietly and does not move any more than necessary.

9. Do not allow the victim to smoke, eat, or drink any fluids. (Water is permissible if it is anticipated more than several hours will pass before arriving at a hospital and prior to establishing an IV line.)

10. Transport the victim to a treatment facility.

11. Apply a bandage, wrapped two to four inches above the bite (towards the heart), to help slow the venom. This should not cut off the flow of blood from a vein or artery. The band should be loose enough to slip a finger under it.

12. Splint the extremity at a level below the heart. **DO NOT ELEVATE THE EXTREMITY**

13. Hospitalize and observe all snakebites for at least 24 hours.

   In the case of spitting cobras (found in Africa, Thailand, Malaysia, Indonesia, and the Philippines), which attempt to spray venom into victims' eyes, rinse the eyes with large volumes of cool water with pressure similar to that of water coming from a water tap. Apply antibacterial eye ointment and a patch with just enough pressure to keep the eyelid from blinking. Other aid will be mainly supportive:

   - Check pulse and respiration frequently. Give artificial ventilation, if necessary
   - Treat for shock, including IV fluids (normal saline or Lactated Ringer’s solution)
   - Clean the area of the bite with soap and water; cover the wound to prevent further contamination
   - Give acetaminophen for pain if delay in hospital treatment is anticipated

**Antivenom** (also called antivenin) is available for many snakes, and is indicated for severe envenomations by *Viperidae* family snakes and snakes of the other poisonous families. Antivenom is best given as soon as possible after an envenomation, but may be of value up to a few days after a bite.
If possible, antivenom specific to the snake should be used. Otherwise, a polyvalent specific antivenom may be used. READ THE PACKAGE INSERT OF THE ANTIVENOM FOR VALUABLE INFORMATION.

Epinephrine and diphenhydramine must be available; as allergic reactions (including anaphylaxis) to antivenom have occurred (they are often prepared from horse serum, to which some people are allergic).

Antivenom is diluted (for example, 1:10) and given at 5 ml/minute IV, and the dose is based on stopping the progression of signs and symptoms, not the victim’s body weight (the children’s dose is the same as the adult dose). For neurotoxic snakebites, if there is no improvement in 30 minutes, the dose should be repeated. For Viperidae (which can cause bleeding disorders), spontaneous bleeding should stop after sufficient antivenom is given; continue giving antivenom until bleeding stops and progression of swelling is retarded. Because the HM may need to administer antivenom a number of times, one vial may not be enough to treat a patient.

Antivenom is available via PCCs and hospitals. It may be available at zoos and embassies.

The “Don’ts” of Snakebite Treatment:
~DO NOT use any ice or cooling on the bite
~DO NOT use a tourniquet. Obstructing blood flow can make local tissue injury much worse
~DO NOT use electric shock
~DO NOT make any cuts or incisions in the wound. Cuts at the bite site may impede circulation and promote infection and make local tissue injury much worse
~DO NOT try to suck venom out by mouth
~DO NOT give victim alcohol or narcotics

Further information may be obtained on an emergent basis from a PCC or from American Association of Poison Control, 1-800-222-1222.

Bites, Stings, and Punctures from Sea Animals

A number of sea animals are capable of inflicting painful wounds by biting, stinging, or puncturing. Except under rare circumstances, these stings and puncture wounds are not fatal. Major wounds from sharks, barracuda, moray eels, and alligators can be treated by controlling the bleeding, preventing shock, giving basic life support, splinting the injury, and transporting the victim to a medical treatment facility. Minor injuries inflicted by turtles and stinging corals require only that the wound be thoroughly cleansed and the injury splinted. Examples of fish that are known to be poisonous AT ALL TIMES are shown in Figure 22-5.

![Poisonous Fish](image)

Figure 22-5.—Poisonous Fish

Venomous Fish⁴ (Excluding Stonefish, Zebrafish, Scorpionfish).—Identification of a fish following a sting is not always possible; however, symptoms and effects of venom do not vary greatly. Venomous fish are rarely aggressive and usually contact is made by accidentally stepping on or handling the fish. Dead fish spines remain toxic. Venom is generally heat-labile and may be decomposed by hot water.
Local symptoms following a sting may first include severe pain later combined with numbness or even hypersensitivity around the wound. The wound site may become cyanotic with surrounding tissue becoming pale and swollen. General symptoms include nausea, vomiting, sweating, mild fever, respiratory distress and collapse. The pain induced may seem disproportionately high to apparent severity of the injury. Medical personnel should be prepared for serious anaphylactic reactions from apparently minor stings or envenomation.

First Aid and Treatment

2. Lay patient down and reassure.
3. Observe for signs of shock.
4. Initially rinse wound with cold salt water or sterile saline solution. Surgery may be required to open up the puncture wound. Suction is not effective to remove this toxin.
5. Soak wound in hot water for 30 to 90 minutes. Heat may break down the venom.
   a. The water should be as hot as the victim can tolerate but not hotter than 114°F (45.6°C).
   b. Immersion in water not hotter than 114°F (45.6°C) for longer than a brief period may lead to scalding.
   c. Immersion in water not hotter than 114°F (45.6°C) should therefore be brief and repeated as necessary.
   d. Use hot compresses if the wound is on the face.
   e. Adding magnesium sulfate (Epsom salts) to the water offers no benefit.
6. Medication usage:
   a. Calcium gluconate injections, diazepam, or methocarbamol may help to reduce muscle spasms.
   b. Infiltration of the wound with 0.5 percent to 2.0 percent Xylocaine without epinephrine is helpful in reducing pain. **If Xylocaine with epinephrine is mistakenly used, local necrosis may result from both the toxin and epinephrine present in the wound.**
   c. Narcotics may also be needed to manage severe pain.
7. Clean and debride wound. Spines and sheath (covering of the spines) frequently remain. Be sure to remove the entire sheath as it may continue to release venom.
8. Injury site management:
   a. Tourniquets or ligatures are no longer advised.
   b. Use an antiseptic or antibiotic ointment and sterile dressing.
   c. Restrict movement of the extremity with immobilizing splints and cravats.
9. Administer tetanus prophylaxis as appropriate.
10. Treat prophylactically with topical antibiotic ointment. If delay in treatment has occurred, it is recommended that the wound be cultured prior to administering systemic antibiotics.

Stonefish, Zebrafish, Scorpionfish Stings by stonefish, zebrafish, and scorpionfish have been known to cause fatalities. While many similarities exist between these fish and the venomous fish of the previous section, a separate section has been included because of the greater toxicity of their venom and the availability of an antivenin.
The antivenin is specific for the stonefish but may have some beneficial effects against the scorpionfish and zebrafish. Local symptoms are similar to other fish envenomation except that pain is more severe and may persist for many days. Generalized symptoms are often present and may include respiratory failure and cardiovascular collapse. These fish are widely distributed in temperate and tropical seas and in some arctic waters. They are shallow-water bottom dwellers. Stonefish (Fig. 22-6) and scorpionfish are flattened vertically, dark and mottled. Zebrafish are ornate and feathery in appearance with alternating patches of dark and light color.

Figure 22-6.—Stonefish


First Aid and Treatment:

1. Give the same first aid as that given for venomous fish.

2. Observe the patient carefully for the possible development of life-threatening complications.

   a. The venom is an unstable protein which acts as a myotoxin on skeletal, involuntary, and cardiac muscle.

   b. It may result in muscular paralysis, respiratory depression, peripheral vasodilation, shock, cardiac dysrhythmias, or cardiac arrest.

3. Clean and debride wound.

4. Antivenin is available from the Commonwealth Serum Lab, Melbourne, Australia. Utilize the medical chain of command to obtain.

   a. If antivenin is used, the directions regarding dosage and sensitivity testing on the accompanying package insert should be followed and the physician must be ready to treat for anaphylactic shock.

   b. In brief, one or two punctures require 2,000 units (one ampule); three to four punctures, 4,000 units (two ampules); and five to six punctures, 6,000 units (three ampules).

   c. Antivenin must be delivered by slow IV injection and the victim closely monitored for anaphylactic shock.

5. Institute tetanus prophylaxis, analgesic therapy, and antibiotics as described for other fish stings.

Figurings - The stingray is common in all tropical, subtropical, warm, and temperate regions. It favors sheltered water and burrows into sand with only eyes and tail exposed. It has a bat-like shape and a long tail (Fig. 22-7). Approximately 1,800 stingray attacks are reported annually in the U.S. Most attacks occur when waders inadvertently step on a stingray, causing it to lash out defensively with its tail.

Figure 22-7.—Stingray

The spine is located near the base of the tail. Wounds are either of the laceration or puncture type and are extremely painful. The wound appears swollen and pale with a blue rim. Secondary wound infections are common. Systemic signs and symptoms may be present and can include fainting, nausea, vomiting, sweating, respiratory difficulty, and cardiovascular collapse.

**First Aid and Treatment**

1. Give the same first aid as that given for venomous fish. No antivenin is available.
2. Institute hot water therapy as described under fish envenomation.
3. Clean and debride wound.
   a. Removal of the spine may additionally lacerate tissues due to retropointed barbs.
   b. Be sure to remove integumental sheath as it will continue to release toxin.
4. Observe patient carefully for the possible development of life-threatening complications.
   a. Signs and symptoms can include cardiac dysrhythmias, hypotension, vomiting, diarrhea, sweating, muscle paralysis, respiratory depression, and cardiac arrest.
   b. Fatalities have been reported occasionally.
5. Institute tetanus prophylaxis, analgesic therapy, and broad-spectrum antibiotics as described for fish envenomation.

**Coelenterates** - Hazardous types of coelenterates include: Portuguese man-of-war, sea wasp or box jellyfish, sea nettle, sea blubber, sea anemone, and rosy anemone (Fig. 22-8). Jellyfish vary widely in color (blue, green, pink, red, or brown) or may be transparent. They appear to be balloon-like floats with tentacles dangling down into the water.

The most common stinging injury is the jellyfish sting. Jellyfish can come into direct contact with a diver in virtually any oceanic region, worldwide. When this happens, the diver is exposed to literally thousands of minute stinging organs in the tentacles called nematocysts. Most jellyfish stings result only in painful local skin irritation. The sea wasp or box jellyfish and Portuguese man-of-war are the most dangerous types. The sea wasp or box jellyfish (found in the Indo-Pacific) can induce death within 10 minutes by cardiovascular collapse, respiratory failure, and muscular paralysis. Deaths from Portuguese man-of-war stings have also been reported. Even though intoxication from ingesting a poisonous sea anemone is rare, sea anemones must not be eaten.

**Avoidance of Tentacles** - In some species of jellyfish, tentacles may trail for great distances horizontally or vertically in the water and are not easily seen by the diver. Swimmers and divers should avoid close proximity to jellyfish to avoid contacting their tentacles, especially when near the surface.
Protection against Jellyfish - Wet suits, body shells, or protective clothing should be worn when diving in waters where jellyfish are abundant. Petroleum jelly applied to exposed skin (e.g., around the mouth) helps to prevent stinging, but caution should be used since petroleum jelly can deteriorate rubber products.

First Aid and Treatment

1. Without rubbing, gently remove any remaining tentacles using a towel or clothing.
2. For preventing any further discharge of the stinging nematocysts, use vinegar (dilute acetic acid) or a 3- to 10-percent solution of acetic acid. An aqueous solution of 20 percent aluminum sulfate and 11 percent surfactant (detergent) is moderately effective but vinegar works better.
3. What NOT to use:
   a. Do not use alcohol or preparations containing alcohol.
      i. Methylated spirits or methanol, 100 percent alcohol and alcohol plus seawater mixtures have all been demonstrated to cause a massive discharge of the nematocysts.
      ii. In addition, these compounds may also worsen the skin inflammatory reaction.
   b. Picric acid, human urine, and fresh water also have been found to either be ineffective or even to discharge nematocysts and should not be used.
   c. Rubbing sand or applying papain-containing meat tenderizer is ineffective and may lead to further nematocysts discharge and should not be used.
4. It has been suggested that isopropyl (rubbing) alcohol may be effective. It should only be tried if vinegar or dilute acetic acid is not available.

Symptomatic Treatment can include topical steroid therapy, anesthetic ointment (Xylocaine, 2 percent), antihistamine lotion, systemic antihistamines or analgesics. Benzocaine topical anesthetic preparations should not be used as they may cause sensitization and later skin reactions.

Anaphylaxis may result from Jellyfish stings.

Antivenin is available to neutralize the effects of the sea wasp or box jellyfish (Chironex fleckeri, Fig. 22-9). The antivenin should be administered slowly through an IV, with an infusion technique if possible. IM injection should be administered only if the IV method is not feasible. One vial of sea wasp antivenin should be used by the IV route and three vials if injected by the IM route. Each vial of sea wasp antivenin is 20,000 units and is to be kept refrigerated, not frozen, at 36–50°F (2–10°C).

Figure 22-9.—Chironex

Sensitivity reaction to the antivenin should be treated with a subcutaneous injection of epinephrine (0.3 ml of 1:1,000 dilution), corticosteroids, and antihistamines. Treat any hypotension (severely low blood pressure) with IV volume expanders and pressor medication as necessary. The antivenin may be obtained from the Commonwealth Serum Laboratories, Melbourne, Australia. Utilize the medical chain of command to obtain.

Coral<sup>4</sup> - Coral, a porous, rock-like formation and found in tropical and subtropical waters. It is extremely sharp and the most delicate coral is often the most dangerous because of their razor-sharp edges. Coral cuts, while usually fairly superficial, take a long time to heal and can cause temporary disability.

The smallest cut, if left untreated, can develop into a skin ulcer. Secondary infections often occur and may be recognized by the presence of a red and tender area surrounding the wound. All cuts should receive medical attention.

Some varieties of coral can actually sting a diver since coral is a coelenterate like jellyfish. Some of the soft coral of the genus Palythoa have been found recently to contain the deadliest poison known to man. This poison is found within the body of the organism and not in the stinging nematocysts. The slime of this coral may cause a serious skin reaction (dermatitis) or even be fatal if exposed to an open wound. No antidote is known.

Protection against Coral - Coral should not be handled with bare hands. Feet should be protected with booties, coral shoes, or tennis shoes. Wet suits and protective clothing, especially gloves (neoprene or heavy work gloves), should be worn when near coral.

First Aid and Treatment<sup>4</sup>

1. Control local bleeding.
2. Promptly clean with hydrogen peroxide or 10-percent povidone-iodine solution and debride the wound, removing all foreign particles.
3. Cover with a clean dressing.
4. Administer tetanus prophylaxis as appropriate.
5. Topical antibiotic ointment has been proven very effective in preventing secondary infection.
6. Stinging coral wounds may require symptomatic management such as topical steroid therapy, systemic antihistamines, and analgesics.
   a. In severe cases, restrict the patient to bed rest with elevation of the extremity, wet-to-dry dressings, and systemic antibiotics.
   b. Systemic steroids may be needed to manage the inflammatory reaction resulting from a combination of trauma and dermatitis.

Octopus<sup>4</sup> - The octopus inhabits tropical and temperate oceans. Species vary depending on region. It has a large sac surrounded by 8 to 10 tentacles (Fig. 22-10). The head sac is large with well-developed eyes and horny jaws on the mouth. Movement is made by jet action produced by expelling water from the mantle cavity through the siphon.

Figure 22-10.—Blue-Ring Octopus

The octopus will hide in caves, crevices and shells. It possesses a well-developed venom apparatus in its salivary glands and stings by biting. Most species of octopus found in the U.S. are harmless. The blue-ringed octopus common in Australian and Indo-Pacific waters may inflict fatal bites. The venom of the blue-ringed octopus is a neuromuscular blocker called tetrodotoxin and is also found in Puffer (Fugu) fish.

Envenomation from the bite of a blue-ringed octopus may lead to muscular paralysis, vomiting, respiratory difficulty, visual disturbances, and cardiovascular collapse. Octopus bites consist of two small punctures. A burning or tingling sensation results and may spread. Swelling, redness, and inflammation are common. Bleeding may be severe and the clotting ability of the blood is often retarded by the action of an anticoagulant in the venom.

First Aid and Treatment

1. Control local bleeding.
2. Clean and debride the wound and cover with a clean dressing.
3. For suspected blue-ringed octopus bites, apply direct pressure with a pressure bandage and immobilize the extremity in a position that is lower than the heart using splints and elastic bandages. Do not apply a loose constrictive band.
4. Be prepared to administer mouth-to-mouth resuscitation and cardiopulmonary resuscitation if necessary.
5. Blue-ringed octopus venom is heat stable and acts as a neurotoxin and neuromuscular blocking agent.
   a. Venom is not affected by hot water therapy.
   b. No antivenin is available.
6. Medical therapy for blue-ringed octopus bites is directed toward management of paralytic, cardiovascular, and respiratory complications.
   a. Respiratory arrest is common and intubation with mechanical ventilation may be required.
   b. Duration of paralysis is between 4 and 12 hours.
   c. Reassure the patient.
7. Administer tetanus prophylaxis as appropriate.

Segmented Worms (Annelida) (Examples: Bloodworm and Bristleworm) - This invertebrate type varies according to region and is found in warm, tropical, or temperate zones. It is usually found under rocks or coral and is especially common in the tropical Pacific, Bahamas, Florida Keys, and Gulf of Mexico.

Annelida have long, segmented bodies with stinging bristle-like structures on each segment. Some species have jaws and will also inflict a very painful bite. Venom causes swelling and pain.

First Aid and Treatment

1. Remove bristles with a very sticky tape such as adhesive tape or duct tape. Topical application of vinegar will lessen pain.
2. Treatment is directed toward relief of symptoms and may include topical steroid therapy, systemic antihistamines, and analgesics.
3. Wound infection can occur but can be easily prevented by cleaning the skin using an antiseptic solution of 10 percent povidone-iodine and topical antibiotic ointment.
4. Systemic antibiotics may be needed for established secondary infections that first need culturing, aerobically and anaerobically.
**Sea Urchins** - There are various species of sea urchins with widespread distribution. Each species has a radial shape and long spines. Penetration of the sea urchin spine can cause intense local pain due to venom in the spine or from another type of stinging organ called the globiferous pedicellariae. Numbness, generalized weakness, paresthesias, nausea, vomiting, and cardiac dysrhythmias have been reported.

**First Aid and Treatment**

1. Remove large spine fragments gently, being very careful not to break them into small fragments that remain in the wound.
2. Bathe the wound in vinegar or isopropyl alcohol. Soaking the injured extremity in hot water up to 122°F (50°C) may help. Caution should be used to prevent scalding the skin which can easily occur after a brief period in water above 122°F (50°C).
3. Clean and debride the wound. Topical antibiotic ointment should be used to prevent infection. Culture both aerobically and anaerobically before administering systemic antibiotics for established secondary infections.
4. Remove as much of the spine as possible. Some small fragments may be absorbed by the body. Surgical removal, preferably with a dissecting microscope, may be required when spines are near nerves and joints. X-rays may be required to locate these spines. Spines can form granulomas months later and may even migrate to other sites.
5. Allergic reaction and bronchospasm can be controlled with subcutaneous epinephrine (0.3 ml of 1:1,000 dilution) and by using systemic antihistamines. There are no specific antivenins available.
6. Administer tetanus prophylaxis as appropriate.
7. Get medical attention for deep wounds.

**Cone Shells** - The cone shell is widely distributed in all regions and is usually found under rocks and coral or crawling along sand. The shell is most often symmetrical in a spiral coil, colorful, with a distinct head, one to two pairs of tentacles, two eyes, and a large flattened foot on the body (Fig. 22-11).

A cone shell sting should be considered as severe as a poisonous snake bite. It has a highly developed venom apparatus: venom is contained in darts inside the proboscis which extrudes from the narrow end but is able to reach most of the shell. Cone shell stings are followed by a stinging or burning sensation at the site of the wound. Numbness and tingling begin at the site of the wound and may spread to the rest of the body; involvement of the mouth and lips is severe. Other symptoms may include muscular paralysis, difficulty with swallowing and speech, visual disturbances, and respiratory distress, with a 25% mortality rate.

Figure 22-11.—Cone Shells

First Aid and Treatment

1. Lay the patient down.
2. Direct pressure with a pressure bandage over the site and immobilization in a position lower than the level of the heart using splints and elastic bandages is recommended. Do not apply a loose constricting band or ligature.
3. Some authorities recommend incision of the wound and removal of the venom by suction, although this is controversial.
   a. General agreement is that if an incision is to be made, the cuts should be small (one centimeter), linear and penetrate no deeper than the subcutaneous tissue.
   b. The incision and suction should only be performed if it is possible to do so within two minutes of the sting. Otherwise, the procedure may be ineffective.
   c. Incision and suction by inexperienced personnel has resulted in inadvertent disruption of nerves, tendons, and blood vessels.
4. Transport the patient to a medical facility while ensuring that the patient is breathing adequately. Be prepared to administer mouth-to-mouth resuscitation if necessary.
5. Cone shell venom results in paralysis or paresis of skeletal muscle, with or without myalgia. Symptoms develop within minutes of the sting and effects can last up to 24 hours.
6. No antivenin is available.
7. Respiratory distress may occur due to neuromuscular block. Patient should be admitted to a treatment facility and monitored closely for respiratory or cardiovascular complications. Treat as symptoms develop.
   Local anesthetic with no epinephrine may be injected into the site of the wound if pain is severe. Analgesics which produce respiratory depression should be used with caution.
8. Management of severe stings is supportive. Respiration may need to be supported with intubation and mechanical ventilation.
9. Administer tetanus prophylaxis as appropriate.

Sea Snakes - The sea snake is an air-breathing reptile which has adapted to its aquatic environment by developing a paddle tail. Sea snakes inhabit the Indo-Pacific area and the Red Sea and have been seen 150 miles from land. The most dangerous areas in which to swim are river mouths as sea snakes are more numerous and the water more turbid. The sea snake is a true snake, usually 3 to 4 feet in length, but may reach 9 feet. It is generally banded (Figs. 22-12 and 22-13). The sea snake is curious and is often attracted by divers and usually not aggressive except during its mating season.

**Figure 22-13.—Hydrophis Snake**

**Figure 22-12.—Yellow-Bellied Snake**
Sea Snake Bite Effects - The sea snake injects a poison that has 2 to 10 times the toxicity of cobra venom. The bites usually appear as four puncture marks but may range from one to 20 punctures. Teeth may remain in the wound. The neurotoxin poison is a heat-stable nonenzymatic protein; hence, bites should not be immersed in hot water as with venomous fish stings. Due to its small jaws, bites often do not result in envenomation.

Bites characteristically produce little pain and there is usually a latent period of 10 minutes to as long as several hours before the development of generalized symptoms: muscle aching and stiffness, thick tongue sensation, progressive paralysis, nausea, vomiting, difficulty with speech and swallowing, respiratory distress and failure, plus smoky-colored urine from myoglobinuria, which may lead to kidney failure.

First Aid and Treatment

1. Keep victim still.
2. Apply direct pressure using a compression bandage and immobilize the extremity in the dependent position with splints and elastic bandages. This prevents spreading of the neurotoxin through the lymphatic circulation. Do not apply a loose constricting band or tourniquet.
3. Incise and apply suction (see cone shell stings).
4. Transport all sea snake-bite victims to a treatment facility as soon as possible, regardless of their current symptoms.
5. Watch to ensure that the patient is breathing adequately. Be prepared to administer mouth-to-mouth resuscitation or cardiopulmonary resuscitation if required.
6. The venom is a heat-stable protein which blocks neuromuscular transmission. Myonecrosis with resultant myoglobinuria and renal damage are often seen. Hypotension may develop.
7. Respiratory arrest may result from generalized muscular paralysis; intubation and mechanical ventilation may be required.
8. Renal function:
   b. Peritoneal or hemodialysis may be needed.
   c. Alkalinization of urine with sufficient IV fluids will promote myoglobin excretion.
9. Vital signs should be monitored closely. Cardiovascular support plus oxygen and IV fluids may be required.
10. Because of the possibility of delayed symptoms, all sea snake-bite victims should be observed for at least 12 hours.
11. If symptoms of envenomation occur within one hour, antivenin should be administered as soon as possible.
   a. In a seriously envenomated patient, antivenin therapy may be helpful even after a significant delay.
   b. Antivenin is available from the Commonwealth Serum Lab in Melbourne, Australia.
   c. If specific antivenin is not available, polyvalent land snake antivenin (with a tiger snake or krait Elapidae component) may be substituted.
   d. If antivenin is used, the directions regarding dosage and sensitivity testing on the accompanying package insert should be followed and the physician must be ready to treat for anaphylaxis.
   e. Infusion by IV method or closely monitored drip over a period of one hour is recommended.
12. Administer tetanus prophylaxis as appropriate.
**Sponges** - Sponges are composed of minute multicellular animals with spicules of silica or calcium carbonate embedded in a fibrous skeleton. Exposure of skin to the chemical irritants on the surface of certain sponges or exposure to the minute sharp spicules can cause a painful skin condition called dermatitis.

**First Aid and Treatment**

1. Adhesive or duct tape can effectively remove the sponge spicules.
2. Vinegar or a 3- to 10-percent acetic acid should be applied with saturated compresses as sponges may be secondarily inhabited by stinging coelenterates.
3. Antihistamine lotion (diphenhydramine) and later a topical steroid (hydrocortisone) may be applied to reduce the early inflammatory reaction.
4. Antibiotic ointment is effective in reducing the chance of a secondary infection.

**POISONOUS MARINE ANIMALS**

**Ciguatera Fish Poisoning**

Ciguatera poisoning is fish poisoning caused by eating the flesh of a fish that has eaten a toxin-producing microorganism; the dinoflagellate, Gambierdiscus toxicus produces ciguatoxin. The poisoning is common in reef fish between latitudes 35ºN and 35ºS around tropical islands or tropical and semitropical shorelines in Southern Florida, the Caribbean, the West Indies, and the Pacific and Indian Oceans. Fish and marine animals affected include barracuda, red snapper, grouper, sea bass, amberjack, parrot fish, and the moray eel. Incidence is unpredictable and dependent on environmental changes that affect the level of dinoflagellates.

The toxin is heat-stable, tasteless, and odorless, and is not destroyed by cooking or gastric acid. Symptoms may begin immediately or within several hours of ingestion and may include nausea, vomiting, diarrhea, itching and muscle weakness, aches and spasms.

Neurological symptoms may include pain, ataxia (stumbling gait), paresthesias (tingling), and circumoral parasthesias (numbness around the mouth). Sensory reversal of hot and cold sensation when touching or eating objects of extreme temperatures may occur.

In severe cases, respiratory failure and cardiovascular collapse may occur. Pruritus (itching) is characteristically made worse by alcohol ingestion. Gastrointestinal symptoms usually disappear within 24 to 72 hours. Complete recovery will occur in the majority of cases with neurological symptoms persisting for months or years. Signs and symptoms of ciguatera fish poisoning may be misdiagnosed as decompression sickness or contact dermatitis from unseen fire coral or jellyfish.

Because of rapid modern travel and refrigeration, ciguatera poisoning may occur far from endemic areas with international travelers or unsuspecting restaurant patrons. Table 22-5 lists some of toxins found in fish and shellfish and their potential sources.

<table>
<thead>
<tr>
<th>Toxin</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ciguatoxin (cholinergic effects)</td>
<td>Tends to be found in fish from Coral reefs, including barracuda, grouper, red snapper, parrot fish</td>
</tr>
<tr>
<td>Scombrozotxin (histamine-like reaction)</td>
<td>Tuna, bonito, skipjack, mackerel, mahi mahi</td>
</tr>
<tr>
<td>Saxitoxin (neurologic effects)</td>
<td>Bivalve shellfish (mussels, clams, scallops) accumulate toxin from dinoflagellate during red tides causing paralytic shellfish poisoning</td>
</tr>
<tr>
<td>*Tetrodotoxin (neurotoxin)</td>
<td>Bacteria found in puffer fish, California newt, eastern salamander</td>
</tr>
<tr>
<td>*Neurotoxin</td>
<td>Moray eel</td>
</tr>
</tbody>
</table>

Table 22-5.—Examples of Toxins from Fish Known to be Poisonous
First Aid and Treatment

1. Treatment is largely supportive and symptomatic. If the time since suspected ingestion of the fish is brief and the victim is fully conscious, induce vomiting (syrup of Ipecac) and administer purgatives (cathartics, laxatives) to speed the elimination of undigested fish.

2. In addition to the symptoms described above, other complications which may require treatment include hypotension and cardiac dysrhythmias.

3. Medication management:
   a. Antiemetics and antidiarrheal agents may be required if gastrointestinal symptoms are severe.
   b. Atropine may be needed to control bradycardia.
   c. IV fluids may be needed to control hypotension.
   d. Calcium gluconate, diazepam, and methocarbamol can be given for muscle spasm.
   e. Amytriptyline has been used successfully to resolve neurological symptoms such as depression.

Scombroid Fish Poisoning

Unlike ciguatera fish poisoning where actual toxin is already concentrated in the flesh of the fish, scombroid fish poisoning occurs from different types of fish that have not been promptly cooled or prepared for immediate consumption. Typical fish causing scombroid poisoning include tuna, skipjack, mackerel, bonito, dolphin fish, mahi mahi (Pacific dolphin), and bluefish. Fish that cause scombroid poisoning are found in both tropical and temperate waters.

A rapid bacterial production of histamine and saurine (a histamine-like compound) produce the symptoms of a histamine reaction: nausea, abdominal pain, vomiting, facial flushing, urticaria (hives), headache, pruritus (itching), bronchospasm, and a burning or itching sensation in the mouth. Symptoms may begin one hour after ingestion and last 8 to 12 hours. Death is rare.

Prevention - Immediately clean the fish and preserve by rapid chilling. Do not eat any fish that has been left in the sun or in the heat longer than two hours.

First Aid and Treatment

Oral antihistamine, (e.g., diphenhydramine, cimetidine), epinephrine (given subcutaneously), and steroids are to be given as needed. Table 22-5 lists some of toxins found in fish and shellfish and their potential sources.

Puffer (Fugu) Fish Poisoning

An extremely potent neurotoxin called tetrodotoxin is found in the viscera, gonads, liver, and skin of a variety of fish, including the puffer fish, porcupine fish, and ocean sunfish. Puffer fish also called blow fish, toad fish, and balloon fish, and called Fugu in Japanese are found primarily in the tropics but also in temperate waters of the coastal U.S., Africa, South America, Asia, and the Mediterranean. Puffer fish is considered a delicacy in Japan, where it is thinly sliced and eaten as sashimi. Licensed chefs are trained to select those puffer fish least likely to be poisonous and also to avoid contact with the visceral organs known to concentrate the poison.

The first sign of poisoning is usually tingling around the mouth, which spreads to the extremities and may lead to a body wide numbness. Neurological findings may progress to stumbling gait (ataxia), generalized weakness, and paralysis. The victim, though paralyzed, remains conscious until death occurs by respiratory arrest with a 50 to 60 % mortality rate if untreated.
First Aid and Treatment

1. Provide supportive care with airway management and monitor breathing and circulation.
3. Monitor and treat cardiac dysrhythmias.

Paralytic Shellfish Poisoning (PSP): Red Tide

Paralytic shellfish poisoning (PSP) is due to mollusks (bivalves) such as clams, oysters, and mussels ingesting dinoflagellates that produce a neurotoxin which then affects man. Proliferation of these dinoflagellates during the warmest months of the year produces a characteristic red tide. However, some dinoflagellate blooms are colorless, so that poisonous mollusks may be unknowingly consumed.

Local public health authorities must monitor both seawater and shellfish samples to detect the toxin. Poisonous shellfish cannot be detected by appearance, smell, or discoloration of either a silver object or garlic placed in the cooking water. Poisonous shellfish can be found in either low or high tidal zones. The toxic varieties of dinoflagellates are common in the following areas: Northwestern U.S. and Canada, Alaska, part of western South America, Northeastern U.S., the North Sea European countries, and in the Gulf Coast area of the U.S. One other type of dinoflagellate, though not toxic if ingested, may lead to eye and respiratory tract irritation from shoreline exposure to a dinoflagellate bloom that becomes aerosolized by wave action and wind.

Symptoms - include circumoral paresthesias (tingling around the mouth) which spread to the extremities and may progress to muscle weakness, ataxia, salivation, intense thirst, and difficulty in swallowing. Gastrointestinal symptoms are not common. Death, although uncommon, can result from respiratory arrest. Symptoms begin 30 minutes after ingestion and may last for many weeks. Gastrointestinal illness occurring several hours after ingestion is most likely due to a bacterial contamination of the shellfish.

Allergic reactions such as urticaria (hives), pruritus (itching), dryness or scratching sensation in the throat, swollen tongue and bronchospasm may also be an individual hypersensitivity to a specific shellfish and not PSP.

First Aid and Treatment

1. No antidote is known.
2. If the victim is fully conscious, induce vomiting with 30 ml (two tablespoons) of syrup of Ipecac.
3. Lavaging the stomach with alkaline fluids (solution of baking soda) may be helpful since the poison is acid-stable.
4. Provide supportive treatment with close observation and advanced life support if needed until the illness resolves.

NOTE:
The poisoning is related to the quantity of poisonous shellfish consumed and the concentration of the dinoflagellate contamination.

Bacterial and Viral Diseases from Shellfish

Large outbreaks of typhoid fever and other diarrheal diseases caused by the genus Vibrio have been traced to consuming contaminated raw oysters and inadequately cooked crabs and shrimp. Diarrheal stool samples from patients suspected of having bacterial and viral diseases from shellfish should be placed on a special growth medium (thiosulfate-citrate-bile salts-sucrose agar) to specifically grow Vibrio species, with isolates being sent to reference laboratories for confirmation.

Prevention - To avoid bacterial or viral disease (e.g., Hepatitis A or Norwalk viral gastroenteritis) associated with oysters, clams, and other shellfish, an individual should eat only thoroughly cooked shellfish. It has been proven that eating raw shellfish (mollusks) presents a definite risk of contracting disease.
First Aid and Treatment

1. Provide supportive care with attention to maintaining fluid intake by mouth or IV if necessary.
2. Consult medical personnel for treatment of the various Vibrio species that maybe suspected.

Sea Cucumber

Frequently eaten in some parts of the world where it is sold as Tre pang or Beche-de-mer. It is boiled and then dried in the sun or smoked. Contact with the liquid ejected from the visceral cavity of some sea cucumber species may result in a severe skin reaction (dermatitis) or even blindness. Intoxication from sea cucumber ingestion is rare.

First Aid and Treatment

1. Because no antidote is known, treatment is only symptomatic.
2. Skin irritation may be treated like jellyfish stings.

Parasitic Infestation

Parasitic infestations can be of two types: superficial and flesh. Superficial parasites burrow in the flesh of the fish and are easily seen and removed. These may include fish lice, anchor worms, and leeches. Flesh parasites can be either encysted or free in the muscle, entrails, and gills of the fish. These parasites may include roundworms, tapeworms, and flukes. If the fish is inadequately cooked, these parasites can be passed on to humans.

Prevention.-Avoid eating raw fish. Prepare all fish by thorough cooking or hot-smoking. When cleaning fish, look for mealy or encysted areas in the flesh; cut out and discard any cyst or suspicious areas. Remove all superficial parasites. Never eat the entrails or viscera of any fish.

DRUG ABUSE

LEARNING OBJECTIVES:

Identify drug abuse assessment and treatment procedures.

Explain patient handling techniques.

Drug abuse is the use of drugs for purposes or in quantities for which they were not intended. Drugs of abuse may be swallowed, inhaled, snorted, injected, or even absorbed through the skin, rectum, or vagina. When abused, therapeutic drugs become a source of “poison” to the body. Drug abuse can lead to loss of income, social isolation, serious illness, dependency, and death. Although drug abuse is commonly associated with the use of illegal drugs, it can also be due to prescription medications as well.

Drugs of abuse can be classified in many different ways. This chapter will classify those drugs of abuse based on the symptoms produced: CNS depression, CNS stimulation, and hallucinations. The CNS depressants include narcotics, ethanol, barbiturates, non-barbiturate sedative-hypnotics (including benzodiazepines). The CNS stimulants include caffeine, nicotine, amphetamines, and cocaine. The hallucinogens include lysergic acid diethylamide (LSD), phencyclidine (PCP), and marijuana.

Table 22-6 lists many of the most frequently abused drugs with the recognizable trade names, commonly used street names, and observable symptoms of abuse. The following sections contain specific information about commonly abused drugs, as classified in Table 22-6, including availability and methods of administration.
<table>
<thead>
<tr>
<th><strong>Stimulants</strong></th>
<th><strong>Depressant</strong></th>
<th><strong>Opium &amp; Opium Alkaloids</strong></th>
<th><strong>Mind-Altering Drugs</strong></th>
<th><strong>Inhalants</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>AMPHETAMINES (Benzedrine, bennies, pep pills, ups, uppers, cartwheels)</td>
<td>AMOBARBITAL (blue devils, downers barbs, Amytal®)</td>
<td>CODEINE (often in cough syrup)</td>
<td>Hallucinogenic: DMT</td>
<td>AMYL NITRATE</td>
</tr>
<tr>
<td>BIPHETAMINE (bam)</td>
<td>BARBITURATES (downers, dolls, barbs, rainbows)</td>
<td>DILAUDID FENTANYL (Sublimaze)</td>
<td>LSD (acid, sunshine)</td>
<td>BUTYL NITRATE</td>
</tr>
<tr>
<td>COCAINE (Coke, snow, crack)</td>
<td>CHLORAL HYDRATE (knockout drops, nocect)</td>
<td>HEROIN (“H”, horse, junk, smack, stuff)</td>
<td>MESCALINE MORNING GLORY SEEDS</td>
<td>(locker room, rush)</td>
</tr>
<tr>
<td>DESOXYN (black beauties)</td>
<td>METHAQUALONE (Quaalude, ludes, sopor, spoors)</td>
<td>METHADONE (dolly)</td>
<td>PCP (angel dust, hog, peace pills)</td>
<td>CLEANING FLUID</td>
</tr>
<tr>
<td>DEXTROAMPHETAMINES (dexies, Dexedrine®)</td>
<td>NONBARBITURATES SEDATIVES (various tranquilizers and sleeping pills, valium or diazepam, miltown, equanil, meprobamate, thorazine, Compazine®, Librium® or chlordiazepoxide, reserpine, Traxene® or chlorazepate and other benzodiazepines)</td>
<td>MORPHINE OPIUM (op, poppy)</td>
<td>PSILOCYBIN (magic mushrooms)</td>
<td>(carbon tetrachloride)</td>
</tr>
<tr>
<td>METHAMPHETAMINES (speed, crack, meth, crystal, diet pills, methedrine)</td>
<td>PARALDEHYDE PENTOBARBITAL (yellow jackets, barbs, Nembutal®)</td>
<td>MEPERIDINE (Demerol®)</td>
<td>STP (serenity, tranquility, peace)</td>
<td>POLISH</td>
</tr>
<tr>
<td>MEHTYLPHENIDATE (Ritalin®, Concerta®)</td>
<td>PHENOBARBITAL (goofballs, phennies, barbs)</td>
<td>PAREGORIC (contains opium)</td>
<td>Cannabis: HASH</td>
<td>GASOLINE</td>
</tr>
<tr>
<td>PRELUDIN</td>
<td>SECOBARBITAL (red devils, barbs, Seconal®)</td>
<td>TYLENOL® WITH CODEINE (1,2,3,4)</td>
<td>MARJUANA (grass, pot, tea, wood, dope)</td>
<td>GLUE</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>THC</td>
<td>HAIR SPRAY</td>
</tr>
</tbody>
</table>

Table 22-6.—Commonly Abused Drugs
CENTRAL NERVOUS SYSTEM
DEPRESSANT INTOXICATION

Opium and Opium Alkaloid Intoxication

This group of drugs includes the most effective and widely used pain killers in existence. Prolonged use of narcotic drugs, even under medical supervision, inevitably leads to physical and psychological dependence.

The more commonly known drugs within this group are opium, morphine, heroin, codeine, and methadone (a synthetic narcotic). Next to cocaine, heroin is the most popular narcotic drug because of its intense euphoria and long-lasting effect. It is far more potent than morphine but has no legitimate use in the United States. Heroin appears as a white or brown powder. The most common method of using heroin is by injection directly into the vein, although it can be sniffed. Codeine, although milder than heroin and morphine, is sometimes abused as an ingredient in cough syrup preparations.

Signs and symptoms of narcotic drug abuse include: coma (or depressed level of consciousness), respiratory depression or arrest (slow, shallow respiratory effort), restlessness, dizziness, lethargy and scars caused by injections. These symptoms can progress rapidly to hypoxia and death.

The narcotic user, suddenly withdrawn from drugs, may appear as a wildly disturbed patient who is agitated, restless, and possibly hallucinating. Initial symptoms start within a few hours after last dose and peak at about 72 hours. Although these signs and symptoms are not commonly life-threatening, most users will state that they feel so bad they wish they were dead. The signs and symptoms of withdrawal immediately stop upon re-administering a narcotic and withdrawing the drug by tapering the dose over several days.

Alcohol Intoxication

Alcohol is the most widely abused drug today. Although there are many other chemicals that are in the chemical grouping of "alcohols," the type consumed by people as a beverage (in wines, beers, and distilled liquors) is known as ethyl alcohol, ethanol, grain alcohol, or just "alcohol." It is a colorless, flammable, intoxicating liquid, classed as a drug because it depresses the central nervous system, affecting physical and mental activities.

Alcohol affects the body of the abuser in stages. Initially, there is a feeling of relaxation and well-being, followed by confusion with a gradual disruption of coordination, resulting in an inability to accurately and efficiently perform normal activities and skills. Continued alcohol consumption can lead to a stuporous state of inebriation resulting in vomiting, an inability to walk or stand, blackouts, and impaired consciousness (sleep or stupor). Excessive consumption can cause loss of consciousness, coma, and death from alcohol poisoning or aspiration.

The potential for physical and psychological addiction is very high when alcohol is abused. The severely intoxicated individual must be closely monitored to avoid inhalation of vomit (aspiration) and other adverse effects and behaviors.

Individuals withdrawing from alcohol are at a greater risk of serious complications or death than those withdrawing from narcotics. The effects of alcohol withdrawal include severe agitation, anxiety, confusion, restlessness, sleep disturbances, sweating, profound depression, delirium tremens ("DTs," a particular type of confusion and shaking that is a medical emergency), hallucinations, seizures, tachycardia and hypertension resulting in stroke.
Barbiturate Intoxication

Benzodiazepines have largely replaced barbiturates, or "downers," as sedatives, hypnotics (sleeping pills), or anxiolytic (anti-anxiety) agents. Barbiturates are still used to treat various seizure disorders. They are classified based on their duration of action: short acting agents (<6 hours), intermediate acting agents (6-18 hours), and long-acting agents (>18 hours). Barbiturate use causes various degrees of CNS depression with nystagmus (eyes moving up and down, or side-to-side involuntarily), vertigo (sensation of the room spinning), and respiratory depression. Severe overdose may result in coma, shock, apnea (stopped breathing), and dilated pupils. In combination with ethanol or other CNS depressants, there are compounded CNS and respiratory depression effects.

Prolonged use of barbiturates can lead to a state of physical and psychological dependence. Upon discontinued use, the dependant patient may go into withdrawal. Unlike narcotic (opiate) withdrawal, barbiturate withdrawal is **LIFE THREATENING!** Depending on the type of barbiturate, signs and symptoms start within 24 hours. The withdrawal syndrome includes anxiety, insomnia, muscle tremors (trembling or shaking), loss of appetite, convulsion, delirium, and death. The signs and symptoms will stop upon re-administration of the barbiturate and by tapering the dose slowly over several days.

Non-Barbiturate Sedative-Hypnotic (Benzodiazepine) Intoxication

Non-barbiturate sedative-hypnotics (a "hypnotic" is a sleeping pill) have actions very similar to the barbiturates. However, they have a higher margin of safety, overdose and addiction require larger doses, and addiction requires a longer time period to occur. Like the barbiturates, when combined with ethanol or other depressants, there are additive CNS- and respiratory-depression effects.

Most of the traditional, non-barbiturate sedative-hypnotics are either no longer available (Methaqualone, Ethchlorvynol, Glutethimide) or rarely used today (chloral hydrate) because of their profound "hangover effect." Newer sedative-hypnotics are emerging for the temporary treatment of insomnia. Benzodiazepines are widely used to treat seizure disorders, anxiety, muscle spasms, and insomnia. Signs and symptoms are sedation, dizziness and drowsiness. Short acting benzodiazepine (Xanax®/alprazolan) withdrawal is particularly harsh.

**CENTRAL NERVOUS SYSTEM STIMULANT INTOXICATION**

The stimulants directly affect the central nervous system by increasing mental alertness and combating drowsiness and fatigue. One group of stimulants, called **amphetamines**, is legitimately used in the treatment of conditions such as mild depression, obesity, narcolepsy (sleeping sickness) and attention-deficit/hyperactivity disorder (ADHD).

Amphetamines are commonly abused and are referred to as speed, or uppers. Amphetamines can be taken orally, intravenously, or smoked as "ice." They are abused for their stimulant effect, which lasts longer than cocaine.

Amphetamines cause central nervous system stimulation with euphoria, increased alertness, intensified emotions, aggressiveness, altered self-esteem, and increased sexuality. In higher doses, unpleasant CNS effects of agitation, anxiety, hallucinations, delirium, psychosis, and seizures can occur. When stimulants are combined with alcohol ingestion, patients have increased psychological and cardiac effects due to patients drinking more alcohol.
Signs and symptoms associated with amphetamine use include mydriasis (dilated pupils), sweating, increased temperature, tachycardia (rapid pulse), and hypertension. Patients seeking medical attention usually complain of chest pain, palpitations, and shortness of breath that can lead to myocardial infarction (MI).

Stimulants are highly addictive. Tolerance to increasingly higher doses develops. Abruptly stopping chronic amphetamine use does not cause convulsions or present a life-threatening situation. The withdrawal is typically characterized by apathy, sleep disturbances, irritability, disorientation, and depression with suicidal tendencies.

Cocaine, although classified as a narcotic, acts as a stimulant and is commonly abused. It is relatively ineffective when taken orally; therefore, the abuser either injects it into the vein or "snorts" it through the nose. Its effect is much shorter than that of amphetamines, and occasionally the abuser may inject or snort cocaine every few minutes in an attempt to maintain a constant stimulation and prevent the depression experienced during withdrawal (come-down). Overdose is very possible, often resulting in convulsion and death. The physical symptoms observed in the cocaine abuser will be the same as those observed in the amphetamine abuser.

MIND-ALTERING DRUGS

Hallucinogen Intoxication

The group of drugs that affect the central nervous system by altering the user’s perception of self and environment are commonly known as hallucinogens. Included within this group are (LSD), mescaline, dimethoxy-methylamphetamine (STP), phencyclidine (PCP), and psilocybin. They appear in the forms of crystals, powders, and liquids.

The symptoms of hallucinogenic drugs include dilated pupils, flushed face, increased heartbeat, and a chilled feeling. In addition, the patient may display a distorted sense of time and self, show emotions ranging from ecstasy to horror, and experience changes in visual depth perception.

Although no deaths have resulted from the drugs directly, hallucinogen-intoxicated patients have been known to jump from windows, walk in front of automobiles, or injure themselves in other ways because of the vivid but unreal perception of their environment.

Even though no longer under the direct influence of a hallucinogenic drug, a patient who has formerly used one of the drugs may experience a spontaneous recurrence (flashback) of some aspect of the drug experience. The most common type of flashback is the recurrence of perceptual distortion; however, victims of flashback may also experience panic or disturbing emotion. Flashback may be experienced by heavy or occasional users of hallucinogenic drugs, and its frequency is unpredictable and its cause unknown.

Cannabis Intoxication

Cannabis sativa, commonly known as marijuana, is widely abused and may be classified as a mild hallucinogen. The most common physical appearance of marijuana is as ground, dried leaves, and the most common method of consumption is smoking, but it can be taken orally.

A commercially prepared product of the active ingredient in marijuana, tetrahydrocannabinol (THC), is dronabinol (Marinol®) available in the U.S. as a controlled Schedule II drug. Dronabinol is used for the treatment of nausea and vomiting in chemotherapy patients. It may also be useful in the treatment of acute glaucoma, asthma, and nausea and vomiting from other chronic illnesses.
The individual response to the recreational use of marijuana varies and depends on the dose, the personality and expectation of the user, and the setting. Unexpected ingestion, emotional stress, or underlying psychiatric disorders can increase the possibility of an unfavorable reaction.

After a single inhaled dose of marijuana, a subjective "high" begins in several minutes and is gone within four hours. Marijuana causes decreased pupil size and injected conjunctiva (reddening of the white of the eye). Smoking marijuana can increase the heart rate (tachycardia) for about two hours. It can slightly increase systolic blood pressure in low doses and can lower blood pressure in high doses. An increased appetite “munchies” and dry mouth are common complaints after marijuana use.

Social setting influences the psychological effects associated with "usual doses" of marijuana smoking. Smoking in a solitary setting may produce euphoria, relaxation, and sleep. In a group setting, increased social interaction, friendliness, and laughter or giddiness may be produced. Subjectively, time moves slower, images appear more vivid, and hearing seems keener. High doses can cause lethargy, depersonalization (a state of mind in which the self appears unreal), pressured speech, paranoia, hallucinations, and mania (excited, over-activity and psychomotor agitation often accompanied by impaired judgment).

Inhalant Intoxication

Inhalants are potentially dangerous, volatile chemicals that are not meant for human consumption. They are found in consumer, commercial, and industrial products intended for use in well-ventilated areas. The vapors they produce can be extremely dangerous when inhaled inadvertently or by design.

Substances in this category include adhesives (synthetic glues), paint, wet markers, lighter fluids, solvents, and propellants in aerosol spray cans, and air fresheners. Inhalants can be abused by "sniffing" which is inhaling through the nose directly over an open container; “bagging” which is holding an open bag or container over the head; or “huffing” which is pouring or spraying material on a cloth that is held over the mouth and inhaling through the mouth. These methods usually use a bag or other container to concentrate and retain the propellant thereby producing a quick high for the abuser.

Patients who regularly abuse inhalants risk permanent and severe brain damage and even sudden death. The vapors from these volatile chemicals can react with the fatty tissues (myelin) in the brain and literally dissolve them. Additionally, inhalants can reduce the availability and use of oxygen causing brain hypoxia. Acute and chronic damage may also occur to the heart, kidneys, liver, peripheral nervous system, bone marrow, and other organs. Sudden death can occur from respiratory arrest or irregular heart rhythms.

Signs and symptoms of inhalant abuse closely resemble a combination of alcohol and marijuana intoxication. Acute symptoms are very short-lived and are completely gone within two hours. Physical symptoms of withdrawal from inhalants include hallucinations, nausea, excessive sweating, hand tremors, muscle cramps, headaches, chills, and delirium tremens (which is a medical emergency).
MANAGEMENT OF DRUG-INTOXICATED PATIENTS

General priorities of care are outlined below:

1. Observe the ABC + D & E.
   a. Assess the ABC’s.
   b. Assess the Drug-induced central nervous system (CNS) depression.
   c. Expose (undressing/uncovering) the patient for disabilities/injuries to ensure areas of contact or exposure to a chemical can be properly visualized and assessed.
   d. Watch for shock!
   e. Give appropriate treatment.

2. If the victim cannot be aroused, place them on the side allowing secretions and vomitus to drain from the mouth and not being aspirated into the lungs.

3. All adult patients with an altered mental status should receive dextrose (after blood sugar testing), thiamine, naloxone (i.e. Narcan®), and oxygen. When in doubt give patients Oxygen, Narcan® and dextrose.

4. If recommended by the PCC or medical officer, place the patient on a cardiac monitor and or obtain specimens for comprehensive laboratory work-up (blood and urine).

5. If recommended by the PCC or medical officer, decontaminate the stomach:
   a. ONLY if the victim is conscious.
      
      AND
   b. The drug was RECENTLY TAKEN ORALLY.

6. Cardiac monitor all patients with an altered mental status.

7. Prevent the victim from self-injury while highly excited or lacking coordination. Use physical restraints only if absolutely necessary.

8. Calm and reassure the excited patient by "talking them down" in a quiet, relaxed, and sympathetic manner. Decrease visual and auditory stimuli.

9. Gather materials and information to assist in identifying and treating the suspected drug problem.
   a. Spoons, paper sacks, eyedroppers, hypodermic needles, and vials are excellent identification clues or witnesses.
   b. The presence of capsules, pills, drug containers, needle marks (tracks) on the patient’s body, or substances noted around the mouth and nose, are also important findings of substance abuse.
   c. A personal history of drug use from the patient or those accompanying the patient is very important and may reveal how long the victim has been abusing drugs, approximate amounts taken, and time between doses.
   d. Knowledge of past medical problems, including history of convulsions (with or without drugs) is also important.

10. Transport the patient and the materials collected to a treatment facility.

11. Inform treatment facility personnel and present the materials collected at the scene upon arrival at the facility.

SUMMARY

This chapter covered the assessment and treatment for poisoning and drug abuse. In the rapidly changing world environment, HMs must be up to date on the latest changes in assessment and treatment for these conditions. Corpsmen may stay informed through contact with the local Poison Control Center (PCC), MEDIC releases, or via the World Wide Web on the Internet through credible sites such as the American Association of Poison Control Centers.
CHAPTER 23

MEDICAL ASPECTS OF CHEMICAL, BIOLOGICAL, AND
RADIOLOGICAL WARFARE

INTRODUCTION

This chapter will outline a brief history of chemical, biological, and radiological (CBR) warfare along with the recognition and treatment of conditions resulting from CBR agents. The chapter is divided into sections by agent type. Each section provides signs and symptoms of CBR conditions along with the treatment and decontamination procedures.

CHEMICAL WARFARE AGENTS

LEARNING OBJECTIVE:

Identify signs and symptoms of chemical agent exposure and provide appropriate medical treatment.

HISTORY

Throughout history, chemical weapons have been used in one form or another. The earliest form of chemical warfare was the use of spears and arrows dipped in poison. The Spartan mixed pitch and sulphur and ignited it to create toxic fumes during battle in order to incapacitate the enemy. Other armies dipped cloth in poison and lit it on fire to create a toxic cloud over opposing armies. These were simple forms of chemical warfare and it was not until recent history that it was used on a large-scale.

The first large-scale use of chemical agents came in World War I when, in 1915, the Germans released chlorine gas against the Allied positions at Ypres, Belgium. Over 5,000 casualties resulted. It is well documented that approximately one-third of all American casualties in this conflict were due to chemical agent attacks.

Chemical warfare during this time period was crude and often personnel were victims of their own chemical attacks, on both sides. During this time the development of gas masks began to protect forces against gas attacks.

During the interval between World Wars I and II, each of the major powers continued to develop its capability for chemical warfare, in spite of a ban by the Geneva Treaty. In isolated cases in the late 1930s, toxic chemicals were used. They were not used during World War II or authorized for use in Korea, Vietnam, or Desert Storm. Defoliants and riot-control agents were used with some degree of effectiveness in the jungles of Vietnam, as well as in tunnel and perimeter-clearing operations.

In recent history there has been documented use of chemical weapons used by other countries and terrorist groups. Iraq used mustard gas during the Iran-Iraq war in 1983. In 1984, Iraq used the nerve agent tabun during the same war. Iraq used chemical weapons in 1987 – 1988 against the Northern Kurds in their own county.

In 1995 a terrorist group in Japan, Aum Shinrikyo, produced and used sarin gas in a Tokyo subway. As a result a dozen people were killed and approximately 5,000 people were incapacitated or injured. The number of dead would have been higher if the agent was in a pure form.

Terrorist groups are adding a new twist to chemical warfare. There have been news reports and admissions by terrorist groups that they are actively developing chemical weapons. The production of chemical weapons on a small scale is not difficult. The space required to set-up a chemical agent lab is no larger than that of a narcotics drug lab (Fig. 23-1). The equipment necessary to produce chemical agents is available on the open market.
OVERVIEW

Chemical weapons are made with toxic chemicals and defined by the Chemical Warfare Convention as “any chemical which through its chemical action on life processes can cause death, temporary incapacitation or permanent harm to humans or animals.” It is also defined as toxic substances developed for the purpose to produce death, serious injury, or incapacitation through their toxicological effects on exposed humans or animals.

Chemical agents can be dispersed by several methods. Attacks can be accomplished with the use of aircraft, munitions, or dispersal devices. Aircraft can deliver a chemical attack by dropping bombs or launching rockets. Munitions that deliver chemical agents are missiles, rockets, and mortars. Terrorist attacks are more likely to be accomplished using dispersal devices such as commercial sprayers or smoke generators. It is unlikely that an attack against a naval vessel in open water will occur. A naval vessel may more likely be involved in a chemical agent incident while in port.

Chemical agents may enter the body by several routes and the nature and onset of signs and symptoms may vary accordingly. The agents can be disseminated as a vapor or aerosol under ambient conditions. Vapor and aerosol chemical agents often enter the body through the respiratory tract (inhalation injury). The agent may be absorbed by any part of the respiratory tract from the mucosa of the nose and mouth to the alveoli of the lungs.

Vapors and droplets of liquids can be absorbed from the surface of the skin and mucous membranes. Toxic compounds that are harmful to the skin can produce their effects in liquid or solid state. Agents penetrating the skin may form temporary reservoirs under the skin; the vapors of some volatile liquids can penetrate the skin and cause adverse effects. See Table 23-1 for a list of common chemical weapons.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Common Name</th>
<th>Class</th>
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<tbody>
<tr>
<td>AC</td>
<td>Hydrogen Cyanide</td>
<td>Blood Agent</td>
</tr>
<tr>
<td>CK</td>
<td>Cyanogen Chloride</td>
<td>Blood Agent</td>
</tr>
<tr>
<td>CG</td>
<td>Phosgene</td>
<td>Pulmonary Agent</td>
</tr>
<tr>
<td>CI</td>
<td>Chlorine</td>
<td>Pulmonary Agent</td>
</tr>
<tr>
<td>CN</td>
<td>Mace</td>
<td>Riot Control</td>
</tr>
<tr>
<td>CR</td>
<td>dibenzoxazepine</td>
<td>Riot Control</td>
</tr>
<tr>
<td>CS</td>
<td>2-chlorobenzalmalononitrile</td>
<td>Riot Control</td>
</tr>
<tr>
<td>CX</td>
<td>Phosgene Oxime</td>
<td>Blister Agent</td>
</tr>
<tr>
<td>DP</td>
<td>Diphosgene</td>
<td>Pulmonary Agent</td>
</tr>
<tr>
<td>DM</td>
<td>Adamsite</td>
<td>Riot Control</td>
</tr>
<tr>
<td>GA</td>
<td>Tabun</td>
<td>Nerve Agent</td>
</tr>
<tr>
<td>GB</td>
<td>Sarin</td>
<td>Nerve Agent</td>
</tr>
<tr>
<td>GD</td>
<td>Soman</td>
<td>Nerve Agent</td>
</tr>
<tr>
<td>GF</td>
<td>cyclosarin</td>
<td>Nerve Agent</td>
</tr>
<tr>
<td>H</td>
<td>Mustard</td>
<td>Blister Agent</td>
</tr>
<tr>
<td>HD</td>
<td>Distilled Mustard</td>
<td>Blister Agent</td>
</tr>
<tr>
<td>HN</td>
<td>Nitrogen Mustard</td>
<td>Blister Agent</td>
</tr>
<tr>
<td>L</td>
<td>Lewisite</td>
<td>Blister Agent</td>
</tr>
<tr>
<td>OC</td>
<td>Oleoresin Capsicum</td>
<td>Riot Control</td>
</tr>
<tr>
<td>VX</td>
<td>S-2-(diisopropylamino)ethyl O-ethyl methylphosphonothioate</td>
<td>Nerve Agent</td>
</tr>
</tbody>
</table>

Table 23-1.—Names, Classes, and Symbols of Chemical Weapons
Chemical agents can be broken down into general classes of agents. The following are the classes of chemical agents that will be covered in this section: Blood Agents; Pulmonary Agents; Blister Agents (Vesicants); Nerve Agents; and Riot Control Agents. They may also be classified as either lethal or nonlethal.

- **Nonlethal** agents that are not designed to kill you
- **Lethal** agents are those that result in a 10 percent or greater death rate among casualties

Chemical agents are further classified as persistent or non-persistent, dependent upon the length of time they retain their effectiveness after dissemination.

- **Persistent** agents continue to present a hazard for considerable periods (days) after delivery by remaining as a contact hazard, or by slowly vaporizing to produce a hazard an inhalation hazard
- **Non-persistent** agents disperse rapidly after release and present an immediate, short duration (hours) hazard. They are released as airborne particles, aerosols, and vapors

Metrological conditions will influence the effectiveness and duration of chemical agents. Wind, temperature, and rain are major considerations when chemical agents are used as they will impact the length and intensity of exposure.

- Wind in an open area will disperse an agent quickly. Calm winds or protected areas (wooded areas, trenches, ditches, and urban areas) will allow an agent to stay in an area longer
- High temperatures decrease the persistency of agents and tend to cause higher vapor concentrations. This is especially true with the use of a Mustard agent
- Low temperatures increase the persistency of agents. Some agents may freeze, thus reducing the immediate contact hazard or vapor hazard. There is a danger of moving frozen agents, on clothing and equipment, into a warm building; when they warm-up there is a subsequent risk of toxic vapor being given off
- Rain washes away, dilutes, and promotes hydrolysis of agents. This reduces their effectiveness but does not make them harmless

**DETECTION EQUIPMENT**

There are several ways to detect the presence of chemical agents. Some detection methods are as simple as chemical reactive paper and as complex as electronic detection devices. Medical personnel should be familiar with three of the common detection methods.

The first method is M9 Chemical Agent Detector Paper. It is the most widely used method of detecting liquid chemical warfare agents. M9 paper indicates the presence of a nerve agent or a blister agent by turning a pink, red, reddish brown, purple color. It does not identify which agent gives the positive reading. The M-9 paper is self-adhesive and attaches to most surfaces.

The second method is the M8 Chemical Agent Detector Paper. It is used to test for the presence of liquid chemical agents. It can detect the presence of particular agents. When the paper touches a liquid agent, the paper will change color. The paper will turn Gold/Yellow for G class nerve agents and turns Olive or Verdana Green for VX. The paper turns red or purple when it comes in contact with blister agents.

**NOTE:**
Neither M8 nor M9 paper can detect chemical warfare agent vapor.
The M256A1 chemical agent detector kit is a portable kit that detects nerve gas, mustard gas, and cyanide. The kit contains a package of M8 paper, detailed instructions, and a vapor sampler (12 enzymatic tickets that contain laboratory filter paper for detecting chemical agent vapors). The vapor sampler uses wet chemistry technology, in which ampules containing different substrates are crushed so that the liquids interact with strips of filter paper, chromatographic media, and glass fiber filter. These substrates are exposed to the vapor under suspicion. The reaction causes a color change, alerting the user to the presence of a chemical agent. The reactions typically take 15 minutes to occur.

**PERSONAL PROTECTION**

In a chemical attack, the first priority is to ensure the HM’s survival so that casualties can be treated. There are several items available to help HMs survive a chemical attack. Along with protective clothing, there is a protective mask, which should be put on at the first indication of a chemical attack. The mask will filter out all known chemical agents from the air and allow HMs to work in a chemically contaminated area.

If there is a known threat of possible chemical, biological, or radiological attack or personal need to enter known contaminated area, protective measures should be taken. Personal Protective Equipment (PPE) consists of the Joint Service Lightweight Integrated Suit Technology (JSLIST), Field M-40 Chemical/Biological Mask with hood, protective gloves, and protective boots.

Dependent upon the threat, forces may adopt a Mission-Orientated Protective Posture (MOPP) and there are five levels (Table 23-2). MOPP Gear consists of previously mentioned PPE to include an individual decontamination kit as well as antidotes. MOPP is a flexible system of protection against chemical, biological and radiological threats, which is used to facilitate mission accomplishment. MOPP does give the commander a range of choices regarding the level of chemical protection. Choices range from no protection at all to full protection.

<table>
<thead>
<tr>
<th>Mission-Oriented Protective Postures (MOPP)</th>
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<tbody>
<tr>
<td>MOPP Level</td>
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<tr>
<td>-----------</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>1</td>
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<td>2</td>
</tr>
<tr>
<td>3</td>
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<tr>
<td>4</td>
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</tbody>
</table>

This chart provides a quick reference of what equipment needs to be worn

* MOPP Level 0 – Protective equipment should be within easy reach.

Table 23-2.—Mission-Oriented Protective Procedures (MOPP)
Chemical agents penetrate ordinary clothing rapidly. However, significant absorption through the skin requires a period of minutes. The effects of clothing penetration may be reduced by quickly removing the contaminated clothing and neutralizing the chemical agent on the skin by washing, blotting, or wiping it away. A chemical agent on the skin can be removed effectively by using the M291 skin decontamination kit (Fig. 23-2) or decontamination procedures associated with each agent.

**Figure 23-2.—M291 Skin Decontamination Kit**

*Image provided by: NAVSEA Damage Control, Fire Protection Engineering and CBR-D.*

Prompt decontamination of the skin is imperative. Decontamination of chemical agents on the skin within 1 minute after contamination is perhaps 10 times more effective than if decontamination is delayed 5 minutes. Quick decontamination procedures are associated with each agent. Detailed instructions on the use of skin decontamination kits can be found in the NAVMED P-5041, Treatment of Chemical Agent Casualties and Conventional Military Chemical Injuries, and in the kits themselves.

### CHEMICAL AGENTS

#### NERVE AGENTS (VX, GA, GB, GD, GF)

Nerve agents are of greatest concern as compared to all chemical agents. They produce their effect by interfering with normal transmission of nerve impulses in the parasympathetic autonomic nervous system. Pharmacologically, the nerve agents are cholinesterase inhibitors (interfering with normal transmission of nerve impulses in the nervous system). Their reaction with cholinesterase tends to be irreversible, and reaction time varies with the agent.

**Characteristics**

Physically, nerve agents are odorless, almost colorless liquids or vapors, varying greatly in viscosity and volatility. They are moderately soluble in water and fairly stable unless strong alkali or chlorinating compounds are added. They are very effective solvents, readily penetrating cloth either as a liquid or vapor. Other materials, including leather and wood, are fairly well penetrated. Butyl rubber and synthetics, such as polyesters, are much more resistant.

**Signs and Symptoms**

Nerve agents can enter the body through the eyes, respiratory tract, and skin. Symptoms vary dependent upon the patient being exposed to either vapor of liquid forms of a nerve agent. The onset of symptoms range from within seconds to 18 hours, dependent upon the form and amount of agent.

- **Vapor**
  - Small Exposure Level – Miosis (constricted pupils), rhinorrhea (runny nose), and mild difficulty breathing
  - Large Exposure Level – Miosis; sudden loss of consciousness; convulsions; apnea (no breathing); flaccid paralysis; copious secretions from the nose, mouth, and lungs
• Liquid
  o Small to Moderate Exposure – Localized sweating, nausea, vomiting, and weakness
  o Large Exposure Level - Sudden loss of consciousness; convulsions; apnea (no breathing); flaccid paralysis; and copious secretions from the nose, mouth, and lungs

Treatment

Immediate care and administration of an antidote can mean the difference between life and death of a patient exposed to a nerve agent. Atropine, an acetylcholine blocker, is the drug of choice for treating nerve agent poisoning. The second drug used for nerve agent poisoning is Pralidoxime Chloride (2-PAM CL). 2-PAM CL removes the nerve agent from the enzyme acetylcholinesterase within the synaptic cleft (the space between the nerve cells) of the nervous system. Convulsive Antidote, Nerve Agent (CANA) or Diazepam 10mg autoinjector is used to control convulsions in patients (Fig. 23-3).

The MARK 1 antidote kit (Fig. 23-4) consists of an autoinjector of Atropine 2mg and an autoinjector of 2-PAM CL 600mg. A new autoinjector called Autoinjector Treatment; Nerve Agent Antidote (ATNAA) will replace the MARK 1 kit. The ATNAA is a single autoinjector that has two chambers that deliver 2.1 mg of Atropine and 600mg of 2-PAM CL in a single injection. ATNAA is used in the same manner as a MARK 1 kit.

How to use an autoinjector

Firm pressure automatically triggers the coiled mechanism and plunges the needle through the clothing into the muscle and at the same time injects the antidote into the muscle tissue. Using a jabbing motion may result in an improper injection or injury.

Self-Aid/Buddy Aid

1. At the first signs of nerve-agent poisoning, don protective mask.
2. Administer one MARK 1 kit intramuscularly, into the lateral thigh muscle or buttocks of the patient.
3. Position the needle end of the injector against the injection site.
4. Make sure not to hit any buttons or other objects.
5. Apply firm and even pressure to the autoinjector until the needle pushes into the injection site.
6. Hold the injector firmly in place for at least 10 seconds.

NOTE:
Do NOT use a jabbing motion. This may result in improper injection of antidote and/or injury to the patient.

7. Wait for 10 to 15 minutes to see if the symptoms subside.
8. If symptoms continue, administer another autoinjector. Note - a total of three MARK 1 kits can be administered at 10 to 15 minute intervals by non-medical personnel.
9. Patients with severe symptoms, more than one system involvement (i.e. gastrointestinal and respiration) should be given all three MARK 1 kits and CANA immediately.

NOTE:
The HM will use the casualty’s autoinjector(s) when providing aid to the casualty. The HM must never use their autoinjector(s) on the casualty as this will limit the antidote available if needed for self-aid.

Medical Personnel

If symptoms continue after three autoinjectors have been administered, medical personnel may administer repeated Atropine (2mg) injections. Atropine can be injected at five to ten minute intervals and until there is a reduction of both secretions and breathing difficulty.

If convulsions continue after 10 minutes of initial injection of CANA (Diazepam), a second dose may be administered. Observe patient for 5 to 10 minutes after injection, if the patient is still convulsing a third dose may be administered. Medical officers may choose to give more diazepam either IM or IV, if they deem it necessary.

Decontamination

Decontamination of the patient should be done as soon as possible. This will eliminate the potential of continued absorption of never agents into the patient. Conduct decontamination in the following order:

- Face
- Neck Area
- Chest Area
- Abdomen
- Arms and Hands
- Other exposed skin areas

Decontamination of liquid nerve agent exposure consists of removing all contaminated clothing. A M291 kit may be used or copiously irrigating the area with water to physically remove the nerve agent. The skin is then washed with an alkaline solution of soap and water or 0.5% hypochlorite solution (made by diluting household bleach 1:10) to chemically neutralize the nerve agent. Avoid hot water, strong detergents, and vigorous scrubbing, since they tend to enhance nerve agent absorption.

BLISTER AGENTS (H, HD, HN, L)

Blister agents, or vesicants, exert their primary action on the skin, producing large and painful blisters that are incapacitating. Although vesicants are classed as nonlethal, high doses can cause death. Mustards (H, HD, and HN) constituted both a liquid and vapor threat. Mustard agents are a major concern due to large stockpiles it and the ease of production.
Characteristics

Each agent is chemically different and will cause significant specific symptoms. They are all similar in their physical characteristics and toxicology. H, HD, and HN are oily, colorless or pale yellow liquids, sparingly soluble in water. HN (Nitrogen Mustard) is less volatile and more persistent than HD (Distilled Mustard) but has the same blistering qualities. Lewisite (L) is an arsenical (an arsenic-based compound). This blistering compound is a light to dark brown liquid that vaporizes slowly. All blister agents have a relatively high vapor density; it is more likely to flow to low spots such as valleys, ditches, holes, and the ground or deck.

Signs and Symptoms

Mustards (Fig. 23-5) are particularly insidious as they do not manifest their symptoms for several hours after exposure. Blister agents attack the eyes and respiratory tract as well as the skin. Patients exposed to mustard may remember seeing an oily substance and smelling an odor of garlic, mustard, or horseradish. Patients exposed to Lewisite (L) may remember observing puddles of a brown liquid or of smelling an odor similar to geranium.

The eyes are the most vulnerable part of the body to mustard gas. Contamination insufficient to cause injury elsewhere may produce eye inflammation. The eyes are the most sensitive part of the body. The first noticeable symptoms of mustard exposure will be pain and a gritting feeling in the eyes, accompanied by spastic blinking of the eyelids and photophobia. This may continue to develop with swelling of the eyelids, cornea damage, and moderate to severe pain.

The skin will develop erythema and blisters (Fig. 23-6). Typical blister agent cause blistering in about 12 hours but may be delayed for up to 48 hours, while Lewisite (L) causes intense pain upon contact. Areas affected the most will be in warm, sweaty areas of the body: the armpits, groin, and on the face and neck.

Figure 23-6.—Blisters from Contact with a Mustard Agent

Image reprinted with permission from: U. S. Army Special Programs Division, Dugway Proving Grounds.
Inhalation of the gas is followed in a few hours by sore throat, sinus pain, and hoarseness. This may progress to a hacking cough and then to a productive cough and shortness of breath. Breath sounds may be crackles and rales. Brochopneumonia is a frequent complication. The primary cause of death is massive edema or mechanical pulmonary obstruction. Due to the pain associated with Lewisite (L) exposure, patients are more likely to don their protective mask early. Thus limiting the respiratory injuries that may normally occur as a result of exposure.

**Treatment**

There is no specific antidotal treatment for mustard (H, HD, and HN) poisoning. Physically removing as much of the mustard as possible as soon as possible, is the only effective method for mitigating symptoms before they appear. All other treatment is symptomatic and supportive; the relief of pain and itching, and control of infection.

In cases of systemic involvement, British

**BLOOD AGENTS (AC, CK)**

Blood agents or cyanides basic physical actions disrupt oxygen utilization at the cellular level causing cellular suffocation. They are rapid acting lethal agents that have limited military use. Cyanide is a common chemical and found widespread in chemical synthesis and is easy for terrorist to obtain and to potentially be used in a terrorist attack.

**Characteristics**

Anti-Lewisite (BAL) was developed as an antidote for Lewisite (L). BAL is used as a chelating agent that combines with the heavy metal to form a water-soluble, nontoxic complex that is excreted. However, BAL is somewhat toxic and an injection of more than 3 mg/kg will cause severe symptoms. Do not use on patients allergic to peanuts.

**Decontamination**

Early decontamination will reduce the affect of blister agents. Decontamination within two minutes will reduce the toxic effects by more than 50%. Decontamination consists of removing all contaminated clothing. A M291 kit may be used or copiously irrigating the area with water to physically remove agents and then washing the skin with soap and water or 0.5% hypochlorite solution (made by diluting household bleach 1:10) to chemically neutralize the agent.
Cyanides are volatile and evaporate quickly to become vapors or gases. Hydrogen Cyanide (AC) has a bitter almonds smell. Although very deadly, they are non-persistent agents. Cyanides usually dissipate in less than 24 hours. Cyanide produces clinical effects by disrupting oxygen uptake by cells.

Signs and Symptoms

- **Moderate Exposure** (low concentrations)
  - Symptoms include transient increased rate and depth of breathing; dizziness; nausea and vomiting; headache; and eye irritation. Symptoms may progress to severe with continued exposure

- **High Exposure** (high concentrations)
  - The onset is rapid, often within minutes. Symptoms include transient increased rate and depth of breathing; convulsions (within 30 seconds); apnea; cardiac arrest (within a few minutes)

Treatment

Treatment begins with personnel protection by using a chemical protective mask. Remove the patient from the agent to fresh air. Treatment of cyanide poisoning is very effective if administered in a timely manner. Antidote treatment consists of a two step process:

1. Initial treatment of cyanides: two amyl nitrite ampules crushed and inhaled (every few minutes until eight ampules have been used) or intravenous sodium nitrate 300mg (a 300mg to 600mg dose given).
2. Administer intravenous sodium thiosulfate 12.5g (1 to 2 doses given).
3. Follow-up treatment consists of the two antidotes given at half the original dose if there is no response to the first dose.

The key to successful cyanide therapy is providing treatment early; cyanide acts rapidly on an essential enzyme system. The antidotes act rapidly to reverse this action.

If the specific antidote and artificial respiration are given early enough, the chance of survival is greatly enhanced.

Decontamination

Skin decontamination is usually not required as the agent evaporates quickly. Wet contaminate clothing should be removed and contained to prevent off gassing hazard. Skin should be cleaned by copiously irrigating the area with water to physically remove agents, and then washing the skin with soap and water.

**PULMONARY AGENTS (CG, CL, DP)**

Pulmonary agents damage the membranes in the lungs that separate the alveolar tissue resulting in fluid from the blood, known as plasma, to leak into the alveoli and fill them with fluid. This prevents necessary gas exchange within the alveoli causing hypoxia. This creates a condition known as pulmonary edema. This group includes phosgene (CG) and chlorine (Cl); HC Smoke and Ammonia should also be included as a pulmonary agent. A terrorist threat may come from the release of chlorine or ammonia.

Characteristics

These agents are usually in vapor form, typically heavier than air, and travel close to the ground. They tend to evaporate and disburse very quickly, dependent upon temperature and wind. Chlorine and ammonia have very distinct smells. Phosgene is a colorless gas with a distinctive odor similar to that of new-mown hay or freshly cut grass.

**Signs and Symptoms**

Early symptoms may be irritation of the eyes, nose, and airway. At this stage it may be difficult to distinguish a pulmonary agent from a riot agent. Symptoms may progress to coughing, difficulty breathing, hoarseness talking, sneezing, wheezing, and a feeling of tightness in the chest. More often, however, there will be no symptoms for 2 to 6 hours after exposure.
Latent symptoms are rapid, shallow, and labored breathing; painful cough; cyanosis; frothy sputum; clammy skin; rapid, feeble pulse; and low blood pressure. Shock may develop, followed by death. Auscultation of the lungs will reveal crackles and rales, in the lower lobes initially and progress to be heard throughout all fields.

**Treatment**

Initial treatment is to remove the patient from the source. There is no antidote for pulmonary agents. Keep the patient at complete rest. Even a little exertion can increase the effects of the agent and speed up the progression of pulmonary edema. Provide supportive care as necessary and treat symptomatically. Patients with shortness of breath may require assisted respirations and/or oxygen.

**Decontamination**

- **Vapors**
  - Exposure to fresh air or ventilate the area

- **Liquids**
  - Remove contaminated clothing and rinse the affected area with copious amounts of water

**RIOT-CONTROL/HARASSMENT AGENTS (CN, CR, CS, DM, OC)**

"Riot-control agents" is the collective term used to describe a collection of chemical compounds, all having similar characteristics which, though relatively nontoxic, produce an immediate but temporary effect in very low concentrations. These agents are used to harass enemy personnel or to discourage riot actions thus the weapon of choice for police when managing riots.
Characteristics

Unlike most agents, which are liquids under temperate conditions, riot control agents are crystallized solids that are dispersed as fine particles or in solution(s). Dispersal devices include small handheld aerosol cans, large tanks, grenades, and bombs. These agents irritate the skin, mucosa membranes, and airway, causing people to become unable to perform their job due to discomfort. There are two classes of riot-control/harassment agents: lacrimators and vomiting agents.

- **Lacrimators** (or tear gases) are essentially local irritants that act primarily on the eyes.
- **Vomiting agents** comprise the second class of agents in the riot-control category and cause nausea, vomiting, and general malaise in victims.

Signs and Symptoms

The main effect of riot control agents is pain, burning, and irritation to exposed skin and mucosa membranes. Other symptoms include salivation, increased nasal secretions, coughing, possible redness of skin, and possible shortness of breath. Lacrimators produce intense pain in the eyes with excessive tearing. Vomiting agents produce prolong periods of nausea and vomiting. The symptoms following the most severe exposure to vapors seldom last over 2 hours. After moderate exposure, they last only a few minutes.

Treatment

At the first signs of exposure, don protective mask. It is of the utmost importance that the mask be worn in spite of coughing, sneezing, salivation, and nausea. If the mask is put on following exposure, symptoms will increase for several minutes in spite of adequate protection. As a consequence, victims may believe the mask is ineffective and remove it, further exposing themselves.

While the mask must be worn, it may be lifted from the face briefly, if necessary, to permit vomiting or to drain saliva from the face piece. Carry on duties as vigorously as possible. This will help to lessen and shorten the symptoms.

Generally, patients require no therapy; removal from the environment is sufficient to affect recovery in a short time. Exposure to fresh air and letting wind blow into wide-open eyes, held open if necessary, is sufficient for recovery in a short time. Talking can relieve any chest discomfort after CS exposure. Less than 1% of people develop severe symptoms. There is no antidote for these agents. Patients need to be treated according to their symptoms.

- **Eyes:** The eyes should be flushed with water or saline and impacted particles should be removed. General care consists of a topical solution to relieve the irritation and topical antibiotics. An ophthalmologist should be consulted for further evaluation and care.
- **Pulmonary:** These agents may exacerbate chronic disease or unmask latent disease. Bronchospasm with wheezing and mild distress continuing hours after exposure may occur in latent asthmatic people. More severe effects and respiratory distress may occur in one with chronic bronchitis or emphysema. Management includes oxygen administration and bronchodilators if bronchospasms are present.
- **Skin:** The early erythema requires reassurance, but no specific therapy is indicated unless severe and prolonged more than an hour or two. Treat symptoms with soothing compounds such as calamine. Small *vesicles* should be left intact, but larger ones will ultimately break. Large, oozing areas have responded to compresses containing substances such as colloidal oatmeal, Burrow’s solution, and other dermatologic preparations.
Decontamination

An important point to remember is that this material adheres to clothing, and a change of clothing may be necessary. Do not forget the hair (both head and facial) as a potential source of recontamination. The crystals can be released from the hair, skin, and clothes by a fan, wind, or the patient flapping their arms and rubbing hair. Heavily exposed patients can be decontaminated by washing with soap and water. Areas can be rinsed with a continuous flow of water. OC can be removed by washing with baby shampoo, milk, or vegetable oil to break up the resin and neutralize the agent.

DECONTAMINATION

The guiding principle in personnel decontamination is to avoid spreading contamination to clean areas and to manage casualties without aggravating other injuries (Fig. 23-7). It can be accomplished by either removing or neutralizing the agent. The process can be very extensive, dependent upon the agent or materials that need to be removed.

Casualty Priorities

It may be necessary to decide whether to handle the surgical condition or the chemical hazard first. If the situation and the condition of the casualty permit, decontamination should be carried out first. The longer the chemical remains on the body, the greater the danger of spreading the chemical to other personnel and equipment.

The following order of priority for first aid and decontaminating casualties is recommended:

- Control of massive hemorrhage
- First aid for life-threatening shock and wounds
- Decontamination of exposed skin and eyes
- Removal of contaminated clothing and decontamination of body surfaces (if not in a toxic environment)
- Adjustment of the patient’s mask, if mask is necessary
- First aid for less severe shock and wounds

Decontamination Station Organization

In general, the decontamination station, or "dirty" area, receives casualties contaminated with a chemical agent. The arrangement of this area will vary with the site of the medical unit and the facilities available for decontamination. See Figure 23-8 for one decontamination site organization.

Figure 23-7.—Decontamination

Image reprinted with permission from: U. S. Army Special Programs Division, Dugway Proving Grounds.
Each ship has a minimum of at least two decontamination stations, insofar as the hull design permits. The "dirty" areas should be topside or in some well-ventilated space. Personnel manning these areas should be provided with protective equipment.

In the "dirty" area, casualties will be decontaminated, undressed, showered, and passed along to clean areas. Both areas will be clearly marked as either "clean" or "contaminated," as appropriate. Decontamination kits, protective ointment, and an abundant supply of soap and water must be provided. In addition, standard first-aid items should be on hand. When possible, improvise supports (e.g., small boxes, blocks of wood, etc.) for stretchers to keep them raised off the deck.

**Handling of Contaminated Casualties**

The spread of contamination to uncontaminated personnel or to spaces not set aside to receive contamination must be avoided. Contaminated personnel, clothing, or equipment must be kept out of uncontaminated areas as the subsequent decontamination of such spaces is quite difficult. Contaminated clothing and gear must be placed in designated dump areas and, whenever practically possible, kept in metal cans with tightly fitting covers.

All casualties, after experiencing a chemical attack are to be considered contaminated unless there is certification of non-contamination. The initial management of a casualty contaminated by chemical agents will require removal of MOPP and decontamination with 0.5% hypochlorite before treatment.
BIOLOGICAL WARFARE AGENTS

LEARNING OBJECTIVE:

Identify signs and symptoms of a biological agent exposure and provide appropriate medical treatment.

HISTORY

The use of biological warfare has been recorded throughout history. Some of the early known uses of biological agents range from using a biological agent in drinking wells to moving driving infected animals into cities in hopes of spreading disease. In 1346, plague broke out in the tartar army during the siege of Kaffa. The attackers hurled the corpses of plague victims over the city walls. This caused an epidemic within the city and forced the defenders to surrender. It is believed that some of the infected people from the siege may have started the Black Death pandemic. The pandemic spread through Europe and is responsible for the death of one third (around 25 million people) of the population of Europe.

Biological Warfare has transformed over the years. It went from a crude form of spreading disease for a military advantage to a complex state sponsored program. In 1937, Japan started a sophisticated biological weapons program. The project was code-named “Unit 731” and was located 40 miles south of Harbin, Manchuria. The unit continued its work until it was destroyed in 1945. An investigation into the unit revealed that the Japanese researched numerous organisms and used war prisoners as research subjects.

It is estimated that about 1,000 human autopsies were carried out at Unit 731 and most of the victims were exposed to anthrax. By 1945 the program had stockpiled 400 kilograms of anthrax to be used in a specially designed fragmentation bomb.

After reports of flights of Japanese planes suspected of dropping plague-infected fleas, plague epidemics broke-out in China and Manchuria. It was evident the Japanese used biological agents on civilian populations.

There has been shift in the use of Biological Weapons from a sophisticated biological program run by other countries to agents used by an individual or terrorist group (Fig. 23-9). The use of Anthrax in letters used in 2001 was believed to have been done by an individual. A domestic terrorist group, Rajneesh, used Salmonella bacteria to contaminate salad bars, in Dalles, Oregon, in order to try and influence the local county election results in 1984.

Figure 23-9.—Small-Scale Biological Fermentor

Image reprinted with permission from: U. S. Army Special Programs Division, Dugway Proving Grounds.

Bioterrorism is a major concern for cities and states around the country. It is also a military concern today. One infected Sailor onboard and a ship can and infect the crew. The ship would have to be quarantined and would become combat ineffective.

The use of biological agents by terrorist groups is not outside the realm of reality. A terrorist plot was uncovered in England to use ricin in January 2003. Ricin was found in a package in a South Carolina postal facility in October 2003. It is not difficult to produce a biological agent.
The process can be done in a kitchen or bathroom within a house. A terrorist group can produce the agent and release it before anyone knows what happens.

**TYPES OF BIOLOGICAL AGENTS**

There are three different types of Biological Agents used as weapons:

**Bacteria**

Single celled organisms capable of causing a variety of diseases in animals, plants, and humans. Bacteria are living cells that carry many complex metabolic functions. Bacteria cause disease in human beings by one of two mechanisms: invading host tissues and producing toxins. Many bacteria utilize both mechanisms. Bacterial Agents are easy to produce in significant quantities to cause a threat to the community’s health (Fig. 23-10). Fortunately, the infections they produce often respond to a specific antibiotic therapy.

**Viruses**

Microorganisms are smaller than bacteria. Viruses are intracellular parasites that lack a system for their own metabolism, meaning, they require living cells in order to multiply. Viruses can infect host cells from humans, animals, plants, and bacteria. Virus-specific host cells can be cultivated in synthetic nutrient solutions and then infected with the virus to be grown. A virus typically causes changes in the host cell that eventually leads to cell death. The best way to control viral infections is to prevent them from occurring through the use of vaccines. Viral Agents can be more expensive and time consuming to produce when compared to bacterial and toxin agents.

**Toxins**

Harmful substances produced by a variety of living organisms, like bacteria, plants, and animals (Table 23-3). They are not man-made, they are non-volatile (i.e. no vapor hazard), and are usually not dermally active (with exception to the mycotoxins). Biological toxins are generally more toxic per weight than the chemical agents and represent some of the most toxic substances on Earth. Their lack of volatility is important to note because it makes them unlikely to produce either a secondary or person-to-person exposure. They will not present a persistent environmental hazard.

### Table 23-3.—Type of Biological Agents and Examples of Each Type

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Virus</th>
<th>Toxin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthrax</td>
<td>Small Pox</td>
<td>Ricin</td>
</tr>
<tr>
<td>Plague</td>
<td>Hemorrhagic</td>
<td>Botulinum</td>
</tr>
<tr>
<td>Tularemia</td>
<td>Fevers</td>
<td>Toxin</td>
</tr>
</tbody>
</table>

Under special circumstances some types of bacteria can form spores (e.g. the genus *Bacillus*). Spores are a dormant form of the bacterium and can germinate when conditions are optimal. When compared to the vegetative bacterial cell, the spore is more resistant to cold, heat, drying, chemicals, and radiation.
NATURAL OR INTENTIONAL DISEASE OUTBREAK

It is difficult to determine if a disease outbreak is a result of a natural occurrence or an intentional biological attack. An epidemiological investigation of a disease outbreak will assist medical personnel in identifying the pathogen and use of proper medical intervention. This should be done whether the outbreak is an intentional release or a natural occurrence.

Some attacks may not be apparent and require a full epidemiological study. Small scale outbreaks or those occurring over a long period of time require further investigation. Outbreaks occurring in multiple geographical locations may be either a natural occurrence or an intentional release. An outbreak of a disease that is difficult to diagnose or that occurs naturally or with low mortality rates requires further studies to determine the cause of the outbreak.

There are incidents that do not require an epidemiological study to determine that an attack or intentional release has occurred. Diseases that have been eradicated, such as smallpox, is a good indication of intentional release. A disease with a low probability of occurrence, such as inhalational anthrax, is another good indicator. The final indicator would be a large scale outbreak occurring in a limited geographical area.

Some additional indicators of a possible biological agent release:

- Unusual disease for geographic area
- Absence of a competent natural vector
- Restricted geographic distribution, epidemiological grouping or clustering
- High morbidity and mortality compared with a normal occurrence of the disease
- Dead animals of multiple species are sentinels

With recent advances in diagnostic testing, biological agents can be detected in the field. A first-line presumptive test is the Hand-Held Assay Panel that can make an indication of the presence of several biological agents within 15 minutes. Portable laboratories have been developed that can provide field confirmatory diagnostics for several biological agents within an hour. These labs weigh less than 1,000 pounds and require three operators to run it. These labs utilize a rapid field detection method incorporating real-time Polymerase Chain Reaction (rt-PCR) based diagnostics for field confirmatory testing (Fig. 23-11). These confirmatory assays are based on the unique DNA sequences of potential biological threat agents. The system is excellent for detecting the presences of the DNA unique to pathogenic bacteria and viruses. These laboratory tests are extremely accurate.

PERSONAL PROTECTION

If a suspected biological agent is released in the field, personnel should don personnel protective equipment (PPE). This consists of the Joint Service Lightweight Integrated Suit Technology (JSLIST), Field M-40 Chemical - Biological Mask, protective gloves, and boots. Personnel should utilize this equipment in an
unknown biological environment and when conducting decontamination procedures

**BIOLOGICAL AGENTS**

**ANTHRAX (BACILLUS ANTHRACIS)**

Anthrax (*Bacillus anthracis*) is a disease caused by the bacterium *Bacillus anthracis*. It is a gram-positive, encapsulated, spore forming, non-motile rod. The bacterium forms spores and these spores are usually the infective form of the bacteria. The *Bacillus* spores can survive in the environment for years or decades, awaiting uptake by the next host. It is primarily a disease of herbivorous mammals, although other mammals and some birds have been known to contract it. As a biological threat it can be produced with little cost from readily available equipment. An intentional release was implemented following the 9/11 attacks via the mail system; the precedent has been set for future terrorist attacks.

**Forms of Disease and Infectious Route**

Transmission of the disease is through contact with contaminated material. Humans generally acquire the disease directly or indirectly from infected animals or occupational exposure to infected or contaminated animal products. Person-to-person transmission does not occur. Articles and soil contaminated with spores may remain infective for several years. There are three types of anthrax in humans:

- **Cutaneous anthrax**: acquired when a spore enters the skin through a cut or an abrasion
- **Pulmonary (inhalational)** anthrax; from breathing in airborne anthrax spores
- **Gastrointestinal** anthrax; contracted from eating contaminated food, primarily meat from an animal that died of the disease

**Incubation Period**

The average is from 1 to 7 days, although incubation periods of up to 60 days can be possible.

**Signs and Symptoms**

- **Cutaneous Anthrax**: occurs within 2 weeks after exposure to spores
  - Skin infection begins as a raised itchy bump that resembles an insect bite, but within 1-2 days develops into a vesicle and then a painless ulcer, usually 1-3 cm in diameter, with a characteristic black necrotic (dying) area in the center
  - Regional adenopathy, fever, malaise, headache, nausea and vomiting may be present
  - About 20% of untreated cases of cutaneous anthrax will result in death
  - Deaths are rare with appropriate antimicrobial therapy
- **Inhalational Anthrax**: Onset, which occurs in two stages, usually begins within 10 days
  - Initial signs and symptoms may resemble nonspecific viral-like symptoms - fever, malaise, headache, sore throat, dyspnea (labored breathing), cough, and congestion of the nose, throat, and larynx are characteristic of the initial stage
  - The chest x-ray is the most sensitive test for inhalational anthrax
  - Mediastinal widening due to hemorrhagic lymphadenitis, a hallmark feature of the disease has been present in 70% of the bioterrorism related cases
  - Pleural effusions were present initially or occurred over the course of illness in all cases
  - These symptoms last generally 2-5 days and can be followed by a short period of improvement
  - The symptoms may progress to anterior chest pain, severe respiratory distress with dyspnea, diaphoresis (sweating), stridor, cyanosis, and shock
  - Inhalation anthrax is usually fatal
• **Gastrointestinal anthrax:** The intestinal disease form of anthrax may occur 2 - 5 days following the consumption of contaminated meat
  
  o Signs and symptoms include fever, diffuse abdominal pain, rebound abdominal tenderness, vomiting, constipation, and diarrhea
  
  o The primary lesion is ulcerative, emesis is blood-tinged or looks like coffee grounds, and stool may be blood-tinged or melenic (dark)
  
  o Bowel perforation can occur
  
  o The oropharyngeal form of the disease is characterized by local lymphadenopathy, cervical edema, dysphasic, and upper respiratory tract obstruction
  
  o Intestinal anthrax results in death in 25% to 60% of cases

**Treatment**

Antibiotics are the primary treatment required for Anthrax. Supportive care and adjunctive care as required for patients.

- **First Line**
  
  o Ciprofloxacin (500 mg twice daily orally or 400 mg every 12 hours intravenously)
  
  OR
  
  o Doxycycline (100 mg every 12 hours orally or intravenously)

- **Second Line**
  
  o Amoxicillin (500 mg three times daily orally)
  
  OR
  
  o Penicillin G (2 mU every 4 hours intravenously)

- **Third Line**
  
  o Rifampin, Clindamycin, Clarithromycin, Erythromycin, Vancomycin, and Imipenem

**Prophylaxis**

An FDA approved vaccine can be used for pre-exposure of high risk personnel. The vaccine is a series of six 0.5 ml subcutaneous doses at 0, 2, and 4 weeks; then 6, 12, and 18 months followed by a annual booster. A post exposure prophylaxis antibiotic regimen can be given following the same regimen as the treatment regimen.

**Isolation and Decontamination**

There is no isolation requirement for patients; use standard precautions when in contact with patients. Protective garments and mask are required when handling contaminated articles. Contaminated materials should be bagged and incinerated or autoclaved (121+1 degree C core temperature for 30 min). Spores are sensitive to 5-10% bleach solutions with a minimum of 10 minutes contact time. Large scale decontamination is difficult and costly.

**PLAGUE (YERSINIA PESTIS)**

Plague (*Yersinia Pestis*) is an infectious disease that affects animals and humans. It is caused by the bacterium *Yersinia pestis*. This bacterium is found in rodents and their fleas and occurs in many areas of the world, including the United States. It is a gram-negative rod that is non-motile, and non-sporulating. It is easily destroyed by sunlight and drying. When released into air, the bacterium will only survive for up to one hour, depending on conditions. Plague is endemic in many countries in Africa, in the former Soviet Union, the Americas and Asia. As a biological threat, plague was produced and weaponized in large quantities by the former Soviet Union. It would not be difficult for a terrorist group to obtain and produce plague.
Forms of Disease and Infectious Route

- **Pneumonic plague**: Occurs when *Y. pestis* infects the lungs. This type of plague can spread from person to person through the air. Transmission can take place if someone breaths in aerosolized bacteria, which could happen in a bioterrorist attack. Pneumonic plague is also spread by breathing in *Y. pestis* suspended in respiratory droplets from a person or animal with pneumonic plague.

- **Bubonic plague**: This is the most common form of plague. This occurs when an infected flea bites a person or when materials contaminated with *Y. pestis* enter through a break in a person's skin. This occurs in nature with infected fleas and rodents.

- **Septicemic plague**: Occurs when plague bacteria multiply in the blood. It can be a complication of pneumonic or bubonic plague, or it can occur by itself.

Incubation Period

The average is 1 to 7 days and may be a few days longer for those immunized who develop the illness. Primary plague pneumonia incubation is usually short 1 to 4 days.

Signs and Symptoms

- **Pneumonic**: The onset is sudden, with high fever, chills, malaise, tachycardia, intense headache, and severe myalgias (muscle pain). The patient appears profoundly ill. Rapidly developing pneumonia followed by cough with hemoptysis, dyspnea, stridor, cyanosis, and death. Death results from respiratory failure, circulatory collapse, and shock. If treatment does not start within 24 hours of onset of symptoms, the disease is 100% fatal.

- **Bubonic**: It is characterized by swollen painful lymph nodes called buboes, high fever, chills, headache, and malaise. The resulting bubo is usually 1 to 10 centimeters in diameter, swollen, painful and warm to the touch. It can cause so much pain that the affected body part cannot be moved. The bubo usually develops in the groin (Fig. 23-12), but may also appear in the armpit or neck, depending on where the flea bite occurred. Bubonic may progress to either Septicemic or Pneumonic.

- **Septicemic**: This phase of plague usually follows bubonic in most cases. In addition to the preceding signs the patient develops prostration, circulatory collapse, septic shock, organ failure, hemorrhage, disseminated intravascular coagulation, and necrosis of the extremities can be seen.

  Laboratory testing can confirm plague. Small gram-negative and/or bipolar-staining coccobacilli can be seen on a smear taken from affected tissues of a sputum sample, cerebral spinal fluid, or aspiration from a bubo. Plague is confirmed by a positive culture.
Treatment

Treatment should be started immediately once plague is suspected. Immediate administration of antibiotics is required to reduce mortality. This is especially true with primary pneumonic plague in which the mortality rate approaches 100% if not initiated within 18 – 24 hours. Supportive care should include hemodynamic monitoring.

- Primary Antibiotics
  - Streptomycin (1g every 12 hours intravenously)
  - Gentamicin (5mg/kg intravenously or intramuscular every day or 2mg/kg loading dose, then 1.7 mg/kg every 8 hours intravenously)
- Alternative Antibiotics
  - Doxycycline, Ciprofloxacin, or Chloramphenicol

Prophylaxis

Post exposure prophylaxis for face-to-face contact of patients with pneumonic plague or personnel exposed to an intentional release aerosol plague should be given antibiotics for the duration of the exposure plus 7 days. There is currently no approved vaccination (in the United States) for plague.

- Primary Prophylaxis
  - Doxycycline (100 mg orally twice a day)
- Alternative Prophylaxis
  - Ciprofloxacin or Chloramphenicol

Isolation and Decontamination

Standard precautions should be used for bubonic and septicemic plague. Respiratory isolation and precautions against airborne spread is required for pneumonic plague. Rid patients and their clothing of fleas. Decontamination can be done with a 1% bleach solution. Patients can be cleaned with a soap and water solution.

The *Y. pestis* bacterium can be inactivated by heat (greater than 15 minutes at 55°-72°C) or direct sunlight (more than 2 hours).

TULAREMIA (FRANCISELLA TULARENSIS)

*Tularemia*, also known as “rabbit fever,” is a disease caused by the bacterium *Francisella tularensis*. It is typically found in animals, especially rodents, rabbits, hares, and ticks. It is usually a rural disease and has been reported in all U.S. states except Hawaii. It is a gram-negative, non-motile coccobacillus. The bacterium has several subspecies with varying degrees of virulence. As a biological threat, it is rarely fatal (approx. 1-2%), but can be seriously incapacitating. *F. tularensis* is one of the most infectious pathogenic bacteria, requiring less than 10 organisms for infection. It was used as a biological weapon during WWII, and engineered to be antibiotic/vaccine resistant by the United Soviet Socialist Republic (USSR); now Russia.

Forms of Disease and Infectious Route

There are two subspecies and several types of the disease that are determined by the route of infection. Of the subspecies, Jellison type A and B, Type A is the most virulent. Humans become infected through bites from infective arthropods (ticks and deer flies), handling infectious animal tissues or fluids, direct contact with, or ingestion of, contaminated matter, or inhalation of infective aerosols. Tularemia is not spread from person to person.

- **Ulceroglandular**: is the most common form of tularemia and usually occurs following a tick or deerfly bite, or after handling of an infected animal.
- **Pneumonic and typhoidal**: forms of the disease would likely be the predominate forms following an intentional aerosol release of the agent. Tularemia, in aerosol form, is considered a possible bioterrorist agent.
Incubation Period

Usually 3 to 5 days with a range of 1 to 14 days.

Signs and Symptoms

Tularemia presents generally with abrupt onset fever, headache, chills, generalized body aches, and nausea begins suddenly. Diagnosis of tularemia is confirmed by serological testing.

- **Ulceroglandular**: A skin ulcer appears at the site where the organism entered the body. The ulcer is accompanied by regional lymphadenopathy usually in the armpit or groin.

- **Pneumonic and typhoidal**: Symptoms include cough, chest pain, and difficulty breathing. This form results from breathing dusts or aerosols containing the organism. Develops when other forms of tularemia are left untreated and the bacteria spread through the blood stream to the lungs.

Treatment

The use of antibiotics is necessary for the treatment of Tularemia.

- **Primary Antibiotics**
  - Streptomycin (1g every 12 hours intramuscular) or
  - Gentamicin (5mg/kg intravenously or intramuscular every day)

- **Alternative Antibiotics**
  - Doxycycline, Ciprofloxacin, or Chloramphenicol

Prophylaxis

Post exposure antibiotics should begin within 24 hours of exposure and continue for 14 days.

- **Preferred Prophylaxis**
  - Doxycycline (100 mg orally twice a day)
  - Ciprofloxacin (500 mg orally twice a day)

Isolation and Decontamination

Isolation is not recommended for tularemia patients, given the lack of person-to-person transmission. Standard precautions are recommended when treating patients. Clothing or linens contaminated with body fluids of patients with tularemia should be disinfected. The agent is rendered harmless when exposed to heat (55°C for 10 minutes) and susceptible to 1% bleach solution followed by 70% alcohol solution and standard water chlorination.

**BOTULINUM TOXIN (CLOSTRIDIUM BOTULINUM)**

Botulinum Toxin is produced by *Clostridium botulinum*, an encapsulated, anaerobic, gram-positive, spore-forming, rod-shaped bacterium. It is a neuroparalytic (muscle-paralyzing) disease blocking acetylcholine release from peripheral nerves. The toxin is highly lethal and easy to produce and release. The toxin is the most toxic substance known and is 10 - 15,000 times more toxic then VX nerve agent by weight. As a biological threat botulinum can be easily produced and disseminated. It has been used in former state sponsored bioweapons programs in Japan, Germany, US, USSR, Iran, Iraq, North Korea, and Syria.

Forms of Disease and Infectious Route

Seven antigen types (A-G) of the toxin exist; only types A, B, E and F are known to cause illness in humans. There are no reported cases of person-to-person transmission. There are four kinds of botulism:

- **Food-borne botulism**: Occurs when a person ingests pre-formed toxin that leads to illness within a few hours to days

- **Infant botulism**: Occurs in a small number of susceptible infants each year who harbor *C. botulinum* in their intestinal tract

- **Wound botulism**: Occurs when wounds are infected with *C. botulinum* that secretes the toxin
Inhalational botulism: Occurs when the *C. botulinum* in aerosol form is inhaled. There is no natural occurrence of this type and is feasible to be used as a weapon by a terrorist group or another country.

**Incubation Period**

Neurological symptoms usually appear within 12 to 36 hours. It may take several days to develop if exposed to a low dose. Time to onset is dose dependent.

**Signs and Symptoms**

The classic symptoms of botulism include cranial nerve palsies (double vision, blurred vision, drooping eyelids, slurred speech), dysphagia, dry mouth and throat, and muscle weakness. These are all symptoms of the muscle paralysis caused by the bacterial toxin. If untreated, these symptoms may progress to cause paralysis of the arms, legs, trunk and respiratory muscles. Laboratory confirmation can be obtained by a bioassay of the patient’s blood serum.

**Treatment**

Early administration of Trivalent antitoxin (which neutralizes against toxin types A, B, and E) or Heptavalent antitoxin (for types ABCDEFG is held by the US Army). Respiratory failure is managed with intubation and mechanical ventilation. Parenteral fluids and supportive care may be required.

**Prophylaxis**

A Pentavalent (ABCDE) toxoid is distributed by the CDC to immunize laboratory workers and protect troops against attack.

**Isolation and Decontamination**

Isolation is not required for botulism patients. Use standard precautions when treating patients and good hand washing after handling soiled material.

The toxin is readily inactivated by sunlight (1 to 3 hours) or heat (80°C for 30 minutes, 100°C for several minutes) and surfaces may be decontaminated with a 1% bleach solution. Clothing and skin should be washed thoroughly with soap and water.

**RICIN**

Ricin is a potent toxin that has potential to be used as an agent of biological warfare and as a weapon of mass destruction (WMD). It is derived from the beans of the castor plant (*Ricinus communis*) and can be made from the waste material left over from processing castor beans. The toxin blocks protein synthesis at the cellular level. The loss of protein synthesis leads to irreversible cell death and tissue damage. As a biological threat, it is considered relatively easy to produce and can be delivered by aerosolization, injection, or ingestion.

**Form of disease and Infectious Route**

Route of exposure is inhaled aerosol, ingestion, and parenteral (injected). Clinical manifestations depend on the route of exposure and amount of absorption. It can be in the form of powder, mist, pellet, or it can be dissolved in water or weak acid. There is no person to person transmission.

**Incubation Period**

Symptoms will onset within a few hours by ingestion and within 18-24 hours by inhalation. If a lethal dose is experienced, time to death is a matter of a few days.

**Signs and Symptoms**

- **Ingestion:** Mild exposure can lead to nausea, vomiting, diarrhea, and abdominal pain. Severe poisoning can result in GI tract symptoms progressing (4-36 hours) to renal and liver failure, and finally death.
• **Inhalational:** Illness within 8 hours including cough, shortness of breath, fever, respiratory distress. This will progress to pulmonary edema, airway necrosis, and death.

• **Injection:** Initial (<6 hours) weakness and myalgias (muscle pain), progressing (24-36 hours) to vomiting, hypotension, multi-organ failure, and death.

### Treatment

There is no known antidote or other specific treatment. Provide supportive care for fluid loss due to gastroenteritis, cardiac and respiratory support as needed.

### Prophylaxis

None.

### Isolation and Decontamination

Isolation in not required for Ricin patients. Use standard precautions when treating patients. Ricin can be heat inactivated at 85°C for 10 minutes or 50°C for 1 hour. Decontamination can be accomplished with soap and water. The agent is inactivated with 1% bleach solution for 10 minutes contact time.

### SMALLPOX (VARIOLA MAJOR AND VARIOLA MINOR)

Smallpox is a serious, contagious, and sometimes fatal infectious disease. It is caused by the *variola* virus that emerged in human populations thousands of years ago. Except for two known laboratory stockpiles, the *variola* virus has been eliminated. However, in the aftermath of the events of September and October, 2001, there is heightened concern that the *variola* virus might be used as an agent of bioterrorism.

As a Biological threat, smallpox presents a great risk. The last reported case was in 1977 and routine smallpox vaccination ceased in 1980, thus the current population is highly susceptible.

If smallpox was intentionally released it would spread rapidly through aerosols or mucous membrane transmission. The virus has been successfully weaponized in long range missiles by the former Soviet Union which is now Russia and various other eastern-block countries. There is some question about the control of Russian virus stocks.

### Forms and Infectious Route

Generally, direct and fairly prolonged face-to-face contact is required to spread smallpox from one person to another. Smallpox can also be spread through direct contact with infected bodily fluids or contaminated material such as bedding or clothing. Humans are the only natural hosts of *variola*. Smallpox is not known to be transmitted by insects or animals. There are two clinical forms of smallpox:

- **Variola major** is the severe and most common form of smallpox, with a more extensive rash and higher fever. There are four types of *variola major* smallpox: Ordinary, modified, flat, and hemorrhagic. Historically, *variola major* has an overall fatality rate of about 30%; however, flat and hemorrhagic smallpox usually are fatal.

- **Variola minor** is a less common presentation of smallpox, and a much less severe disease, with death rates historically of 1% or less.

### Incubation Period

From 7 to 19 days, usually 10 to 14 days to the onset of illness and 2 to 4 additional days before the onset of a rash.

### Signs and Symptoms

Symptoms of smallpox infection usually appear within 10 to 12 days after exposure to the virus. The first symptoms of smallpox may be difficult to distinguish from other flu-like illnesses and include: High fever, fatigue, malaise, headache, backache, and rash.
A characteristic rash, most prominent on the face, arms, and legs, follows 2 to 3 days after the first symptoms. The rash starts with macules and quickly progress to papules (Fig. 23-13). After a few days, the lesions become pustular vesicles and begin to crust early in the second week. Scabs develop and then separate and fall off after about 3 weeks.

![Image](image.png)

**Figure 23-13.—Typical Centrifugal Rash Distribution**

*Image reprinted with permission by: National Museum of Health and Medicine, Armed Forces Institute of Pathology (Reeve 48135). Washington, DC.*

**Treatment**

There is no proven treatment for smallpox. People with the disease can benefit from intravenous fluids and medicine to control fever or pain as well as antibiotics for any secondary bacterial infections that may occur. If an infected person gets the smallpox vaccine within 4 days after exposure to the virus, it may lessen the severity of illness or even prevent illness.

**Prophylaxis**

Immediate vaccination or revaccination should be administered to all exposed personnel and those living in the immediate vicinity (ring vaccination).

**Isolation and Decontamination**

Patients should be considered contagious from the onset of the rash until all scabs separate. They should be isolated using airborne and droplet precautions during this period. The aerosolized virus may persist for 24 hours under optimal conditions. Extra care must be taken with infected clothing and bedding as well as infected scabs and bodily fluids. Contaminated materials should be bagged and incinerated or autoclaved. Decontamination can be accomplished by using standard hospital-grade disinfectants such as quaternary-ammonia compounds as these are effective in killing the virus. They should be used on surfaces to disinfect hospitalized patients’ rooms or other contaminated surfaces. A 5-10% bleach solution with at 10 minute contact time is also recommended.

**HEMORRHAGIC FEVERS**

Viral hemorrhagic fevers (VHFs) refer to a group of illnesses that are caused by four distinct families of viruses. The viruses are characterized by fever and bleeding. The overall vascular system is damaged and the body's ability to regulate itself is impaired. While some types of hemorrhagc fever viruses can cause relatively mild illnesses, many of these viruses cause severe life-threatening disease.

As a biological threat, Marburg and Ebola viruses exhibit potential for development as biological weapons. They are highly infective and provide a person-to-person aerosol transmission. These particular viruses have an extremely high mortality and there is no treatment available.
Forms of Disease and Infectious Route

There are four families of VHF:

**Arenaviruses:** Family of viruses whose members are generally associated with rodent-transmitted disease in humans via rodent urine and excrement. There has also been documented person-to-person transmission with close contact in a health care setting. Each virus usually is associated with a particular rodent host species in which it is maintained. Arenavirus infections are relatively common in humans in some areas of the world and can cause severe illnesses.

**Filoviruses:** Family of viruses called Filoviridae can cause severe hemorrhagic fever in humans and nonhuman primates. So far, only two members of this virus family have been identified: Marburg virus and Ebola virus. Four species of Ebola virus have been identified: Ivory Coast, Sudan, Zaire, and Reston. Ebola-Reston is the only known filovirus that does not cause severe disease in humans. This group of viruses is transmitted by persons-to-person contact.

**Bunyaviruses:** This group of viruses is vector-borne and transmission occurs via an arthropod vector (mosquito, tick, or sandfly), with the exception of Hantaviruses. Hantaviruses are transmitted through contact with deer mice feces. This group includes Crimean Congo Hemorrhagic Fever, Rift Valley fever, and Hantaan.

**Flaviviruses:** This is a group of several viruses that includes Dengue virus and Yellow Fever Virus. These viruses are transmitted by the bite from an infected arthropod (mosquito or tick).

Incubation Period

This varies with each virus.

Signs and Symptoms

VHF are illnesses that are characterized by fever and bleeding. Specific signs and symptoms vary by the type of VHF, but initial signs and symptoms often include marked fever, fatigue, dizziness, muscle aches, loss of strength, and exhaustion. Patients with severe cases of VHF often show signs of bleeding under the skin, in internal organs, or from body orifices like the mouth, eyes, or ears. However, they may bleed from many sites around the body; patients rarely die because of blood loss. Severely ill patient cases may also show shock, nervous system malfunction, coma, delirium, and seizures. Some types of VHF are associated with renal (kidney) failure. Laboratory diagnosis is required.

Treatment

Patients receive supportive therapy, but generally speaking, there is no other treatment or established cure for VHF. Ribavirin, an antiviral drug, has been effective in treating some individuals with Lassa fever or hemorrhagic fever with renal syndrome. Treatment with convalescent-phase plasma has been used with success in some patients with Argentine hemorrhagic fever.

Prophylaxis

The only approved VHF vaccination is for Yellow Fever.

Isolation and Decontamination

All VHF patients should be placed in strict isolation. Strict contact precautions should be instituted along with airborne precautions to the maximum extent possible. Providers who must be in contact should be in protective clothing and wear a HEPA respirator. All contaminated materials should be autoclaved or incinerated. These agents are susceptible to 1% bleach solution and phenolic disinfectants.
LEARNING OBJECTIVE:

Identify medical conditions that occur after due to radiation exposure and provide appropriate medical treatment.

The principles for medical treatment of casualties, as developed from previous experiences in conventional warfare, are applicable in the treatment of casualties produced by radiological warfare. With the exception of ionizing radiation effects, the type of injuries produced in nuclear warfare are similar to those of conventional warfare. Standardized techniques of treatment must be adopted for all types of casualties so the greatest number of patients can receive maximum medical care in the shortest period of time with the greatest economy of medical personnel and equipment.

HISTORY

The first use of an atomic weapon during war took place during WWII. The death and devastation evidenced by the nuclear weapons in wartime (in Hiroshima and Nagasaki, Japan, at the end of World War II) has, to date, kept it from being used again. Although a nuclear non-proliferation treaty has been signed by most of the major powers, nuclear weapons are still a part of the arsenal of many countries of the world. Other countries are continuing to develop nuclear weapons such as North Korea and Iran.

Recent history has shown a disturbing change in the potential use of nuclear weapons. Terrorist organizations have added a new dimension to the use of radiological material. These groups have been seeking a nuclear bomb or the materials necessary to develop a nuclear device. Terrorist organizations may not be able to develop a fully functional nuclear bomb; they may develop and utilize a radiological disbursal device (RDD) or dirty bomb.

A RDD is any device that causes the purposeful dissemination of radioactive material across an area without a nuclear detonation. Such a weapon can be easily developed and used by a person with conventional explosives and access to radioactive material (radionuclides; radioactive isotopes). A radioactive source is blown up using conventional explosives and radioactive material is scattered across the targeted area as debris. The material dispersed can originate from any location that uses radioactive sources, such as a nuclear waste processor, a nuclear power plant, a university research facility, a medical radiotherapy clinic, or an industrial complex.

The use of a RDD type of weapon is likely to cause more of a psychological impact than that of radiation injuries. The resulting blast would cause conventional casualties to become contaminated with radionuclides and would complicate medical evacuation within a contaminated area.

The detonation of a nuclear weapon or RDD is not the only form of potential radiological contamination of military forces. Other sources of radiological contamination are:

- The destruction of a nuclear reactor
- A nuclear accident
- Improper nuclear waste disposal
- Many materials used in military ordnance, equipment, and supplies

U.S. forces may be operating in a theater that has nuclear reactors that are not designed to U.S. specifications and are without containment vessels. These reactors may be lucrative enemy artillery or bombing targets. Military operations in these areas, if contaminated, could result in military personnel receiving sufficient radiation exposure or particulate contamination to warrant medical evaluation and remediation.
TYPES OF RADIATION

Radioactivity may be defined as the spontaneous and instantaneous decomposition of the nucleus of an unstable atom with the accompanying emission of a particle, a gamma ray, or both. The actual particles and rays involved in the production of radiation injuries are the alpha and beta particles, the neutron, and the gamma ray.

When radiation interacts with atoms, energy is deposited, resulting in ionization. It is this ionization that becomes a health concern because it may damage certain critical molecules or structures in a cell. Damage to a sufficient number of molecules within the cell, the cell will not be able to carry on its normal functions and will die. There are two modes of radiation action within a cell:

- **Direct action** is when radiation may directly hit a particularly sensitive atom or molecule in the cell. The resulting damage is irreparable; the cell either dies or performs improperly
- **Indirect action** is when radiation interacts with water molecules in the body. The energy deposited in the water leads to the creation of unstable, toxic peroxides. These molecules damage sensitive molecules and affect sub-cellular structures

**Alpha**

Alpha particles are emitted from the nucleus of some radioactive elements. They are heavy, very short-range particles that are not able to penetrate clothing or human skin. Alpha-emitting materials can be harmful to humans if the materials are inhaled, swallowed, or absorbed through open wounds. If absorbed in the body, particles will cause significant cellular damage in the immediate area adjacent to the particle’s physical location. Care must be taken around possible contaminated sites because instruments cannot detect alpha radiation through even a thin layer of water, dust, paper, or other material, because alpha radiation is non-penetrating.

**Beta**

Beta radiation is a light, short-range particle and is actually an ejected electron. This form of radiation may travel several feet in the air and is moderately penetrating, more than Alpha particles. Beta radiation can penetrate human skin to the "germinal layer," where new skin cells are produced. If high levels of beta-emitting contaminants are allowed to remain on the skin for a prolonged period of time, they may cause skin injury. They cause serious internal damage if absorbed into the body.

**Gamma and X – Rays**

Gamma rays are electromagnetic waves. Gamma rays and x-rays are different types of radiation, as a biological impact they have the same effect. Gamma radiation and x rays are highly penetrating electromagnetic radiation. Gamma radiation or x rays are able to travel many feet in air and many inches through human tissue. They readily penetrate most materials and are sometimes called "penetrating" radiation and constitute mainly an external hazard to humans. Dense materials are needed for shielding from gamma radiation. Clothing provides little shielding, but will prevent contamination of the skin by gamma-emitting radioactive materials.

**Neutrons**

Neutrons are part of the nucleus in an atom. Neutrons are emitted only during a nuclear fusion or detonation and are a form of high penetrating radiation that presents no fallout hazard. They have significant mass and interact with the nuclei of atoms, severely disrupting atomic structures. Compared to gamma rays, they can cause 20 times greater damage to tissue. Neutrons and gamma rays are an important medical consideration in a nuclear explosion since their range is great enough to produce biologic damage, either alone or in conjunction with blast and thermal injuries.
UNITS OF RADIATION

The radiation absorbed dose (rad) is used to measure a quantity of absorbed dose of radiation. It relates to the amount of energy absorbed in material. This does not describe the biological effects of different radiation. The International System of Units (SI) is replacing common American terminology; the new absorbed dose unit for radiation is the gray (Gy). The unit for dose, gray, is used for all forms of ionizing radiation (Table 23-4). Dose is the total amount of energy absorbed per gram of tissue. The exposure could be single or multiple and either short or long in duration.

<table>
<thead>
<tr>
<th>SI Unit</th>
<th>Old Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Gy</td>
<td>1 joule/kg</td>
</tr>
<tr>
<td>1 Gy</td>
<td>100 Rad</td>
</tr>
<tr>
<td>10 milliGray (mGy)</td>
<td>1 Rad</td>
</tr>
<tr>
<td>1 Sv</td>
<td>100 rems</td>
</tr>
<tr>
<td>10 milliSievert (mSv)</td>
<td>1 rem</td>
</tr>
</tbody>
</table>

Table 23-4.—SI Conversion Chart

Adapted from Medical Management of Radiological Casualties 2nd ed.

Two other units that may be used to express radiation units are Roentgen equivalent man (Rem) and Sievert (Sv):

- **Rem** is the special unit used to derive a quantity of exposed dose
  - It relates to the absorbed dose in human tissue as related to biological damage from radiation
  - The dose equivalent in rems is equal to the absorbed dose in rads multiplied by the quality factor (1 rem = 0.01 Sv)

- **Sievert** is the SI unit of any of the quantities expressed as dose equivalent
  - The dose equivalent in sieverts is equal to the absorbed dose in grays multiplied by the quality factor (1 Sv=100 rems)

Equal doses of different types of radiation cause different amounts of damage to living tissue. For example, 1 Gy of alpha radiation causes about 20 times as much damage as 1 Gy of x-rays. The energy from x-rays are dispersed through the human body, whereas the energy from an alpha particle is highly concentrated and will kill cells in the immediate vicinity of the particle. Therefore the equivalent dose was defined to give an approximate measure of the biological effect of radiation. For comparison, the 'background' dose of natural radiation received by a US citizen is around 3 mSv (300 mrem) per year. A lethal full-body dose of radiation for a human is around 4 - 5 Sv (400 - 500 rem) instantaneously.

MEASUREMENT DEVICES

There are special devices used to measure field radiation levels. Some devices are currently available to conduct radiological surveys and measure radiation levels on equipment and personnel. They are the AN/VDR-2 and the AN/UDR-13 for field use and the AN/PDQ-1 for shipboard use. There are other radiation detection systems available; these are a few examples of what is in current use.
Radiac Set AN/VDR-2

The AN/VDR 2 (Fig. 23-14) is used to perform ground radiological surveys in vehicles or in dismounted mode by individual personnel as a handheld instrument. The device provides a quantitative measure of radiation to assist with the decontamination of personnel, equipment, and supplies. The device can be used with vehicle power or internal batteries.

Figure 23-14.—Radiac Set AN/VDR-2


Radiac Set AN/UDR 13

The AN/UDR 13 (Fig. 23-15) is a compact, handheld, or pocket carried, tactical device that can measure prompt gamma/neutron doses from a nuclear event. It can measure the total gamma dose and the dose rate from nuclear fallout. The LCD provides data readout and warning and mode messages. The unit is worn by an individual and allows the monitoring of radiation dose. It provides a warning to inform a person they have received a set amount of radiation; they can depart the contaminated site.

Figure 23-15.—Radiac Set AN/UDR-13


Radiac Set AN/PDQ 1

The AN/PDQ-1 (Fig. 23-16) is a multi range Radiac device that detects beta and gamma radiation. The AN/PDQ-1 uses a Geiger-Mueller ionization chamber and has two ranges for radiation levels, mR/hr and R/hr. The probe measures gamma radiation and can also be used to detect beta radiation when the probe shield is open. It is powered by two D cell batteries and is used for personnel monitoring and surveys for hot spots onboard a ship. The device can be used to detect radiation levels on a patient during decontamination. The AN/PDQ-1 uses a Geiger-Mueller ionization chamber and has an operating range of 0-1000 R/HR. The device has two ranges for radiation levels, mR/hr and R/hr. The probe measures gamma radiation and can be used to detect beta radiation when the probe shield is open.

Figure 23-16.—Radiac Set AN/PDQ 1

*Image reprinted with permission from: NAVSEA Damage Control, Fire Protection Engineering and CBR-D.*
EXPOSURE FACTORS

Personnel entering contaminated areas to either remove casualties or work in decontamination stations have two major concerns. The first concern is the prevention of their own contamination, and the second is the prevention or reduction of radioactive exposure. Contamination can be avoided by decontaminating patients and equipment before handling, wearing appropriate protective clothing and equipment, avoiding highly contaminated areas, and strictly observing personal decontamination procedures.

Radioactive material presents a direct risk to the health and safety of all personnel. This risk can be avoided (or at least minimized) by following some simple guidelines and using common sense. The three major factors that guide actions to avoid exposure are time, distance, and shielding.

Time

Radioactive decay and the decomposition of fallout products progress rapidly in the early hours after a nuclear blast, and the hazards to rescue workers can be reduced considerably if operations can be delayed until natural decay has reduced the level of radioactivity. Some radioactive materials may take a number of years to decay before it reaches a safe level of radioactivity. In either case, a rescue worker may have to enter a contaminated area before safe levels can be achieved. If so, the workers exposure time to radioactive material must be limited.

The more time spent in a contaminated environment, the higher Gy dose. Limiting the time of exposure is essential if total avoidance is not possible. Rotating personnel entering an exposure risk area, planning actions to minimize time in the area, and prompt decontamination reduce the total time the individual is exposed, thereby reducing the dose of radiation absorbed by the body.

Distance

Both radioactive particles and electromagnetic waves (gamma rays) lose energy and consequently lose their ability to harm tissue as they travel away from their source. The farther a person is away from the source, the reduction of the exposure level. The closer a person is to a radioactive source, the higher Gy dose will be absorbed by that person.

Shielding

Shielding is an essential component in preventing/reducing radiation exposure. Alpha and beta particles have very little penetrating power, and intact skin forms an adequate barrier in most cases. Gamma radiation has much greater penetrating power and presents the greatest risk of exposure and damage to tissue.

Lead is the most effective shielding material. Wood, concrete, other metals, and heavy clothing will somewhat reduce the amount of gamma radiation that reaches the body. Most particle exposure is the result of inhalation or ingestion, although radiation particles may enter the body through burned, abraded or lacerated skin. Breaks in skin integrity (i.e. rash, laceration, or psoriasis) will increase the penetration of gamma rays, x-rays, and beta rays resulting in a more contaminated patient.

PERSONNEL PROTECTION EQUIPMENT (PPE)

Protective Masks

Standard issue chemical protective masks afford excellent protection from inhalation and ingestion of radioactive material. Radon and tritium gas will pass through the filters, but short exposures are not medically significant. Increasing oral fluids and maintaining sufficient urine output will adequately treat tritium exposures. Vehicle fires produce dangerous chemical fumes from burning metals and plastics and deplete closed-space oxygen; a self-contained breathing apparatus may be necessary in such cases.
Protective Clothing

Commercial anti-contamination suits (Tyvek® Anti-C Suits) are ideal but offer little advantage over standard MOPP–4. Chemical-protective over-garments provide excellent contamination protection as well as protection from chemical-biological agents in the combat environment.

Standard hospital barrier clothing as used in Universal Precautions is adequate for emergency treatment of limited numbers of contaminated casualties. Medical personnel should be decontaminated following patients’ emergency treatment and decontamination.

In avoiding particle exposure, full personnel-protective clothing and a protective mask with hood provides the best protection. A protective mask and foul-weather gear will provide lesser, but adequate protection. In cases where no protective breathing devices are available, some protection is afforded by breathing through a folded towel, handkerchief, or several surgical masks. Avoid hand-to-mouth contact, eating, or smoking in contaminated areas.

EFFECTS ON PERSONNEL

Direct exposure to radiation will damage body tissue. The extent of the damage is dependent upon the quantity of radiation delivered to the body, the type of radiation, the dose rate, duration of exposure, and the organs exposed (Table 23-5). Experience has shown that the faster the onset of early symptoms (nausea and vomiting); the higher the dose of radiation received by the patient.

<table>
<thead>
<tr>
<th>Time Onset</th>
<th>Estimated Dose</th>
<th>Degree of ARS</th>
<th>Fatality Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1 hr</td>
<td>&lt; 30 Gy</td>
<td>Lethal</td>
<td>100</td>
</tr>
<tr>
<td>&lt; 1 hr</td>
<td>6 – 30 Gy</td>
<td>Lethal</td>
<td>90 - 100</td>
</tr>
<tr>
<td>1 – 2 hr</td>
<td>6 – 8 Gy</td>
<td>Very Severe</td>
<td>90 – 100</td>
</tr>
<tr>
<td>2 – 4 hr</td>
<td>2 – 6 Gy</td>
<td>Moderate</td>
<td>0 - 80</td>
</tr>
<tr>
<td>3 – 6 hr</td>
<td>1 – 2 Gy</td>
<td>Mild</td>
<td>0</td>
</tr>
<tr>
<td>None</td>
<td>0 – 1 Gy</td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

Table 23-5.—Estimated (Whole Body) Radiation Dose by Time of Symptom Onset

Adapted from Medical Management of Radiological Casualties 2nd ed.

ACUTE RADIATION SYNDROME (ARS)

Acute Radiation Syndrome or ARS is an acute illness caused by irradiation of the body by a high dose of penetrating radiation in a very short period of time, usually a matter of minutes. It is also known as radiation toxicity or radiation sickness. The major cause of this syndrome, in its simplest form, is cell death in specific tissues. Examples of people who suffered from ARS are the survivors of the Hiroshima and Nagasaki atomic bombs or the firefighters that first responded after the Chernobyl Nuclear Power Plant event in 1986.
Signs and Symptoms

The first symptoms (Prodromal Phase) of ARS are typically nausea, vomiting, diarrhea, and malaise. These symptoms will start within minutes to days after the exposure, will last for minutes up to several days, and may come and go.

The second phase or (Latent Phase) results in the person usually looking and feeling healthy for a short time, after which will become sick again (Latent Period). Time of onset will vary between 0 – 15 days dependent upon the degree of ARS.

Patients may experience loss of appetite, fatigue, fever, nausea, vomiting, diarrhea, and possibly even seizures and coma. This seriously ill stage may last from a few hours up to several months.

The third phase (Manifested Illness) time of onset ranges from day one (Lethal) to over 2 weeks (Mild). Symptoms are convulsions, ataxia, tumor, lethargy, severe diarrhea, fever, and electrolyte disturbance for lethal ARS. Symptoms for moderate to very severe ARS are severe leucopenia (decreased white blood cells), purpura (purple colored spots or patches), hemorrhage, pneumonia, and hair loss after 3 Gy. Mild ARS is demonstrated by moderate leucopenia (decreased total number of white blood cells in the circulating blood).

People with ARS typically have some skin damage. This damage can start to show within a few hours after exposure and include swelling, itching, and redness of the skin (resembling a severe sunburn). Hair loss is common with these patients. The skin may heal for a short time, followed by the return of swelling, itching, and redness days or weeks later. Complete healing of the skin may take from several weeks up to a few years depending on the radiation dose received.

The chance of survival for people with ARS decreases as the radiation dose increases, an inverse relationship. Most people who do not recover from ARS will die within several months of exposure. The cause of death in most cases is the destruction of the person’s bone marrow, which results in infections and internal bleeding. For the survivors, the recovery process may last from several weeks up to 2 years.

Treatment

Evaluat e ABCs, stabilize any life threatening injuries, and decontaminate. Provide supportive care: Antiemetic, fluids, antibiotics, pain management, and a clean environment. Treat other wounds as necessary. Transfer patient to a medical treatment facility for additional care when he/she is decontaminated.

CHRONIC RADIATION SYNDROME (CRS)

Chronic Radiation Syndrome (CRS) is a medical condition caused by long term exposure to low dose radiation. It is highly unlikely to affect military personnel in an operational setting. It would require prolonged deployments to heavily contaminated areas or long term ingestion of highly contaminated food or water. A person may develop this condition after prolonged exposed to a near-ground weapon detonation, RDD, or major reactor accident that creates contamination with high dose rates.

Signs and Symptoms

Clinical symptoms are diffuse and may include sleep and/or appetite disturbances, generalized weakness and easy fatigability, increased excitability, loss of concentration, impaired memory, mood changes, vertigo, ataxia, paresthesias, headaches, epistaxis, chills, syncope episodes, bone pain, and hot flashes.

Clinical findings may include localized bone or muscle tenderness, mild hypotension, tachycardia, intention tremor, ataxia, weakness, hyperreflexia (occasionally hyporeflexia), delayed menstrual cycles, and underdeveloped secondary sexual characteristics.
Laboratory findings include mild to marked shortage of all types of blood cells and abnormal bone growth.

Treatment

After the patient is removed from the radiation environment, clinical symptoms and findings slowly resolve, and complete recovery has occurred from the lower doses. The patient should receive follow-up care at a treatment facility when possible.

RADIATION DERMATITIS\textsuperscript{36, 37}

There are two types of Radiodermatitis, Acute and Chronic. Acute Radiodermatitis usually occurs after heavy contamination of bare skin with beta emitting material. This can result from the use of a RDD. It rarely develops in situations where personnel are fully clothed.

This condition is best prevented by washing off the contaminated material. Chronic Radiodermatitis is a result of long term exposure to low levels of radiation (Table 23-6).

<table>
<thead>
<tr>
<th>Radiation</th>
<th>Dose</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute</td>
<td>6 – 20 sv</td>
<td>Erythema only</td>
</tr>
<tr>
<td></td>
<td>20 – 40 sv</td>
<td>Skin breakdown in 2 weeks</td>
</tr>
<tr>
<td></td>
<td>&gt; 3000 sv</td>
<td>Immediate skin blistering</td>
</tr>
<tr>
<td>Chronic</td>
<td>&gt;20 sv</td>
<td>Dermatitis with possible cancer risk</td>
</tr>
</tbody>
</table>

Table 23-6.—Radiation Dermatitis

Signs and Symptoms

In either Acute or Chronic Radiodermatitis, the symptoms are the same and the severity is dependent upon the dose received. The area becomes red and irritated. Other symptoms include hair loss in the affected area, edema, decreased sweating, wet or dry shedding of the outer layers of skin, ulcerations, bleeding, and skin cell death. Chronic exposure may result in permanent and irreversible symptoms. Additionally, Squamous Cell Carcinoma may develop within a few years.

Treatment

The primary treatment is removal of the radiation source. Removal of contaminated clothing and the bare skin, to include the hair, should be thoroughly washed with soap and water. Cool compresses and pain medication may be used to control the pain. A topical moisturizing cream may provide some relief. Transfer patient to a treatment facility when possible.

PSYCHOLOGICAL EFFECTS

Radiation illness symptoms in just a few personnel can produce devastating psychological effects on an entire unit that is uninformed about the physical hazards of radiation. This acute anxiety has the potential to become the dominant source of stress within a unit.

Personnel are more likely to focus on radiation detection and thus increase the potential of injury from conventional battlefield hazards.

OTHER INJURIES

Apart from the ionizing radiation effects, most of the injuries suffered in a nuclear weapon explosion will not differ greatly from those caused by ordinary high explosives and incendiary bombs. The types of injuries usually seen are blast, shock wave, burns, and eye burns (flash blindness).

Treatment

Most injuries resulting from the detonation of a nuclear device are likely to be mechanical wounds resulting from collapsing buildings and flying debris, and burns caused by heat and light released by the detonation.
A burn is a burn, regardless of whether it is caused by a nuclear explosion or by napalm, and its management remains the same. This is also true of fractures, lacerations, mechanical injuries, and shock. In none of these is the treatment dictated by the cause. For most of the conventional injuries, standard first-aid procedures should be followed.

NOTE:
The following words of caution should be considered when treating wounds and burns:

Dressings for wounds and burns should follow a closed-dressed principle, with application of an adequate sterile dressing using aseptic techniques.

Make no attempt to close the wound, regardless of its size, unless authorized by a physician.

If signs of infection and fever develop, give antibiotics.

DECONTAMINATION

The presence of radiological contamination can be confirmed by passing a radiation detector (radiac) over the entire body. Open wounds should be covered prior to decontamination. Wound debridement is completed by irrigation with normal saline and a clean dressing placed over the wound. Wounds can be verified clean with the use of a radiac. Contaminated clothing should be carefully removed, placed in marked plastic bags, and removed to a secure location within a contaminated area. Bare skin and hair should be thoroughly washed, and if practical, the waste water should be sequestered and disposed of appropriately.

Radiological decontamination should never interfere with medical care. Unlike chemical agents, radioactive particles will not cause acute injury to medical personnel. Decontamination sufficient to remove chemical agents is more than sufficient to remove any radiological contamination.

Radiological decontamination is performed in an identical manner to chemical decontamination. The main difference is in timing. Chemical decontamination is an emergency. Radiological decontamination is not.

Care must be taken to not irritate the skin. If the skin becomes erythematous, some radionuclides can be absorbed directly through the skin. Surgical irrigation solutions, normal saline, should be used in liberal amounts to clean wounds, the abdomen, and the chest. All such solutions should be removed by suction instead of sponging and wiping. Only copious amounts of water, normal saline, or eye solutions are recommended for the eye.

CERTIFICATION OF DECONTAMINATION

Careful examination of the body with a certified radiac, such as the AN/VDR–2, will confirm adequate decontamination. Particular attention must be paid to the hands, fingers, face, hair, and feet. Once safe levels are achieved, the patient can be certified clean.

SUMMARY

There have been changes in recent years with regard to the threat of chemical, biological, and radiological warfare. Terrorism has added a new aspect to this threat. This chapter has outlined a brief history of CBR warfare, agents (chemical and biological), detection devices for CBR weapons, and decontamination methods.
INTRODUCTION

Traditionally, the dentist is responsible for all dental diagnosis and treatment; certain circumstances may occur that warrant the Hospital Corpsman (HM) to provide emergency dental treatment to patients. If an emergency occurs, always contact a dental officer to obtain an appropriate treatment plan. The dentist may authorize the HM to provide the following treatments: temporary treatment that provides relief from pain, fights infection, or prevents further damage to the mouth. Following an emergency visit, always instruct the patient to return the next day to dental sick call or to make an appointment in the appropriate dental specialty area for definitive treatment. Advise the patient to keep the appointment even if symptoms disappear.

Oral conditions are identified by signs and symptoms. A **sign** is what the HM observes when examining the oral structures, such as bleeding gums, carious lesion, or heavy deposits of plaque or calculus. A **symptom** is what a patient reports about his or her disease or injury such as a toothache or sore gums.

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**EMERGENCY TREATMENT GUIDELINES**

**LEARNING OBJECTIVE:**

*Explain the Emergency Treatment Guidelines for dental emergency treatment of patients.*

Certain emergency guidelines have been established to assist the HM in providing emergency treatment to patients. Before any emergency treatment is rendered, the HM **must** follow the emergency treatment guidelines **first** as listed below for **every** dental emergency:

- Check the patient’s general physical condition
- Interview the patient and record the symptoms
- Review patient’s health history
- Examine the patient and record assessment findings, including vital signs
- Check for other injuries if trauma has been found
- Consult with the dentist and report the patient’s condition
- Request instructions from the dentist or other on site provider (IDC, PA, NP) and follow the treatment plan exactly
- Record the emergency treatment provided in the Health Record, Dental, EZ603A
- Advise the patient the treatment provided is temporary and to return for definitive treatment
DISEASES OF THE TISSUES OF THE TEETH

LEARNING OBJECTIVE:

Describe the signs, symptoms, and the emergency treatment for diseases of the tooth tissues.

An important part of the HM’s job is the ability to recognize oral diseases and their signs and symptoms.

DENTAL CARIES

Dental caries, also known as tooth decay or cavities, occurs when bacterial processes damage hard tooth structures (enamel, dentin and cementum, discussed in Chapter 7). Initially, it may appear as a small chalky white spot which may eventually develop into a large cavitation. If the lesion progresses, it will continue into the dentin and eventually involve the pulp.

Symptoms

Once the decay passes through the enamel and into the dentinal tubules, it will expose the tooth nerve resulting in pain.

- Pain may worsen with exposure to heat, cold (more often), or sweet foods and drinks
- Pain from an affected tooth can manifest in a healthy, noninvolved tooth; this is called referred pain

Signs

- Chalky white spot on the enamel
- Roughness on the surface of the tooth
- Dark, stained cavity
- Cavity filled with food or a spongy mass of decaying dentin

Treatment

- Perform emergency treatment guidelines
- Gently remove all debris from the cavity with a spoon excavator
- Flush the cavity with warm distilled water, if unavailable use clean tap water
- Isolate the tooth with cotton rolls or gauze
- Carefully dry the cavity with cotton pellets
- Mix a temporary filling (zinc oxide eugenol, IRM® “Intermediate Restorative Material,” etc.)
- Gently fill the cavity with the temporary filling material
- Check the occlusion (previously discussed in Chapter 7). Make sure the temporary restoration does not touch the opposing tooth
- Instruct the patient to return to the DTF (dental treatment facility) for definitive treatment on the next work day

ACUTE PULPITIS

Acute pulpitis is an inflammation of the pulp usually due to injury from dental caries or trauma. It is the most frequent cause of severe tooth pain. Pressure from inflammation can cause mild to extreme pain depending upon the severity of the inflammation.

Symptoms

- Spontaneous, continuous, or intermittent pain that lingers
- Piercing and pulsating pain in the affected area
- Increased pain when lying down
Signs

- Large carious lesion
- Large carious lesion with pulpal exposure
- Blood or puss oozing from the pulpal exposure
- Fractured tooth or missing restoration (filling)

Treatment

- **Perform emergency treatment guidelines**
- Gently remove loose debris from the cavity
- Dry the cavity with cotton pellets
- Pack the cavity with a cotton pellet slightly moistened with eugenol
- Gently fill the cavity with a temporary filling material
- Check the occlusion
- Instruct the patient to return to the DTF for definitive treatment

PERIAPICAL ABSCESS

A periapical abscess (Figs. 24-1 and 24-2) usually results from an infection of the pulpal tissue causing the pulp to become necrotic (die). This type of infection causes fluids and by-products to build up within the walls of the pulp chamber and root canal(s). The periapical abscess is formed when these materials escape through the apical foramen of the tooth. An area of pus and fluid accumulation forms in the bone surrounding the apex of the tooth. As the pressure builds up, a channel may form through the alveolar bone and the soft tissue. This channel is called a sinus tract. When the pus reaches the soft tissue, vestibular or facial swelling can occur. Extensive swelling is called cellulitis. Swelling that is confined to a small area at the site of a sinus tract is called a gumboil.

Symptoms

- Constant, throbbing pain in the affected area
- Increased pain when chewing
- Increased pain when lying down
- Bad taste in the mouth
- A gumboil (painful swelling on the gum)
- The tooth “feels longer” than the others
- Malaise
- Tender lymph nodes locally
Signs

- Severe pain reaction is experienced when light pressure is applied to the affected tooth
- A gumboil
- Facial swelling (general or localized)
- Increased tooth mobility
- An elevated temperature
- Enlarged lymph nodes locally

Treatment

- **Perform emergency treatment guidelines**
  - Expose a periapical radiograph of the affected tooth. The abscess will appear radiolucent around the apex of the tooth (see Fig. 24-2)
  - Drain the abscess
    - If the abscess is soft and pus is evident, drainage can be done without local anesthesia
    - Puncture the most raised portion of the abscess with an explorer
  - If a carious lesion is present, gently excavate the cavity

  **NOTE:**
  If drainage occurs through the cavity, the patient may experience a rapid relief from pain.

- If drainage still does not occur, apply an ice pack to the affected area. This may reduce the patient’s discomfort until the dentist can provide emergency treatment
- When drainage is established, give the patient instructions about home care and notify the dental officer to see if a prescription for antibiotics can be called into the pharmacy
- Instruct the patient to return to the DTF for definitive treatment as soon as possible

**DISEASES OF THE PERIODONTAL TISSUES**

**LEARNING OBJECTIVE:**

Describe the signs, symptoms, and the emergency treatment for diseases of the periodontal tissues.

Periodontal diseases are a group of diseases that affect the periodontium that support and anchor the teeth. Left untreated, periodontal disease results in the destruction of the gums, alveolar bone (the part of the jaws where the teeth arise), and will lead to the loss of teeth.

**MARGINAL GINGIVITIS**

Gingivitis is an inflammation of the gingival tissue. Marginal gingivitis is a relatively mild inflammation of the borders of the gingival tissue. Sometimes the inflammation is localized; it may exist around one, two, or a group of teeth. If the condition is generalized, then it will exist around all the teeth. The most frequent cause of marginal gingivitis is the presence of bacterial plaque buildup due to lack of adequate oral hygiene, (i.e. daily brushing and flossing).
Symptoms

- Sore or swollen gums
- Bright-red, or purple gums
- Severe oral odor
- Gums that are tender, or painful to the touch
- Gums that bleed easily, even with gentle brushing, and especially when flossing

Signs

- Painful reaction or gingival bleeding when finger pressure is applied
- Red, swollen gingiva with a loss of stippling (healthy gums have an “orange peel” appearance known as stippling)
- Heavy plaque and calculus deposits in the affected area
- Severe oral odor

Treatment

- **Perform emergency treatment guidelines**
  - Give the patient OHI (oral health instruction consists of motivating and educating the patient on proper brushing and flossing techniques)
  - Have the patient rinse with a warm saline solution
  - Gently scale the teeth to remove soft debris and any obvious supragingival (above the gum) calculus using hand scaling instruments

Necrotizing ulcerative gingivitis (NUG) (Fig. 24-3) is a severe infection of the gingival tissue, commonly referred to as trenchmouth. The condition is caused by an overpopulation of established oral bacteria due to a number of interacting factors such as poor hygiene, poor diet, smoking, stress, lifestyle, and other infections.

![Necrotizing Ulcerative Gingivitis](image)

**Figure 24-3.—Necrotizing Ulcerative Gingivitis**

Image reprinted with permission from: North East Regional Board of Dental Examiners, INC., Silver Spring, MD.

**NOTE:**

NUG is more common in deployed Sailors and Marines.

Symptoms

- The same symptoms as that of marginal gingivitis
- Bad taste in the mouth
- Pain when eating or brushing
- Excessive bleeding
Signs

- Same as those of marginal gingivitis, but more severe
- Heavy plaque and calculus deposits
- Ulceration and cratering of the interdental papillae. Frequently, so much of the papillae is lost that the triangular area between the crowns of the teeth present a “punched out” appearance
- A gray-white membrane covering the gingiva
- A foul odor from the oral cavity
- Pus oozing from the gingiva
- Elevated temperature

Treatment

- **Perform emergency treatment guidelines**
- If the patient has an elevated temperature (101° or above), the dentist should treat the patient
- If the HM is authorized to treat the patient, the treatment plan will be the same as for marginal gingivitis

PERIODONTITIS

*Periodontitis* (Fig. 24-4) involves progressive loss of the alveolar bone around the teeth, and if left untreated can lead to the loosening and subsequent loss of teeth. It usually results from untreated marginal gingivitis. It is marked by the gradual loss of attachment of the periodontal tissues. Periodontitis may affect the entire dentition or only localized areas.

![Image of Periodontitis](image.jpg)

*Figure 24-4.—Periodontitis*

*Image reprinted with permission from: North East Regional Board of Dental Examiners, INC., Silver Spring, MD.*

Symptoms

- “Deep, gnawing pain” in the affected area
- Itching of the gums
- Sensitivity to heat and cold
- Bleeding gums
- Food sticking between the teeth
- Gingival recession resulting in apparent lengthening of teeth
- A tooth aching with the absence of caries
- Uneven bite
- Increased spacing between the anterior teeth
- Halitosis, or bad breath
- Persistent metallic taste in the mouth
- Loose teeth in the later stages
Signs

- Heavy plaque and calculus deposits
- Gingival inflammation, bleeding, or discoloration (bluish-red)
- Localized or generalized gingival bleeding
- Ulcerated or cratered papilla
- Tooth mobility increased

Treatment

- Perform emergency treatment guidelines
- The emergency treatment plan will be the same as for marginal gingivitis

PERIODONTAL ABSCESS

A periodontal abscess (Fig. 24-5) is caused by an infection of the periodontal tissues. It is usually the result of a long-continued irritation by food debris, deep deposits of calculus or a foreign object packed in the sulcus or interproximal spaces.

The signs and symptoms for periodontal abscesses are similar to those for periapical abscesses.

Treatment

- Perform emergency treatment guidelines

Figure 24-6.—Probing Affected Area with Scaler

Photograph provided by the Biomedical Photography Department of Naval Support Command, Bethesda, MD.

- Gently probing the affected area with a scaler (Fig. 24-6) or an explorer to establish drainage. Probe the space between the tooth surface and the gingival tissue
- If probing does not establish drainage, have the patient apply warm saline to the affected area

Figure 24-5.—Periodontal Abscess

Photograph provided by Captain David Hartzell of the Naval Post Dental Graduate School, Bethesda, MD.
PERICORONITIS

Pericoronitis (Fig. 24-7) is an inflammation of the gingiva around a partially erupted tooth. During eruption the tooth breaks through the gingiva tissue and sometimes a small flap of tissue remains over the crown of the tooth. Debris accumulates beneath the tissue flap resulting in an acute inflammation. Inflammation can also result from constant contact between the tissue flap and the tooth in the opposing arch. Pericoronitis most often affects mandibular third molars (Teeth #17 & #32).

Symptoms

- Pain when chewing
- Bad taste in the mouth
- Difficultly in opening the mouth
- Swelling in the neck or in the area of the affected tooth
- Fever

Signs

- Partially erupted tooth
- Red, inflamed tissue around a partially erupted tooth
- Pus oozing from under an overlaying tissue flap
- Painful reaction when finger pressure is applied
- Swelling in the cheek near the affected tooth
- Enlarged lymph nodes
- Elevated temperature

Treatment

- Perform emergency treatment guidelines
- Irrigate under the tissue flap with a warm saline solution (Fig. 24-8)
- Gently clean the area with a sonic scaler or hand scaler
- Instruct the patient to rinse with a warm saline solution every 2 hours
- Contact dental officer if patient is febrile or if lymph nodes are palpable. The dental officer will determine the need to prescribe antibiotics
OTHER ORAL DISEASES

LEARNING OBJECTIVE:

Describe the conditions resulting from inflammation of the oral mucosa, postexodontic complications, and trauma to the teeth and their supporting structures.

This section describes emergency conditions resulting from inflammation of the oral mucosa, postexodontic complications, and trauma to the teeth and their supporting structures.

STOMATITIS AND RECURRENT LABIAL HERPES

“Stomatitis” is a general term used to denote inflammation of the oral mucosa. Two types of stomatitis are common in dentistry; they are herpetic gingivostomatitis and aphthous stomatitis (canker sore). Herpetic gingivostomatitis usually occurs on the masticatory or keratinized tissues (e.g. gingivae, hard palate), while aphthous stomatitis usually occurs on the lining mucosa or non-keratinized tissue. Both conditions are marked by the formation of small blisters and ulcers on the oral mucosa.

Symptoms

- A painful swelling
- A fever blister, cold sore, or canker sore
- Pain when eating or drinking
- A fever, headache, or rundown feeling (for herpetic gingivostomatitis ONLY)

Signs

- Red, swollen areas with blisters or small craters formed in the center
- Blisters or craters covered with a grayish-white or yellowish membrane

Treatment

- Perform emergency treatment guidelines
- Follow instructions given by the dentist
- Instruct the patient NOT to smoke, eat acidic or hot foods, or drink alcohol or use products that contain alcohol (such as mouth rinses) that will dry out the mouth.

POSTEXTRACTION HEMORRHAGE

Postextraction hemorrhage may occur any time from a few hours to several days after the extraction of a tooth. The bleeding from the extraction site may be light or heavy. Any form of hemorrhage is considered serious, so inform the dentist as soon as possible.

Symptoms

- Bleeding that starts, or fails to stop, after an extraction
- Large amounts of blood in the mouth
- Weakness in conjunction with blood loss
- Blood on the pillow after sleeping

Signs

- Blood oozing or flowing from a recent extraction site
- Blood or a large blood clot in the patient’s mouth
Treatment

- **Perform emergency treatment guidelines**
- Notify the dentist
- Monitor the patient’s vital signs watching for changes in his or her condition until the dentist arrives
- To help stop the bleeding, place a pack of moistened sterile gauze over the extraction site and instruct the patient to bite down firmly

POSTEXTRACTION ALVEOLAR OSTEITIS

*Postextraction alveolar osteitis* is a condition commonly referred to as a “dry socket”. It’s a common occurrence following the surgical removal of mandibular molars, occurring in 20% to 25% of patients. It’s rarely observed in the maxilla. It normally results when a blood clot fails to form or washes out of the socket of a recently extracted tooth. This condition is very painful.\

**Symptoms**

- Increasing pain and discomfort 3 to 4 days after extraction
- Experiencing radiating pain
- Foul taste and odor

**Signs**

- The absence of a blood clot
- Food visible in the socket
- Alveolar bone visible in the socket
- A foul odor in the mouth
- An elevated temperature

FRACTURED TEETH

Pain from fractured teeth usually results from exposed dentin, or irritation of the pulp tissue as a result of trauma. The HM may also observe lacerations of the gingiva, lips, and cheeks. Except in a few rare cases, the dental officer will treat all tooth fractures. If authorized, the HM’s primary duty is to lessen the pain and prevent further injury to the patient until the dentist arrives to provide more definitive emergency treatment. The HM must be able to recognize the four different types of tooth fractures.
### Symptoms (Type I: Enamel Fracture) (Fig. 24-9)

- Rough or sharp area on a tooth
- Pain when eating or drinking
- Sensitivity to heat, cold, or air

### Signs

- A slight chip or fracture of the tooth enamel layer only, or with possible minimal dentin involvement
- No exposure of the dentin or pulp

### Treatment

- **Perform the emergency treatment guidelines**
  - Smooth sharp edges of the chipped area with sandpaper strips or disk to eliminate irritation of the tongue and lips
  - Carefully dry the chipped area with a cotton roll or pellets
  - Apply small coats of cavity varnish over the chipped area with cotton forceps and cotton pellets
  - Instruct the patient to eat a bland diet and avoid extremely hot and cold foods or liquids and sticky foods

### Symptoms (Type II: Enamel/Dentin Fracture) (Fig. 24-10)

- Very rough or sharp edges
- Severe pain from heat, cold, or air
- Toothache

### Signs

- Extensive fracture involving the enamel and dentin layers
- No pulp exposure

### Treatment

Except in rare cases, the dental officer will provide emergency treatment. The dental officer may authorize the assistant to cover the exposed dentin with a temporary type paste or place a temporary crown until definitive treatment is available. Begin with performing the emergency treatment guidelines and then going into the remaining treatment steps.
The procedures for covering a Type II fracture with zinc oxide and eugenol (i.e. IRM®) paste or other temporary paste are as follows:

- Isolate area with cotton rolls
- Carefully dry the fractured tooth off with cotton rolls or 2 x 2 gauze (Do not use direct air with the 3-way syringe)
- Coat all exposed dentin with a zinc oxide and eugenol paste or other temporary material, including light cured glass ionomer cement
- Advise the patient that this is a temporary procedure to relieve pain and sensitivity. The coat of zinc oxide and eugenol may come off the fracture
- Instruct patient to eat a bland diet and avoid extremely hot and cold foods, liquids, or sticky foods, and not to chew on the fractured tooth

Procedure for placing a temporary crown on a Type II fracture:

- Select a plastic crown form
  - Trim the form with scissors to adapt it to the fractured crown
  - Ensure that the entire fracture will be covered
- Also ensure the incisal edge in not in occlusion with the opposing teeth, while fitting the plastic crown
- Place two or three small holes in the incisal edge of the crown form with a sharp explorer
- Fill the crown form with a thin mix of calcium hydroxide (i.e. Dycal®) or zinc oxide and eugenol (i.e. IRM®)
- Gently place the crown form over the fractured crown. The HM will see any excess material expressed from the holes of the incisal edge while placing the crown
- Remove any excess material from and around the crown with gauze and cotton pellets
- Instruct the patient to eat a bland diet and avoid extremely hot and cold foods or liquids and sticky foods

Symptoms (Type III: Enamel/Dentin Fracture with Pulp Exposure) (Fig. 24-11)

- Severe, throbbing pain
- Very rough or sharp edges
- Severe pain from heat, cold, or air

Figure 24-11.—Enamel/Dentin Fracture with Pulp Exposure

- Inability to chew food

Signs

- Extensive fracture with the pulp exposed
  *Possible bleeding from the pulp
- Most or all of the crown is fractured off
Treatment

In almost all cases of a fracture this severe, the dental officer will treat the patient. Only in rare cases would the HM treat the patient. The following is a treatment plan that the dental officer might authorize to treat a Type III fracture.

- Perform the emergency treatment guidelines
- Place a crown form over the affected tooth. Refer back to this procedure under the treatment for type II fractures
- At times, it may be impossible to place a crown form over a fractured tooth. The pressure of the crown form against the pulp tissue may cause the patient pain or there may not be enough tooth structure left for retention of the crown
- If this occurs, a splint rather than a crown form is placed on the tooth as shown in Figure 24-12

Figure 24-12.—Properly Placed Splint

- To make the splint:
  o Prepare a large mixture of zinc oxide and eugenol (i.e. IRM®)
  o Add cotton fibers from a cotton pellet to the mixture for strength
  o The mixture should have a dough-like consistency for molding the splint
- Place the splint so it covers the affected tooth and the teeth immediately adjacent to it (Fig. 24-12)
- Ensure that the mixture is placed well up on the lingual and facial aspects of the gingival tissue
- Gently compress the splint between a finger and thumb to lock it into the interproximal spaces
- Trim the splint from the incisal edges of the teeth
- Check the occlusion to see if the splint is interfering with the patient’s bite
- Advise the patient to let the splint harden for several hours before attempting to eat
- Tell the patient to return to dental sick call ASAP for more definitive care

Symptoms (Type IV: Root Fracture)
(Fig. 24-13)

- Severe pain from heat, cold, air
- Inability to eat anything without severe pain
- A tooth that is moving or loose

Figure 24-13.—Root Fracture
Signs

Upon examination of a type IV fracture, the dental officer may direct the HM to take a radiograph of the tooth to determine if there is a fracture of the root. The following may be observed:

- A fractured root (as seen in the patient’s X-ray), which may be further complicated by a fracture of the crown
- Tooth mobility
- Other facial trauma associated with the accident

Treatment

Because of the severity, almost all cases of type IV fractures will be treated by the dental officer. Only in very rare cases, will the HM provide treatment.

- Perform emergency treatment guidelines
- Place a splint in the same way as for the Type III fracture

TRAUMATICALLY EXTRACTED TEETH

If a tooth has been traumatically extracted from the socket (Fig. 24-14), notify the dentist as soon as possible. The dental officer may instruct the HM to replace the tooth back in the socket after rinsing it with sterile saline. Time is of the essence for the replantation to be a success. Perform emergency treatment guidelines and control hemorrhaging until the dentist arrives.

Figure 24-14.—Traumatically Extracted Tooth
Photograph provided by Captain David Hartzell of the Naval Post Dental Graduate School, Bethesda, MD.

FRACTURES OF THE MANDIBLE AND MAXILLA

The dentist will treat this type of injury. The HM’s responsibility is to prevent further injury and to lessen the pain while waiting for the dentist. A person who has a fractured jaw may suffer serious interference with breathing. One of the most important phases of emergency care is to clear the upper respiratory passage of any obstructions. Fractures are usually the result of a high-velocity accident (e.g., the face striking the dashboard of a car). Of all the facial bones, the nasal bones, followed by the mandible, are the most frequently injured (Fig. 24-15).

Figure 24-15.—Fractured Mandible
Image reprinted with permission by: Photograph of Kim E. Goldman. (August 18, 2009). Figure 24-12. Fracture Mandible Associates in Oral & Maxillofacial Surgery. Louisville, KY.
Less common is a fracture of the maxilla. It can be distinguished from a mandibular fracture because the fractured maxilla will cause severe malocclusion consisting of an open bite. The face will also look elongated. Both the mandible and maxilla fractures are treated in the same manner until a dentist arrives.

**Symptoms**

- Difficulty in breathing, talking, eating, or swallowing
- Pain when the mandible or maxilla is moved
- An inability to move the mandible or maxilla
- Bleeding from the gums and around the teeth
- A complaint from the patient that the teeth do not come together
- A complaint that the lower lip is numb (mandibular fracture)

**Signs**

- Facial swelling
- Abnormal occlusion
- Fractured bones on dental radiographs ordered by the dentist
- Abnormal movement of mandible or maxilla

**Treatment**

- Perform emergency treatment guidelines
- Reporting the patient’s condition to the dentist
- Immobilizing the injured area by applying an elastic bandage as shown in (Fig. 24-16) and ensuring that a pair of scissors is standing by to cut the bandage off if the patient starts to vomit or has respiratory difficulties

**Figure 24-16.—Bandaging to Immobilize Both Mandible and Maxilla**

- Applying ice packs to reduce swelling of the injured area and to lessen the pain.

**SUMMARY**

Emergency treatment of oral diseases and injuries is key to keeping the Sailors and Marines on task with the mission. Especially in the deployed setting, care of teeth and its support structures can be an extremely difficult task to accomplish. Understanding the various dental diseases (i.e. acute pulpitis, NUG, and stomatitis) and injuries (tooth and jaw fractures) will prepare the HM to provide emergent dental care when most needed to ensure the completion of the mission by dental ready forces.
CHAPTER 25

DECEDEDNT AFFAIRS

INTRODUCTION

The Navy’s Decedent Affairs Program consists of search, recovery, identification, care, and disposition of the remains of deceased personnel for whom the Department of the Navy is responsible. The Decedent Affairs Program is considered a highly visible and extremely sensitive program. Arrangements for the burial of the deceased should be conducted in an expedient but dignified manner, and survivors of the deceased should be given the greatest possible amount of support and assistance.

ASSIGNMENT OF RESPONSIBILITIES

For this reason, Hospital Corpsmen (HMs) should have a working knowledge of decedent affairs procedures, which are outlined in OPNAVNST 5360.1 series, Decedent Affairs Manual.

PROGRAMS

LEARNING OBJECTIVE:

Identify military activities that are responsible for the management of the Navy and Marine Corps Decedent Affairs Program.

The overall manager of the Navy and Marine Corps Decedent Affairs Program is Navy Casualty, Navy Mortuary Affairs, located in Millington, TN. At the local level, decedent affairs officers assigned to various naval hospitals and other naval activities are responsible for inspecting remains, briefing escorts, making travel arrangements, selecting locations, and coordinating the burial at sea of caskets and cremated remains via Navy vessels.

Naval hospitals manage deaths that occur within the hospital and in their local area of responsibility. At small independent operational units and on board naval vessels, the responsibility for managing the Decedent Affairs Program falls on the Commanding Officer or Officer-in-Charge, Medical Service Corps Officer, and the senior corpsman under the guidance of Navy Mortuary Affairs.

CURRENT DEATH PROGRAM

The Current Death Program provides professional mortuary services, supplies, and related services incident to the care and disposition of remains of persons eligible for these services. Under this program, remains are shipped to a place designated by the primary next of kin also known as the Person Authorized Direct Disposition (PADD), such as a spouse or parents, for permanent disposition. The PADD serves as the person who directs all activities having to do with the deceased. The decedent’s personal effects will be shipped to the legal recipient.
The Current Death Program is normally operational on a worldwide basis during peacetime, but may also be used during major conflicts.

GRAVES REGISTRATION PROGRAM

The Graves Registration Program (GR or GRREG) provides for the search, recovery, evacuation to a temporary cemetery or a mortuary, initial identification, disposition of personal effects found, and burial in the temporary cemeteries. This program is only operational when authorized by the responsible commander during major military operations. When necessary, the GR program includes the establishment and maintenance of temporary burial sites. Detailed guidance on graves registration procedures are contained in the Mortuary Affairs Joint Operations 4-06, 05JUN06, and Navy and Marine Corps publication NAVMED P-5016/NAVMC 2509A, Handling of Deceased Personnel in Theaters of Operation.

CONCURRENT RETURN PROGRAM

The Concurrent Return Program combines the Current Death Program and Graves Registration Program. The program provides for the search, recovery, and evacuation of remains to a processing point; identification and preparation of remains in a mortuary; and shipment, for permanent disposition to a final destination designated by the PADD. The Concurrent Return Program normally becomes operational when large numbers of military personnel are committed to a strategic area. Remains buried in temporary cemeteries (under the GR program or in emergencies) will normally be disinterred and evacuated under the Concurrent Return Program if conditions and capabilities permit.

RETURN OF REMAINS PROGRAM

The Return of Remains Program provides for permanent disposition of remains of persons buried in temporary cemeteries who could not be evacuated under the Concurrent Return Program.

The Return of Remains Program is activated only upon the enactment of special legislation. This special legislation may authorize the establishment of one or more permanent American cemeteries in the overseas area and may give PADD the option of having the remains buried therein or shipped to another place of their choosing. When the Return of Remains Program becomes activated, the Chief, Bureau of Medicine and Surgery (BUMED), is responsible for notifying field activities of its activation.

CASUALTY ASSISTANCE CALLS PROGRAM

The Casualty Assistance Calls Program (CACP) is administered by the Chief of Naval Operations Personnel Command, and the Commandant of the Marine Corps (CMC). Although integrally related, the CACP is not part of the Decedent Affairs Program. The CACP details a Casualty Assistance Calls Officer (CACO), a commissioned officer or senior enlisted personnel, to personally contact the PADD. The CACO helps the PADD and SNOK (secondary next of kin) with problems surrounding the death and provides information regarding:

- Disposition of remains, to include funeral planning
- Death gratuity and unpaid pay and allowances
- Shipment of service member’s personal effects, household goods, POV, etc.
- Claim documents to aid in the movement and/or settlement of the decedent’s estate (wills, bank accounts, property, savings bonds, commercial insurance, etc.)
- Servicemen’s Group Life Insurance (SGLI), and travel of all eligible dependents to grave site funeral services and final move to permanent residence
The Navy and Marine Corps Casualty Assistance Calls Programs are operated differently. The individual service instructions noted below should be consulted for specifics.

- NAVPERS 15560, Naval Military Personnel Manual (MILPERSMAN)
- BUPERSINST 1770.1 series, The Navy Casualty Assistance Calls Program (CACP) Manual
- MCO P3040.4 series, Marine Corps Casualty Procedures Manual (MARCORCASPROCMAN)

ELIGIBILITY FOR DECEDENT AFFAIRS

LEARNING OBJECTIVE:
Identify individuals who are eligible for decedent affairs benefits.

Navy and Marine Corps members who die while serving on active duty or active and inactive duties for training are entitled to Decedent Affairs Program benefits. Generally, the following persons under the jurisdiction of the Department of the Navy are entitled to some decedent affair benefits: dependents, retirees, and civilian employees. Refer to OPNAVINST 5360.1 series, Decedent Affairs Manual and U.S. Code, Title 10, Subtitle A, Part II, Chapter 75, Subchapter II, 1481, for detailed guidance.

NOTIFICATION OF DEATH

LEARNING OBJECTIVE:
Identify forms used to report casualties, deaths, and personnel missing or missing in action.

Within four hours after it is determined that a casualty has occurred, submit a casualty report in accordance with MILPERSMAN 1770-030, Personal Casualty Report Procedures.

PERSONNEL CASUALTY REPORT

A personnel casualty report must be completed for the following category incidents:

- Active Duty Navy
- Retired Navy personnel while inpatient at Military Treatment Facilities
- Certain former service members, while inpatient at Military Treatment Facilities
- All active duty and reserve military dependents
- All active duty members of other Armed Forces
- Civilians, to include contract employees, serving with or attached to Navy commands
- Others deaths occurring aboard Military Sealift Command vessels

When a member becomes a casualty, the service member’s Commanding Officer (CO) must submit a personnel casualty report. If a service member becomes a casualty while away from his or her command, the command or activity that learns of the casualty occurring should submit the personnel casualty report. The member’s command should supplement the personnel casualty report that was previously submitted by another command. If a service member has detached and was en route to the next command, the gaining command is responsible for generating the personnel casualty report.

METHOD OF REPORTING CASUALTIES

Personnel casualty reports should be sent by priority message.

Action Addressees on Personnel Casualty Reports

The following activities should be action addresses on personnel casualty reports:

- Commander, Naval Personnel Command, MILL_navycasualty@navy.mil
- Chief, Bureau of Medicine and Surgery
The appropriate Navy Regional Casualty Office will be notified concerning a casualty or death in the coverage area. The Casualty Assistance Calls Officer/Funeral Honors Support (CAC/FHS) Program oversees family notification in the area in which the PADD and SNOK reside, or the appropriate overseas CAC/FHS program coordinators.

**NOTIFICATION OF NEXT OF KIN**

**LEARNING OBJECTIVE:**

Explain notification of the next of kin procedures.

In cases of death, PADD are personally notified by a uniformed Navy or Marine Corps representative as appropriate. Personal notification of the PADD will normally be made between 0500 and 2400, except under unusual circumstances (e.g., the news media is expected to make a press release; or the member has been hospitalized in serious or very serious condition within CONUS, and the NOK is already aware of the prognosis).

When a death occurs within CONUS, it is the responsibility of the member’s CO to make sure that personal notification is made. Outside CONUS, individual commands shall follow standard procedures when reporting a casualty. Navy Personnel Command (NAVPERSCOM) duty watch personnel are available 24 hours a day to receive message traffic, phone calls, and email traffic from OCONUS commands when a death occurs. NAVPERSCOM will forward the personnel casualty report to the designated CACP regional headquarters, where CACO officers will proceed with notification assignment, and support. CACOs are assigned for a period of 90 days to 9 months depending on the needs of the families.

**CONFIRMATION OF THE CASUALTY**

In all cases, notification shall be made in person. Due to modern technology, casualty reports are forwarded through the region headquarters locations. An initial notification is made by the CACO who schedules a follow-up notification to take place within 24 hours. The purpose of the follow-up notification is to complete the paperwork associated with a death.

**CONDOLENCE LETTER**

COs are required to write a letter to the appropriate NOK within 48 hours of a casualty. The letter, in addition to expressions of condolence, should contain appropriate details of how the casualty died unless the cause is under investigation (i.e. suicide). No details should be included that are likely to distress the NOK. A copy of the letter is sent to NAVPERSCOM and Office of the Judge Advocate General (OJAG) Investigations Division. Example formats for condolence letters can be found in the Decedent Affairs Manual.

**AUTOPSY**

**LEARNING OBJECTIVE:**

Identify which circumstances require an autopsy to be performed.

An autopsy will be performed on the remains of active duty or active duty for training personnel. It will be performed if the death is considered accidental, intentional, suicide, homicide, or absent care of a physician. Individuals that are involved in motorcycle accidents, automobile accidents, or under the care of a physician, autopsies are at the discretion of the local medical examiner; it is not a requirement. An autopsy may be requested when the CO deems it necessary. The CO’s request may be self-initiated or based upon the recommendation of an investigating officer, other fact-finding body, or a medical officer.
An autopsy may be necessary to determine the true cause of death, to get information for completing military records, or to protect the welfare of the military community.

**AIRCREW AUTOPSY**

The *Manual of the Medical Department (MANMED), NAVMED P-117*, states that when an aircrew member dies while serving as an aircrew member on a military aircraft, the medical officer will recommend to the CO that an autopsy be performed to determine the cause of death. The cause of death in these cases is interpreted to mean any correlation between pathological evidence and the accident cause factor.

**REQUESTING PERMISSION FOR AUTOPSY**

When an autopsy is desired but not mandatory, the following sentence will be incorporated in the casualty notification message that requests disposition instructions from the PADD:

"In the interest of medical science and to confirm medical diagnosis, it is requested that your telegram include whether or not permission is granted to accomplish mortem examination."

**NONMILITARY AND RETIRED PERSONNEL AUTOPSY**

When an autopsy is deemed necessary for retired personnel or non-military persons who die at a naval treatment facility or on a Navy installation, written authorization from the NOK must be obtained before performing the autopsy. The request for permission to perform an autopsy should be incorporated into the casualty notification message as noted above.

**PRIVATE AUTOPSY**

If the federal government or local jurisdiction has determined that an autopsy is not necessary, the PADD may elect a private autopsy. Families must be made aware that they are financially responsible for the movement of the remains and the pathologist’s autopsy fees. A private autopsy costs thousands of dollars. Families can seek professional assistance through the CACO prior to pursuing a private autopsy.

**SEARCH, RECOVERY, AND IDENTIFICATION**

**LEARNING OBJECTIVE:**

Identify procedures used to search, recover, and identify remains.

The search, recovery, and identification of remains shall be accomplished as soon as possible and must be coordinated with an administrative fact-finding body. The need for these operations results from acts of violence, such as an aircraft accident, fire, explosion, or natural disaster. The *JAGINST 5800.7 series, Manual of the Judge Advocate General (JAGMAN)*, requires the convening of an administrative fact-finding body when incidents of this nature occur. This responsibility is usually delegated to a naval activity with necessary capabilities at or near the scene of disaster. In establishing identification of remains, search and recovery operations are part of the fact-finding functions with technical assistance furnished by appropriate medical authorities.

**SEARCH AND RECOVERY**

Every effort should be made to recover all remains. Disasters such as aircraft accidents, fires, and explosions that result in the death of naval members and members of other services must be reported to the Bureau of Medicine and Surgery (BUMED) and Navy Mortuary Affairs by priority message.
This assures immediate interdepartmental cooperation and the early dispatch of necessary supplies, equipment, medical and dental records, and technical personnel. The priority message should include the following information:

- Name, grade or rate, and social security number of all personnel believed dead or missing
- Names of those personnel already identified and method of identification
- Names of those personnel tentatively already positively identified, and whether remains are anatomically intact
- Type and quantity of mortuary supplies, transfer cases, chemicals, and other equipment required
- Whether technical help is desired

Do not release information to the NOK, family, or news media unless specific instructions are received from BUMED and the Navy Casualty Office to do so.

When search, recovery, and identification operations continue for more than 36 hours, chronological progress reports should be dispatched every 24 hours to BUMED and Navy Casualty Office, with the appropriate information addressees directed by OPNAVINST 5360.1 series.

**IDENTIFICATION**

When the CO is satisfied that identification has been established beyond doubt and documented accordingly, the remains may be considered identified. A minimum of two statements of recognition, substantiated by dental and/or fingerprint comparison of intact remains will substantiate identification requirements.

Navy Mortuary Affairs will establish final conclusions and take action required for final disposition of these remains if shipped from outside CONUS to CONUS.

Disposition of unidentified remains will be directed by Navy Mortuary Affairs for Navy personnel or CMC for Marine Corps personnel. After thorough study of all evidence, final conclusions made by Navy Mortuary Affairs will result in one of the following determinations:

- Identification of the remains
- Unidentified, but believed to be a specific individual
- Unidentified, unknown
- Group remains, known individuals
- Group remains, unknown individuals

When an autopsy of remains is required or requested, the identification specialist should schedule the autopsy to be performed during the identification process or immediately following. This will preclude any delays in releasing the body for burial and make sure that methods of identification are included in the autopsy report.

Personal effects found on or with remains, after having served all identification purposes, will be disposed of in accordance with current instructions contained in the *Naval Supply Manual, NAVSUP P-485*, or the *MARCORCASPROCMAN, MCO P3040.4*.

**IDENTIFICATION PROBLEMS**

Currently, all active duty service members have DNA samples on file with the Armed Forces DNA Identification Laboratory, Gaithersburg, Maryland. When a service member passes away and is not easily identifiable, there are numerous avenues utilized to determine positive identification. This includes fingerprint analysis, forensic odontology review of complete or partial dental remains, and DNA. Except for those portions of remains that have been positively identified, the Armed Forces Medical Examiner and or state agencies will pursue DNA identification methods. This style of identification is costly and not always available.
For those cases that are pending identification, the personnel casualty report status shall categorize the service member as Duty Status Whereabouts Unknown (DUSTWUN). With advances in science and technology, active duty service members that are killed in theater are identified in short periods of time. There will be exceptions to this case.

Families will be provided the opportunity to receive partially identified remains, primarily for funeral purposes. Families that grieve need something they can see, feel, and touch. This is a healthy part of the funeral process and basic concepts of death and dying. Remains identified at a later date (days/weeks/months) will be delicately processed with services coordinated through the CACO as directed by the family. The CACO will be contacted by the Navy Casualty Office, Navy Mortuary Affairs for the coordination and return of the partial remains. All elections (choices) will be determined by the PADD.

The Armed Forces Institute of Pathology (AFIP) and or local medical examiners may be requested to provide an identification specialist to make a complete review to ensure that all possible techniques, methods, and procedures have been used to provide a positive identification.

**PROCURING MORTUARY SERVICES**

**LEARNING OBJECTIVE:**

Identify mortuary services procurement methods and recognize both primary and secondary burial expenses.

Mortuary services for the remains of individuals eligible for Decedent Affairs Program benefits outside CONUS are specified in local instructions. Mortuary services within CONUS are provided by naval activities through annual contracts, individual purchase orders, or by private arrangements.

**ANNUAL CONTRACTS**

Annual contracts are awarded to funeral directors serving the local area of activities anticipating three or more deaths per year.

**ONE-TIME CONTRACTS**

One-time contracts (individual purchase orders) are created through Navy Casualty Office, Chief of Naval Operations (OPNAV) to a funeral home when an annual contract is not in effect.

**PRIVATE ARRANGEMENTS**

Private arrangements are made by the PADD. The PADD should be advised of services, supplies, and reimbursement funding available through Navy Mortuary Affairs or the local Naval Hospital Decedent Affairs Office. Private arrangements are coordinated between the PADD, CACO, Navy Mortuary Affairs, and the funeral home. When choosing this option the Statement of Disposition, CJMAB 5360/1, is thoroughly briefed by the CACO to the PADD. Selection of Option 5A or 5B authorizes the release of funds to reimburse funeral providers engaged in the responsibility of removing, preparing, embalming, dressing, casketing, and preparing for the funeral. Financial limits are updated biannually, where the services set the allowances. All mortuary billing questions shall be forwarded to Navy Casualty Office, Navy Mortuary Affairs.

**AUTHORIZED SERVICES**

Annual contracts and one-time contracts cover primary funeral expenses but do not include secondary expenses. NOK should be tactfully encouraged to allow the Navy to make all primary-care arrangements, since greater benefits can be furnished. For more information concerning procedures and authorized items, consult OPNAVINST 5360.1 series.
Primary Expenses

Primary expenses are expenses incurred in connection with the recovery, preparation, encasement, and burial of the remains. Primary expenses include:

- Embalming
- Autopsy preparation
- Dressing
- Casketing
- Cosmetics
- Hair styling
- Cremation
- Uniform

Secondary Expenses

Secondary expenses are expenses incurred in connection with the funeral and burial of remains. Secondary expenses include:

- Primary services of funeral director and staff
- Funeral service, visitation, graveside service
- Limousine
- Single grave plot
- Vault
- Honorarium
- Opening and closing the grave
- Flowers
- Obituary notices
- Memory folders
- Prayer cards
- Cemetery equipment, tent and chairs
- Soloist
- Organist

Transportation Expenses

Transportation expenses are expenses incurred when an active duty member, eligible retiree, or eligible dependent are moved. Transportation expenses include:

- Recovery of remains from crime scene/accident scene
- Removal from home, hospital or medical examiner’s office
- Delivery of the remains to a common-carrier terminal
- Delivery to mortuary, local cemetery, or crematorium
- Transportation of authorized retirees, and dependent remains of those that pass away in a Military Treatment Facility, or authorized civilian facilities:
  - Includes from place of death to funeral home
  - To church or offsite location
  - Air fare from shipping mortuary
  - Delivery of remains to airport
  - Air tray for casket
  - Receiving funeral home pick up from airport
  - Delivery of remains to cemetery
PREPARATION AND PROCESSING REMAINS

LEARNING OBJECTIVE:

Identify procedures for preparing and processing remains.

It is imperative that preservative treatment be initiated as soon as possible after death. The naval authority with decedent affairs responsibility should maintain close coordination with appropriate military or civilian authorities to ensure the prompt release and delivery of remains to the mortuary facility. Remains must be prepared under approved high standards of the mortuary profession and returned to the final destination in their most normal and life-like appearance.

INITIAL PREPARATION

Remains may be refrigerated for short periods pending arrival of a transportation vessel or arrival of the government embalmer. To minimize cellular deterioration, remains should be refrigerated above the freezing point at 36° to 40°F (2.2° to 4.4°C).

OVERSEAS FACILITIES

Government mortuary facilities are located in various overseas areas and have the responsibility to furnish mortuary services for all eligible categories of military and civilian personnel. The geographical areas of responsibility are outlined in the CINCPACINST 5360.1 series, Geographic Responsibilities for Mortuary Operations. Also consult OPNAVINST 5360.1 series for locations of overseas mortuaries.

When death occurs in overseas areas not served by one of the designated facilities listed, request assistance from the senior naval command. In some areas, Department of State sources may have the capability to render advice or assistance. The senior naval command may also be able to arrange airlift of remains from the place of death to a point where a government mortuary or a commercial facility is available or arrange for emergency dispatch of a qualified embalmer from an overseas government mortuary to the place of death.

CERTIFICATE OF DEATH (OVERSEAS)

When remains are transferred from an overseas activity to a CONUS point of entry, three signed copies of DD Form 2064, Certificate of Death (Overseas), must accompany the remains. Failure to include the DD Form 2064 may cause delays in providing further transfer within CONUS. Additionally, at least two DD Form 565, Statement of Recognition, should be included.

BURIAL CLOTHING

The service dress blue uniform or (if this uniform is not available for deceased personnel) the appropriate service dress uniform, with authorized insignia, devices, badges, decorations, underwear, and hose are the only approved items for burial, unless other items are specifically requested by the PADD. Shoes and headgear are not authorized and thus unfunded. It is recommended to obtain these items from the deceased’s personal effects. If unavailable, contact Navy Mortuary Affairs to obtain through Uniform Support Services, Navy Exchange, Navy Retail Clothing Store, or Marine Corps Exchange. When suitable items are not available for personnel who die outside the 48 contiguous United States, the U.S. port of entry should be contacted and given estimated uniform sizes, as soon as possible, so burial clothing can be obtained.

When requested by the PADD, remains may be attired in a white uniform or civilian clothing consisting of appropriate outer clothing, underwear, hose, and, if specifically requested, shoes. Items of clothing in the individual’s possession at the time of death may be used if available and in satisfactory condition.
PLACEMENT OF REMAINS IN CASKET OR TRANSFER CASE

Normally, remains are placed in a specified casket or transfer case in a manner that will create an appearance of rest and composure. Precautions should be taken to ensure maintenance of position during transit. The remains will be returned in a transfer case and will be wrapped in a white cotton sheet plus a second wrapping in a polyethylene cover. They will be sealed with pressure-sensitive tape or heat sealed.

CASKETS

There are two sizes of caskets. Each is an 18-gauge silver tone metal sealer with a cut top. The standard size casket has internal dimensions of 23 x 78 inches (58.4 cm x 1.98 m), while the oversize casket has internal dimensions of 25 x 81 inches (63.5 cm x 2.06 m).

INSPECTION OF REMAINS

After preparation of remains but prior to shipment, all remains should be inspected in accordance with OPNAVINST 5360.1 series. The Decedent Affairs Officer (DAO) or designated official is responsible for coordinating transportation arrangements for the remains with the local Navy Personnel Transportation Office (NAVPTO) or SATO travel office. Navy Mortuary Affairs must be kept apprised of transportation details so that the appropriate line of accounting is made available. Personnel should be available at all times, including Saturdays, Sundays, and holidays, to perform inspections and arrange travel. Before acceptance, the inspector must make sure that all services and supplies meet current specifications.

CREMATION

LEARNING OBJECTIVE:

Identify guidelines for requesting cremation of remains.

When requested in writing, cremation can be authorized. It is subject to compliance with civil regulations. No overt action by naval authorities should be made to encourage the NOK to elect cremation. Cremation will not be permitted if any member of the deceased’s PADD or SNOK objects.

AT-SEA DISPOSITION

LEARNING OBJECTIVE:

Identify burial at sea procedures.

Commanding Officers who receive requests for at-sea disposition of remains or cremains (cremated remains) will forward the request to the appropriate fleet commander-in-chief (CINC) and requested port of embarkation. Fleet CINCs are authorized to designate activities to accept remains or cremains on a "not-to-interfere basis." The port of embarkation will coordinate the arrangements. Upon receipt of authorization, the date of committal or dispersion will be determined by the availability of resources. Except under unusual circumstances, civilian personnel are not authorized to attend services aboard naval ships at sea or aboard naval aircraft. Exceptions that cannot be resolved at the delegated authority level will be referred to the CNO for final determination.

PUTRETFIED REMAINS

When the mortician is unable to arrest the odor of the remains, they will not be accepted for burial at sea. The odor generated for such remains will detract from the dignity of the ceremony and will have a detrimental effect on the crew of the vessel. Cremated putrefied remains may be accepted.
CEREMONY RECORDS

Civilians are not normally allowed to attend ceremonies aboard naval ships or aircrafts. Photographs and or video of the ceremony will be taken. A letter describing the ceremony, photographs and or video will be sent at the command’s discretion to the NOK.

CONSIGNMENT AND TRANSPORTATION OF REMAINS

LEARNING OBJECTIVE:

Identify consignment policies and authorized methods of transportation of remains.

Activities that arrange transportation for remains have the responsibility to provide expeditious transportation and a confirmed schedule as soon as possible by whatever methods meet the requirements. Consideration should be given to any special desires of the NOK including releasing the remains for transportation that they may wish to provide.

CONSIGNMENT

Remains may only be consigned (turned over) to a funeral director, the director or superintendent of a national cemetery, or the consignee (receiver) designated by the Navy Mortuary Affairs for unclaimed remains. In addition to the above consignees, cremains may be consigned to the PADD or person designated by the PADD.

AUTHORIZED METHODS OF TRANSPORTATION WITHIN THE UNITED STATES

Authorized methods of transportation within the United States include government air, commercial air, chartered air taxi, and funeral coach.

Government Air

Government air is not authorized within CONUS without approval of the CNO (OP-414). If the circumstances indicate government air, Navy Mortuary Affairs should be contacted for guidance and assistance.

Commercial Air

Commercial air may be supplemented by either rail or funeral coach transportation. An escort must travel with the remains. If delays en route or changes in schedule occur, the escort must notify the installation arranging the transportation and the consignee.

Chartered Air Taxi

Chartered air taxi service may be authorized when commercial air is not available to the destination and the use of a funeral vehicle or rail would cause undue delay.

Funeral Coach

The funeral coach method of transportation may be used under any of the following circumstances:

- To transfer remains from the place of preparation to another local funeral home, to a local cemetery, or to a common-carrier terminal
- When common-carrier service is not available
- When a common-carrier is available only part of the way to the place designated by the PADD
  - Funeral coach service may be used for the remaining portion of the transportation authorized
  - When the cost is not in excess of the common-carrier cost
• When the cemetery cannot provide transportation from the terminal to the cemetery, a funeral coach may be used as a continuation of common-carrier service when remains are consigned directly to a national cemetery, a Navy cemetery, or a Navy plot.

• To transfer remains from the common-carrier terminal at destination to the funeral establishment and to deliver remains to the local cemetery or crematory.

• When requested by the NOK, and the family member defrays costs in excess of the method that would have been used by the government.

• When the use of a common-carrier service will involve extended layover and this method will expedite the arrival.

TRANSPORTATION OF CREMATED REMAINS

Cremated remains (cremains) of active duty personnel will be hand carried by an escort, and transported using commercial air, rail, a funeral director’s vehicle, or other appropriate vehicle. When an escort is not authorized, cremains may be transported by registered mail (preferred method), air, or surface transportation to the PADD or to a specified individual designated by the PADD.

TRANSPORTATION OF REMAINS OF CONTAGIOUS OR COMMUNICABLE DISEASE VICTIMS

When death is the result of a contagious or communicable disease, remains, after embalming, must be placed immediately in a transfer case or casket. The transfer case or casket must be closed immediately and a gummed 2” x 4” label marked “CONTAGIOUS” will be affixed to the outside of the receptacle at the head end. Information concerning diseases considered contagious may be obtained from local or state health officials.

When the remains carry communicable or contagious disease, make sure that the consignment message specifically states that death was due to a contagious or communicable disease.

AUTHORIZED TRANSPORTATION TO OR FROM CONUS

Remains of eligible decedents who die outside the 48 contiguous United States will be transported by the most expeditious U.S. government means; normally, government airs (Air Mobility Command (AMC) flights) are used. If such transportation is not available, impractical, or would cause undue delay, commercial air may be authorized by Navy Casualty.

OUTSIDE CONUS DESTINATIONS

When persons eligible for decedent affairs benefits are consigned to a destination outside the 48 contiguous United States, the activity responsible for preparation and transportation will contact the nearest consul of the country concerned to ascertain the requirements for entry and assure that all requirements are met before arranging transportation of the remains. Failure to do so could lead to serious delays. Ten certified copies of the civilian certificate of death should accompany the remains.

ESCORTS

LEARNING OBJECTIVES:

Identify criteria for escort selection.

Identify escort duties and responsibilities.

Escorts are provided to accompany remains to ensure prompt, safe delivery; to show respect to the decedent; and as an indication of the Navy’s desire to help the NOK. Only one escort is authorized. More than one may be assigned; however, two escorts may not serve at the same time.
Problems concerning arrangements for a Navy escort that cannot be resolved by the responsible command should be referred to Navy Mortuary Affairs or the area commander OCONUS. Problems concerning Marine Corps members should be referred to CMC.

INSIDE CONUS ESCORTS/ OUTSIDE CONUS ESCORTS

Within CONUS, escorts are detailed to accompany the remains or cremains of each Navy and Marine Corps decedent to the final destination. Furnishing escorts is the responsibility of the activity arranging transportation of the remains or cremains. When selecting an escort for the deceased, the activity arranging transportation is encouraged to consult the last duty station of the deceased.

When remains are consigned to a place OCONUS where Armed Forces representatives or other government officials are not available to assist in transportation arrangements, military escorts will be provided.

Unless a special escort is requested by the PADD and approved by Navy Mortuary Affairs, remains transported by AMC aircraft from a point OCONUS to a CONUS port of entry will not be accompanied by an escort; the aircraft commander will act as the escort during the time of transport. The escort detailed by the military activity responsible for transportation arrangements will join the remains at the CONUS port of entry.

SELECTION OF ESCORTS

Any Navy or Marine Corps member on active duty may serve as an escort. Navy and Marine Corps members who volunteer may be accepted if they meet the criteria for selection. Unless a special escort is requested by the NOK, the escort selected should be of the same branch of service, status, and pay grade of the deceased. It is recommended that the escort should be a friend of the deceased, from the same unit, same geographical region, and preferably of the same religion.

SPECIAL ESCORTS

A special escort is defined as a person requested specifically by the PADD or by his representative, or a person assigned by an appropriate command because unusual circumstances prevail and such assignment is considered in the best interest of the naval service. All requests for special escorts must be referred to Navy Mortuary Affairs.

If desired by the PADD, a civilian or member of another service may be assigned as a special escort. An escort in retired or inactive status should be treated as a civilian. All military special escorts are assigned subject to availability as determined by their CO and, unless closely related to the deceased, generally are not authorized OCONUS.

DUTIES OF THE ESCORT

A naval escort is a representative of the Navy who will be required to perform services of a very special and personal nature. It is very important that these duties are thoroughly explained to the escort. Providing instructions to the escort is the responsibility of the command arranging for transportation of the remains. The Manual for Escorts of Deceased Naval Personnel, NAVPERS 15555 series, will assist in this function. For additional information, you should consult OPNAVINST 5360.1 series.
DISPOSITION OF PERSONAL EFFECTS

LEARNING OBJECTIVE:

Explain disposition of personal effects policies.

All personal effects of the deceased are to be collected and inventoried, except where the member occupied government or public housing and the spouse requires no assistance. In the event the spouse dies simultaneously with the service member, the CO cooperates with surviving relatives of the deceased and civil authorities by providing protection for the property of the deceased.

The CO appoints an inventory board consisting of two members, of which one member is normally a Commissioned Officer. The inventory should be recorded on an Inventory of Personal Effects Form, NAVSUP Form 29. An original and four copies will be prepared and signed by the board members. The board will send all five copies with the personal effects to the Supply Officer for completion, disposition, and signature. The Supply Officer returns three signed copies. The inventory board sends one copy to NAVPERSCOM, files one in the service record of the deceased, and sends one to the officer who appointed the board.

CIVIL CERTIFICATES OF DEATH

LEARNING OBJECTIVE:

Identify when civil certificates are required and where they should be distributed.

A civil certificate of death must be obtained if a death occurs within one of the 50 United States or the District of Columbia. If a death occurs outside these areas, with the exception of Guam, a Certificate of Death (Overseas), DD 2064, should be prepared. This certificate is in addition to the civil certificate of death; however, the civil certificate of death is not required in all overseas areas.

Civil authorities should be consulted to determine local requirements. When a death occurs at a naval activity in any state, territory, or insular possession of the United States, the CO will report the death to civil authorities (usually the coroner or medical examiner). It is a general practice for medical officers to complete a civil certificate of death for all deaths occurring in naval medical treatment facilities.

The medical officer or Medical Department Representative (MDR) of the ship or station where the deceased was attached will obtain the certificate from the civil authorities. If requested by the authorities, the civil certificate of death may be prepared and signed by a naval officer. If problems arise in getting a certificate, request assistance from Navy Mortuary Affairs. If death occurs abroad and no naval activity is available, the nearest consulate officer should be requested to get a certificate. The medical officer or MDR will prepare and forward a DD 2064 with the civil certificate of death, supporting papers, and the closed health record.

In general (except where the state has retained concurrent jurisdiction with the United States), civil authorities have no jurisdiction over deaths occurring on naval reservations. A transit or burial permit must be obtained from civil authorities to remove the remains from a naval reservation either for shipment or burial. If death of any person for whom the Department of the Navy is responsible occurs outside the limits of a naval reservation, the remains normally will not be moved until permission has been received from civil authorities.

DISTRIBUTION OF DEATH CERTIFICATE FOR DEATHS OCCURRING IN CONUS

When a Navy or Marine Corps death occurs in one of the 50 United States or the District of Columbia, follow local civil requirements.
DISTRIBUTION OF DEATH CERTIFICATE FOR DEATHS OCCURRING OUTSIDE CONUS

When a Navy or Marine Corps death occurs outside the 50 United States or the District of Columbia, follow the local civil requirements. In addition, a DD 2064 is prepared and copies are distributed as outlined in current instructions and local policies.

DEATH CERTIFICATES FOR SHIPMENT OF REMAINS

When death occurs OCONUS, three signed copies of DD 2064 will accompany the remains to CONUS. When death occurs within CONUS, three certified copies of the civil certificate of death will accompany the remains from CONUS to OCONUS, in addition to all other forms required by OPNAVINST 5360.1 series.

NOTE:
A certificate of death should not be prepared for persons listed as missing.

PAYMENTS AND COLLECTIONS

LEARNING OBJECTIVE:
Identify funeral payment and collection procedures.

Authorized Decedent Affairs Program expenses are chargeable to the special open allotment held by BUMED. These items include primary, transportation, and secondary expenses. In circumstances involving reimbursable transactions, costs may also be initially charged to the open allotment subject to reimbursement. The allotment may be charged by any Navy or Marine Corps activity assigned procurement or payment responsibility. Army and Air Force activities may charge the allotment when arranging for authorized supplies and services at the request of a naval activity.

PRIMARY EXPENSES

If the NOK makes arrangements for disposition of remains, rather than using services of DoD, or completes funeral arrangements before DoD services are offered, the NOK will be reimbursed at the current biannually updated amount approved. Consult the latest OPNAVINST 5360.1 series and or Navy Mortuary Affairs for the authorized allowances.

When an Armed Forces contract or mortuary is available (and services were offered to the NOK) but not used, an amount not to exceed what procurement would have cost the Navy is allowed. This includes costs the Navy would have incurred over and above contract expenses.

TRANSPORTATION EXPENSES

If the NOK arranges for transportation of remains, reimbursement may be made in an amount not to exceed what transportation would have cost the government. If the Navy has arranged for transportation and the final destination cannot be reached by common-carrier, reasonable costs may be allowed for supplemental transportation by funeral coach or other vehicle.

SECONDARY (INTERMENT) EXPENSES

Secondary expenses will be provided to the NOK whether the remains or cremains are interred in a private cemetery, a national or federal government cemetery, or in a burial at sea.

MEMORIAL SERVICE FOR NONRECOVERABLE REMAINS

When remains of eligible military personnel, whose determination of death has been made but the remains are non-recoverable, reimbursement to the PADD (or designee) may be made for memorial service expenditures.
A claim for reimbursement may be allowed if presented within the approved time frame after notification of the NOK of the date of death. The PADD must submit receipted invoices or a certified claim to Navy Mortuary Affairs.

HEADSTONES AND MARKERS

Personnel serving on active duty at the time of their death are eligible for a headstone or marker provided by the Veterans' Administration (VA). At a national cemetery, the director or superintendent will make the arrangements. In naval plots and cemeteries, the Navy will make the arrangements. In other cemeteries, an application should be submitted to the VA. If a commercial headstone or marker is procured, a limited reimbursement is authorized. A memorial marker may be provided upon request to commemorate the death of a member whose remains were not recovered or were buried at sea.

REIMBURSEMENT PROCEDURES

LEARNING OBJECTIVE:
Identify procedures for reimbursement of funeral costs.

When the Navy has arranged for primary services and transportation, a claim for payment of the supplemental transportation charges may be submitted to Navy Mortuary Affairs by the funeral director at the final destination. DD Form 1375, Request for Payment of Funeral and/or Interment Expenses, should be given to the PADD (or PADD’s designee) to claim reimbursement or payment for primary expenses, transportation, and secondary expenses.

GOVERNMENT SERVICES NOT UTILIZED WITHIN CONUS

Claims relating to primary expenses and transportation costs to a common-carrier terminal for transportation to the final destination will be forwarded to Navy Mortuary Affairs.

Claims relating to interment (secondary) allowances and supplemental transportation costs will be forwarded to Navy Mortuary Affairs.

GOVERNMENT SERVICES NOT UTILIZED OCONUS

Area commanders outside CONUS are authorized to make local payment of expenses incurred in areas under their jurisdiction.

Claims in areas outside the jurisdiction of the activities (area commanders) should be submitted to BUMED for resolution.

GOVERNMENT SERVICES UTILIZED

When the Navy has arranged for primary services and transportation, submit claims for payment and reimbursement of interment costs or supplemental transportation expenses to Navy Mortuary Affairs.

REPORTING EXPENSES

LEARNING OBJECTIVE:
Identify reporting procedures for funeral expenses.

Activities incurring expenses in connection with disposition of remains of Navy and Marine Corps personnel do not report these expenses to BUMED except when indicated on the DD Form 2062, Record of Preparation and Disposition of Remains (Outside CONUS), and DD Form 2063, Record of Preparation and Disposition of Remains (Within CONUS).
When arranging for disposition of remains of other services' deceased personnel using commercial sources, the activity should forward a letter report, MED 5360-3, *Report of Disposition and Expenditures Remains of the Dead*, to the service obligated for reimbursement. Costs for which the activity's funds have been cited should be shown on the letter report.

**NATIONAL CEMETERIES**

**LEARNING OBJECTIVE:**

Identify services that are available at National Cemeteries.

Except for Arlington National Cemetery (which is under the jurisdiction of the Department of the Army) and a few other exceptions noted in OPNAVINST 5360.1 series, national cemeteries are under the jurisdiction of the Chief Memorial Affairs Director, Department of Memorial Affairs, Veterans' Administration, Washington, DC.

**NATIONAL CEMETERY CLASSIFICATIONS**

There are three classifications of national cemeteries:

- **Open (Active):** Cemeteries with grave spaces available
- **Closed (Inactive):** Cemeteries without grave spaces available
- **New (Inactive):** Cemeteries planned but not yet opened

**ELIGIBILITY FOR INTERMENT**

Remains of the following naval and former naval members may be buried in any open national cemetery except at the National Cemetery at Arlington, Virginia (which has separate criteria for acceptance):

- Navy or Marine Corps member who was serving on active duty at time of death (other than active duty for training)
- Any member of a Navy or Marine Corps Reserve organization whose death occurred under honorable conditions while the individual was in one of three categories:
  - On active duty for training (including authorized travel to and from active duty training)
  - On inactive duty training (including authorized travel to and from such training)
  - Hospitalized or undergoing treatment at the expense of the government for injury or disease incurred or contracted during the period covered by 1 and 2 above
- Former Navy or Marine Corps members who were discharged under conditions other than dishonorable
- Members of the Naval Reserve Officers' Training Corps whose death occurred under honorable conditions while they were in one of the following situations:
  - Attending an authorized training camp or authorized training cruise
  - Performing authorized travel to and from that camp or cruise
  - Hospitalized or undergoing treatment at the expense of the government of the United States for injury or disease incurred or contracted during the period covered by 1 and 2 above
- Surviving spouse and minor children of individuals covered above
At the discretion of the Chief Memorial Affairs Director, unmarried adult children of eligible individuals may be buried in any open national cemetery (except Arlington) if they were totally disabled either physically or mentally before attaining the age of 21. The Chief Memorial Affairs Director may also authorize the burial of unremarried widows or widowers; eligible deceased members whose remains were either lost at sea or buried at sea not at their own volition; or who were officially determined missing or missing in action and subsequently administratively declared dead.

HONORS

Military honors for interment in national cemeteries are the responsibility of the member’s service. Honors for services at Arlington National Cemetery are coordinated by the superintendent of the cemetery with BUPERS or the CMC.

VAULTS

A metal, asphalt, or concrete vault may be procured at the NOK’s expense if it is preferred. If a vault is privately procured, the superintendent or director must be notified of the outside dimensions to ensure the proper preparation of the grave. The contractor furnishing the vault must also provide necessary equipment and personnel for placing the vault in the grave before the funeral service and for placement of the vault lid after the service.

VIEWING REMAINS

National cemeteries no longer have facilities for viewing remains. If the NOK desires a viewing before interment, the remains must be consigned to a local funeral director.

SCHEDULING

Unless extraordinary circumstances exist with respect to the condition of remains, interment in national cemeteries will not be made on Saturdays, Sundays, or holidays.

NAVAL PLOTS AND CEMETERIES

LEARNING OBJECTIVE:

Identify the policy for interment at a Naval Cemetery.

With two exceptions, Navy Mortuary Affairs exercises technical direction of naval plots and cemeteries. Presently, there are only a few active naval cemeteries, so plot availability is extremely limited. For this reason, decedents who are eligible for interment in national cemeteries will not normally be authorized interment in a naval plot or cemetery. However, exceptional or unusual circumstances will be referred to BUMED for determination.

GROUP INTERMENTS

LEARNING OBJECTIVE:

Identify guidelines for group internments.

When remains of two or more individuals killed in the same incident cannot be individually identified, a priority message detailing the circumstances should be sent to Navy Mortuary Affairs who will determine if there is a need for an identification specialist to be sent. If remains cannot be individually identified, the collective remains will be interred as a group interment. Group interments should be made in a national cemetery, within the 50 United States, as close to the midpoint of the two most widely separated homes of record of known deceased individuals involved, or as otherwise directed by the program managers. Navy Mortuary Affairs will coordinate with the other services as required.
Procedures followed in group interments are:

1. Unidentified remains should be prepared, wrapped, and placed into the minimum number of caskets possible without overcrowding. Partially segregated but identifiable remains should be wrapped separately.

2. One or more escorts should be provided as long as the number of escorts does not exceed the number of deceased persons.

3. The PADD and two blood relatives of each deceased member in a group interment are authorized round-trip transportation to the place of interment at Government expense.

4. The graveside ceremony should be conducted with full military honors and be in accordance with the religious preference applicable to all denominations represented within the group. Photographs should be provided to the PADD, if desired.

5. The headstone or headstones should be inscribed with the names of all unknown deceased personnel.

**SUMMARY**

The Decedent Affairs Program consists of the search, recovery, identification, care, and disposition of remains of deceased personnel for whom the Department of the Navy is responsible. Large medical treatment facilities normally manage decedent affairs matters. However, when a death occurs at small independent operational units, senior HMs will be responsible for the proper management of this program. For further guidance refer to OPNAV 5360.1 series, Decedent Affairs Manual or contact the N135C, Navy Mortuary Affairs, Millington, TN.
APPENDIX I

GLOSSARY

The following terms are explained as used in this manual and as commonly defined.

ABDUCTION—Moving an extremity away from the body.
ABRASION—An area of skin or mucous membrane worn from the body mechanically by some unusual or abnormal process.
ABSCESS—A localized collection of pus.
ABSORBENT—A drug which "takes up" other substances by absorption.
ACIDOSIS—A condition resulting from acid accumulating in the body.
ACUTE PULPITIS—An inflammation of the pulp caused by injury to the pulp, usually from dental caries or trauma.
ADDUCTION—Bringing an extremity toward the body.
ADIPOSE—Of a fatty nature.
ADRENERGIC—Activated by, characteristic of, or secreting epinephrine or similar substance.
ADSORPTION—The attachment of one substance to the surface of another.
AEROBIC—Growing only in the presence of oxygen.
AFFECT—Feeling experienced in connection with an emotion.
ALBUMINURIA—Albumin in the urine.
ALIMENTARY—Pertaining to food or digestion.
ALKALOSIS—A pathogenic condition resulting from accumulation of base in, or loss of acid from, the body.
AMBULATORY—Walking or able to walk.
AMPUTATION—The intentional removal of a limb or body part with the intention of removing diseased tissue or relieving pain.
ANABOLISM—The constructive process by which the simple products of digestion are converted by living cells into more complex compounds and living matter for cellular growth and repair.
ANAEROBIC—Growing only in the absence of oxygen.
ANALGESIC—A drug used to relieve pain without producing unconsciousness or impairing mental capacities.
ANATOMY—The science of the structure of the body and the relationship of its parts to each other.
ANEMIA—A decrease in certain elements of the blood, especially red cells and hemoglobin.
ANESTHESIOLOGIST—A physician who specializes in anesthesiology.
ANESTHESIOLOGY—A branch of medicine that studies anesthesia and anesthetics.
ANESTHETIST — A registered nurse trained in administering anesthetics.

ANISOCORIA — Unequal diameter of the pupils.

ANODYNE — A drug that relieves pain.

ANOREXIA — Loss of appetite.

ANTHELMINTIC — A drug that expels, paralyzes, or kills intestinal worms.

ANTHRAX — Disease caused by *Bacillus anthracis* where infective bacteria form spores and transmission occurs through contact with contaminated material.

ANTIBIOTIC — A synthetic product or a product of living microorganisms that kills or inhibits the growth of undesirable microorganisms.

ANTIBODES — The specific defensive proteins produced when an antigen stimulates individual cells.

ANTIDOTE — An agent that counteracts a poison.

ANTIGEN — A substance which, under certain conditions, is capable of inducing the formation of antibodies and reacting specifically with the antibodies in a detectable manner.

ANTIPYRETIC — A drug that lowers elevated body temperature.

ANTISEPTIC — A drug or chemical that inhibits the growth of microorganisms without necessarily destroying them.

APNEA — A temporary cessation of breathing.

ARENAVIRUSES — A family of viruses whose members are generally associated with rodent-transmitted diseases in humans via rodent urine and excrement that may cause severe illnesses.

ARTICULATION — The place of union or junction between two or more bones of the skeleton.

ASEPTIC — Clean; free of pathogenic organisms.

ASSISTANT’S ZONE — Between 2 and 4 o’clock; for left-handed dentists seated to the right of the patient, the assistant’s zone is between 8 and 10 o’clock.

ASTRINGENT — A drug or preparation that produces shrinkage of body membranes, especially mucous membranes.

ASYMPTOMATIC — Having no symptoms.

ATTRITION — The loss of substance of a tooth from a wearing away process caused by teeth against teeth.

AUSCULTATION — The act of listening for sounds within the body, with or without a stethoscope.

AUTOMATED EXTERNAL DEFIBRILLATOR (AED) — A portable electronic device that is capable of analyzing cardiac rhythms and selecting the appropriate strength of defibrillation or electrical therapy which stops the arrhythmia allowing the heart to reestablish an organized electrical message to the heart tissue, all at the touch of a button.

AUTOLYSIS — The spontaneous disintegration of tissues or cells by the action of their own serum or enzymes, such as occurs after death and in some pathological conditions.

AVULSED — A forcible separation; also, a part torn from another.

AXILLARY — Pertaining to the area of the armpit.
**BACTERIA**—Single celled organisms capable of causing a variety of diseases in animals, plants, and humans.

**BACTERICIDE**—An agent that destroys bacteria.

**BACTERIOSTATIC**—An agent that inhibits the growth of bacteria.

**BAROTRAUMA**—Damage to tissues caused by a change in ambient pressure.

**BATTLE DRESSING**—A combination compress and bandage in which a sterile gauze pad is fastened to a gauze, muslin, or adhesive bandage.

**BIOBURDEN**—The number of microorganisms contaminating an object; known as bioload or microbial load.

**BIOLOGICALS**—Medicinal preparations made from living organisms and their products, including serums, vaccines, antigens, and antitoxins.

**BLANCHING**—Turning white.

**BLEB**—Blister, bubble.

**BLOODBORNE PATHEOGENS**—Pathogenic organisms present in human blood and capable of causing disease in humans.

**BODY MASS INDEX (BMI)**—A healthy weight calculated by dividing a person’s weight in kilograms (2.2# = 1 kg) by the person’s height in meters squared (2.54 cm = 1 inch) or kg/m².

**BODY SUBSTANCE ISOLATION (BSI)**—The practice of using personal protective equipment in order to prevent the spread of disease and contagious pathogens.

**BRADYCARDIA**—Abnormally slow heartbeat, evidenced by a pulse rate of 60 or less.

**BRADYPNEA**—Abnormally slow breathing.

**BUBO**—An inflamed swelling of a lymphatic gland, especially in the area of the armpit or groin.

**BUCCAL**—Referring to the cheek.

**BUNYAVIRUSES**—Group of vector-borne viruses that are transmitted through an arthropod vector.

**CARBOHYDRATES**—Molecular chains of carbon and hydrogen atoms bound together with main role of providing energy to the cells. All carbohydrates contain 4 calories per gram.

**CARBUNCLE**—A painful purulent inflammation of the skin and deeper tissues with multiple openings for the discharge of pus usually accompanied by necrosis and sloughing of dead tissue.

**CARRIER**—A person or animal that harbors specific infectious agents in the absence of discernible clinical disease, and serves as a potential source of infection for humans.

**CASTS**—Urinary sediments formed by coagulation of albuminous material in the kidney tubules.

**CATABOLISM**—A destructive process in which the complex compounds are reduced to simpler substances during the digestive process.

**CATHARTICS**—Drugs that promote bowel movement.

**CAVITY**—A disease where bacterial processes damage the hard tooth structure.

**CELLULITIS**—A diffuse inflammation of connective tissue with severe inflammation of dermal and subcutaneous layers of the skin.
CERVICAL—Pertaining to the neck or the neck of any organ or structure.

CHEYNE-STOKES—Breathing characterized by alternating periods of apnea and deep respirations.

CHILLBLAIN—Mild cold injury characterized by redness, swelling, tingling, and pain to the affected skin area, caused by prolonged and repeated exposure for several hours to air temperatures from above freezing 32°F (0°C) to as high as 60°F (16°C).

CLARK'S RULE—The rule governing pediatric doses based upon weight; the child’s weight is the numerator, and the average adult weight (150) is the denominator. This fraction is multiplied by the adult dose.

COAGULATION—Clotting.

COAPTATION—To fit together, as the edges of a wound or the ends of a fractured bone; category of splint.

COCCYX—Tailbone.

CONCURRENT—Done or occurring at the same time; i.e. concurrent disinfection while infectious patient is still in the room.

CONTAMINATED—The presence or reasonably expected presence of blood or other potentially infectious material on an item or surface.

COLATION—The process of straining or filtration.

COMMUNICABLE—Capable of being transmitted from one person to another.

COMMUNICABLE PERIOD—The period of time in which an infectious agent may be passed from an infected animal or human to a receptive host. There may be more than one such period of time during the course of disease.

COMMINUTION—The process of physical reduction of a substance to fine particle size.

CONTACT—A person or animal known to have been associated with an infected person or animal, or a contaminated environment, and to have had the opportunity to acquire the infection.

CONTAMINATION—The presence of an infectious agent or toxin on the surface of a body or inanimate article, such as clothing, dishes, surgical dressings or instruments, as well as in food or water.

CONTRACTURE—A condition of muscle shortening and fibrous tissue development that results in a permanent joint deformity.

CONTUSION—A bruise.

CORROSIVE—A substance that rapidly destroys or decomposes body tissue at point of contact.

CREPITUS—The cracking or grating sound produced by fragments of fractured bones rubbing together.

CULTURE—The reproduction and growth of micro-organisms in living tissue cells or on a nutrient medium.

CYST—An enclosed pouch or sac that contains fluid or semi-solid material.

DEBILITY—The state of abnormal bodily weakness.

DEBRIDEMENT—The removal of all foreign matter and devitalized tissue in or about a wound.
DECANTATION—Separating liquids from solids by letting the solids settle to the bottom and pouring off the liquid.

DECEREBRATE—A person with brain damage that produces certain abnormal neurologic signs with arms extended to the sides.

DECONTAMINATION—The process of removing or neutralizing and properly disposing of contaminants that have accumulated on personnel and equipment.

DECORTICATE—Abnormal posturing with arms flexed over the chest.

DECORTICATION—Removing portions of the cortical substance of a structure or organ, such as the brain, kidney, or lung.

DECUBITUS ULCER—Bed or pressure sore.

DENTAL CARRIES—Also known as cavities, a disease where bacterial processes damage the hard tooth structure.

DESQUAMATE—To shed, peel, or scale off.

DIASTOLE—The dilation or period of dilation of the heart, especially of the ventricles.

DIATHERMY—The generation of heat in tissue by electric current for medical or surgical purposes.

DISINFECTION—The killing of infectious agents outside the body by physical or chemical means applied directly.

DISINFESTATION—A physical or chemical means of destroying animal or insect pests in a particular area.

DISLOCATION—Injury where a bone is forcibly displaced from the normal position of function.

DISTILLATION—Converting a liquid to a vapor by applying heat and condensing the vapor back to liquid by cooling.

DIURESIS—Urine excretion in excess of the usual amount.

DIURETICS—Drugs that increase the secretion of urine.

DOSAGE—The amount of medication to be administered.

DOSAGE RANGE—The range between the minimum and the maximum amounts of a given medication required to produce the desired effect.

DRESSING—A sterile pad or compress (usually made of gauze or cotton wrapped gauze) used to cover wounds, to control bleeding, and to prevent further contamination.

DYSPNEA—Labored or difficult breathing.

ECCHYMOSIS—A small hemorrhagic spot, larger than a petechia, in the skin or mucous membrane, forming a non-elevated, rounded or irregular, blue or purplish patch.

EDEMA—Swelling.

EFFECT—The direct change, result, or consequence caused by an action.

ELECTROLYTE—A substance that dissociates into ions in solution or when fused, thereby becoming capable of conducting electricity.

ELIXIR—An aromatic, sweetened, hydro alcoholic solution containing medicinal substances.
EMBOLISM—When an object in one part of the body migrates and causes blockage of a blood vessel in another part of a body.

EMBOLUS—A clot or other plug brought by the blood from another vessel and forced into a smaller one, thereby obstructing circulation.

EMETIC—A substance that causes vomiting.

EMOLLIENT—A drug that softens, soothes, or smoothes the skin or irritated surfaces.

EMPHYSEMA—A progressive long-term disease of the lung that primarily causes shortness of breath and destruction of the lung tissue around the bronchioles over time.

EMULSION—A liquid preparation containing two unmixable liquids, such as oil and water, one of which is dispersed as globules in the other.

ENCAPSULATED—Enclosed within a capsule.

ENDEMIC—The constant presence of a disease in a given locality.

ENGINEERED CONTROLS—Method of managing environment and health by placing a barrier between contamination and the rest of the site, thus limiting exposure pathways.

ENTERIC—Of or within the intestine.

EPIDEMIC—The outbreak of disease in a geographic area in excess of normal expectations.

EPIDEMIOLOGY—The study of epidemics and epidemic diseases.

EPISTAXIS—Nosebleed.

EPIZOOTIC—Disease attacking many animals in a region at the same time.

ERADICATE—Wipe out; destroy.

EROSION—A loss of tooth substances from a chemical process that does not involve bacteria, usually occurring on the facial surfaces at the gingival third of the crown and often involves the maxillary incisors.

ERYTHEMMA—Redness.

ERYTHROCYTE—Red blood cell.

EUPNEA—Ordinary, quiet breathing.

EUTAXIA—The liquification of solids mixed in a dry state.

EVERSION—The extremity is twisted outward.

EXSANGUINATION—Fatal process of total blood loss.

EXTENSION—Straightening or unbending, as in straightening the forearm, leg, or fingers.

EXTRAVASATION—A discharge or escape, such as blood from a vessel into the tissue.

EXTRICATION—The process of freeing a victim, such as from a wrecked car or flooded compartment.

FATS—Primary role is to supply energy to the body, 9 calories per gram.

FILOVIRUSES—A family of viruses called Filoviridae that can cause severe hemorrhagic fever in humans and nonhuman primates.
FIRST AID—Temporary measures to save life, prevent further injury, and preserve resistance to vitality.

FISTULA—An abnormal connection between an organ, vessel, or intestine and another structure, usually the result of injury or surgery that can lead to infection or inflammation.

FLAVIVIRUSES—Group of several viruses that are transmitted by the bite from an infected arthropod.

FLEXION—Bending, as in bending an arm or leg.

FOMITE—An object, such as a book, wooden object, or an article of clothing, that is not in itself harmful, but is able to harbor pathogenic microorganisms and thus may serve as an agent of transmission of an infection.

FRACTURE—Break in a bone.

FROSTBITE—Occurs when ice crystals form in the skin or deeper tissues (primarily the face and the extremities) after exposure to a temperature of 32°F (0°C); formation of frost bite may vary from a few minutes to a few hours.

FUMIGATION—The destruction of disease-producing animals or insects by gaseous agents.

FUNGI—Plants that lack chlorophyll.

FUNGICIDE—A drug that kills fungus.

FURCATION—When teeth have more than one root, the regions where the roots separate.

FURUNCLE—An abscess in the true skin caused by the entry of microorganisms through a hair follicle or sweat gland.

FUSION—Melting.

GASTROSTOMY—A surgical opening from the external surface of the body into the stomach, usually for inserting a feeding tube.

GAVAGE—Introducing a substance into the stomach through a tube.

GERMICIDE—An agent that kills germs.

GESTATION—The period of carrying developing offspring in the uterus after conception.

GINGIVITIS—An inflammation of the gingival tissue usually resulting from the presence of bacterial plaque buildup due to lack of adequate oral hygiene.

GLYCOSURIA—Glucose in the urine.

GRAM-NEGATIVE—A micro-organism that does not retain Gram's crystal voile and is stained by the counter stain.

GRAM-POSITIVE—A microorganism that is stained by Gram's crystal violet.

GUMBOIL—Swelling that is confined to a small area at the site of a sinus tract.

HAZARDOUS MATERIAL—All types of compressed gases and other materials that present a fire hazard or are otherwise dangerous.

HEMACYTOMETER—An instrument for estimating the number of blood cells in a measured volume of blood.

HEMATEMESIS—Vomiting blood.
HEMATOCRIT—A determination of the volume percentage of red blood cells in whole blood.
HEMATOMA—A localized collection of blood that escaped from blood vessels due to trauma.
HEMIPLEGIA—Loss of motion and sensation of one side of the body.
HEMOGLOBIN—Iron containing red pigment (heme) combined with a protein substance (globin).
HEMOLYSIN—Substance that breaks down red blood cells, thereby liberating hemoglobin.
HEMOPTYSIS—Coughing up blood.
HEMOSTATICS—Drugs that control external bleeding by forming an artificial clot.
HISTOLOGY—The microscopic study of tissue structure.
HOST—A man or other living animal affording subsistence or lodgment to an infectious agent under natural conditions.
HYDROPHOBIA—Also known as rabies, disease caused by a virus that is present in the saliva of infected animals.
HYDROTHERAPY—The scientific use of water in the treatment of disease.
HYPERGLYCEMIA—Abnormally increased content of sugar in the blood.
HYPERPNEA—Increased rate and depth of breathing.
HYPERTENSION—High blood pressure.
HYPERTHERMIA—Abnormally high body temperature, especially that induced for therapeutic purposes.
HYPOGLYCEMIA—Low blood sugar.
HYPOPNEA—Abnormal shallowness and rapidity of breathing.
HYPOSTASIS—Poor or stagnant circulation in a dependent part of the body or organ, as in venous insufficiency.
HYPOTENSION—Low blood pressure.
HYPOTHERMIA—Abnormally low body temperature.
HYPOVOLEMIA—Abnormally decreased volume of circulating fluid (plasma) in the body.
HYPOXIA—Low oxygen content or tension; deficiency of oxygen in the inspired air.
IMMERSION FOOT—Results from prolonged exposure to wet cold at temperatures ranging from just above freezing to 50°F (10°C); may also occur in the hands.
IMMISCIBLE—Incapable of being mixed.
IMMUNE PERSON—An individual who does not develop clinical illness when exposed to specific infectious agents of a disease, due to the presence of specific antibodies or cellular immunity.
IMMUNITY—A defense mechanism of the body which renders it resistant to certain organisms.
INAPPARENT INFECTION—An infection with no detectable clinical symptoms, even though the causative infectious agent may be identifiable with laboratory examinations. It is also known as an asymptomatic or subclinical infection.
INCIDENCE RATE—The number of specific disease cases diagnosed and reported in a specific population in a defined period of time. It is usually expressed as cases per 1,000 or 100,000 annually.

INCISION—A cut, or a wound produced by cutting with a sharp instrument.

INCOMPATIBLE—Not suitable for combination or simultaneous administration.

INCONTINENT—Unable to control excretory functions.

INCUBATION PERIOD—The period of time between the initial exposure to an infectious agent and the first clinical symptoms of the disease.

INDURATION—An abnormally hard spot or place.

INFECTION—A condition resulting when pathogens enter body tissues, multiply, and cause injury to cells.

INFECTION CONTROL—Process in which steps are taken to prevent the spread of infectious agents.

INFECTIOUS AGENT—An organism capable of producing infection or disease.

INFECTIOUS DISEASE—A disease of man and animal resulting from an infection.

INFECTIOUS WASTE—Liquid or solid waste containing pathogens in sufficient numbers and of sufficient virulence to cause infectious disease in susceptible hosts exposed to the waste.

INFESTATION—The establishment and multiplication of small animals or arthropods (especially insects and rodents) on the body, clothing, or habitat of individuals or animals.

INGUINAL—Pertaining to the abdomen.

INSTRUCTION—A directive containing authority or information having continued reference value or requiring continuing action.

INVENTORY—The stock on hand.

INTEGUMENTARY (SYSTEM)—The skin and its accessory structures, including hair and nails.

INTRADERMAL—Into the dermis.

INUNCTION—Rubbing in.

INVASIVE PROCEDURES—A surgical entry into tissues, cavities, organs, or repair of major traumatic injuries. This includes the manipulation, cutting, or removal of any oral or perioral tissue during which bleeding occurs, or the potential for bleeding exists.

INVERSION—Injury where the foot is twisted inward.

ISCHEMIA—The lack of blood supply to specific areas due to constriction or obstruction in the blood vessels.

ISOLATION—Procedures taken to separate infected persons or animals, dispose of their secretions, and disinfect or sterilize the supplies, equipment, utensils, etc., used for their care, in order to prevent the spread of disease to susceptible persons or animals. Different procedures may be required for the specific infectious agent involved.

ISOTONIC—A solution having the same salinity as whole blood.

KERATOLYTIC—Removes horny layers of epidermis.

LACERATED—Torn.
LACERATION—A wound made by tearing and resulting in jagged edges.
LACRIMATION—The secretion of tears.
LACRIMATORS—Tear gases.
LACTATION—The production of milk.
LATENT—Concealed; not manifest; potential.
LAVAGE—The irrigation or washing out of an organ (such as the stomach or bowel).
LESION—Any pathological or traumatic discontinuity of tissue or loss of function of a part.
LEUKOCYTE—White blood cell.
LEUKOCYTOSIS—Abnormally high white blood cell count.
LEUKOPENIA—Abnormally low white blood cell count.
LEVIGATION—Adding a small amount of liquid to a mortar and pestle while triturating.
LIGAMENT—A sheet or band of tough, fibrous tissue connecting two or more bones or cartilages, or supporting an organ, fascia, or muscle.
LINIMENT—Solution or mixture of various substances in oily, alcoholic, or emulsified form, intended for external application.
LOGISTICS—The acquisition, accounting, sustainment, and disposition of assets within the Department of the Navy.
LUMBAR—Pertaining to the part of the back between the thorax and the pelvis.
LYOPHILIZATION—The creation of a stable preparation of a biological substance (blood plasma, serum, etc.) by rapid freezing and dehydration of the frozen product under high vacuum.
MACERATION—Softening of a solid by soaking.
MAGMAS—Thick, creamy, aqueous suspensions of inorganic substances in a very fine state.
MALAISE—A vague feeling of bodily discomfort.
Mastication—Chewing.
MATERIAL SAFETY DATA SHEETS—Sheets that provide information on the hazards of potentially harmful material and precautions for using such material safety.
MEDICAL ASEPSIS—Practices used to prevent the transfer of pathogenic organisms from person to person, place to place, or person to place.
MEDICAL ASEPTIC TECHNIQUE—The practice that prevents the spread of pathogens from person to person, place to place, or place to person.
MELENA—Excretion of black tarry stools.
METABOLISM—The sum of all the physical and chemical processes by which living organized substance is produced and maintained. Also, the transformation by which energy is made available to the organism.
METAMORPHOSIS—Change of shape or structure, particularly a transition from one development stage to another, as from larva to adult form.
METROLOGY—The science of weights and measures.
MICRO-ORGANISM—A minute, living organism invisible to the naked eye; bacteria, fungi, viruses, and bacterial spores.

MICTURATION—Voiding; urinating.

MINERALS—Substances found in the Periodic Chart of Elements that serve critical functions in the body and can be found in a wide variety of food groups.

MODE OF TRANSMISSION—The mechanism by which the infectious agent is transmitted from its reservoir to a susceptible host. Air, water, food, dust, dirt insects, inanimate objects, and other person are examples of modes of transmission.

MORBIDITY RATE—An incidence rate that includes all persons in a particular population who become ill during a specific period of time.

MORPHOLOGY—The science of forms and structure of organized beings.

MORTALITY RATE—The number of deaths, reported in a particular population, over a specific period of time, divided by the total population, reported as deaths per 1,000 population. If the deaths are from one cause, then it is known as a disease-specific mortality rate.

MOTTLED—Marked with blotches or spots of different colors or shades.

MUCUS—A sticky substance secreted by mucous membranes.

MYDRIATIC—Any drug that dilates the pupil.

MYELIN—A lipid substance that forms a sheath around certain nerve fibers.

MYELINATED—Covered with a myelin sheath.

NECROSIS—The death of tissue, usually in small, localized areas.

NON-TACTICAL TRIAGE—Civilian sector triage with the primary purpose of treating the most vitally wounded patients first.

NOSOCOMIAL—Originating in a hospital.

NOTICE—A directive of a one-time or limited nature that has a self-canceling provision and the same force or effect as an instruction.

NECROSIS—The death of living tissue.

NECROTIZING ULCERATIVE GINGIVITIS (NUG)—A disease commonly referred to as trench mouth, or Vincent’s infection, characterized by redness, swelling, pain, accumulation of calculus around the sulcus of the teeth, and bleeding of the gingival tissues. Usually there is a film of necrotic white or grayish tissue around the teeth and the ulceration of the gingival crest results in a characteristic punched-out appearance and loss of the interdental papille.

NUTIRENT—A substance that contributes to growth or maintenance of the body.

NUTRITION—The total process of providing the body with nutriments, and assimilating and using them.

OINTMENT—A semisolid, fatty, or oily preparation of medicinal substances for external application.

OLFACTORY—Pertaining to the sense of smell.

OLIGEMIA—Deficiency in the volume of blood.
OPERATING BUDGET—The annual budget of an activity is assigned by the Chief of Naval Operations (CNO), Fiscal Management Division, to major claimants.

OPERATOR’S ZONE—Between 8 and 11 o’clock; for left-handed dentists seated to the right of the patient, the operator’s zone is between 1 and 4 o’clock.

OPHTHALMIC—Pertaining to the eye.

ORAL DIASTIMA—Area between teeth where there is no contact point and the teeth do not touch.

ORAL LESIONS—Any pathological traumatic disorder of tissue that creates a loss of function of the area affected.

ORAL PATHOLOGY—The science that treats the nature, causes, and development of oral diseases; includes both the clinical and the microscopic study of structural and functional changes that cause, or are caused by, oral and other diseases.

ORGANISM—Any living thing.

OSMOSIS—The diffusion of fluids through a membrane or porous partition.

OSSIFICATION—Changing or developing into bone.

OXIDATION—The union of a substance with oxygen.

PALPABLE—Capable of being touched or felt.

PALPITATION—An abnormal, rapid, regular or irregular beating of the heart, felt by the patient.

PARAPLEGIA—Loss of motion and sensation of the lower half of the body.

PARASITICIDES—Drugs that kill parasites.

PARENTERAL—Administration of drugs by injection.

PARESIS—Slight or partial paralysis.

PAROXYSM—A sudden attack, or intensification of the symptoms of a disease, usually recurring periodically.

PATHOGEN—An organism capable of producing disease or causing infections.

PATHOGENIC ORGANISMS—Disease producing organisms.

PATHOGENICITY—The capability of an infectious agent to cause disease in a susceptible host.

PERCUSSION—The act of striking a body part with short, sharp blows as an aid in diagnosing the condition by evaluating the sound obtained.

PERIAPICAL ABCESS—Occurs when an infection of the pulpal tissue causes the pulp to become necrotic (die).

PERIAPICAL ABSCESS—Results when the pulp of the tooth has been inflamed and a small pus-like abscess forms in the pulpal canal.

PERICORONITIS—An inflammation of the gingival around a partially erupted tooth.

PERINEAL—The genital area between the vulva and the anus in a woman, and between the scrotum and the anus in a man.
PERIODONTAL ABCESS—Abscess caused by an infection of the periodontal tissues, usually resulting from long-continued irritation by food debris, deep deposits of calculus, or a foreign object packed in the sulcus or inter-proximal spaces.

PERIODONTAL DISEASE—All diseases of the periodontium that affect the tissues around and supporting the tooth.

PERIODONTITIS—Progressive loss of the alveolar bone around the teeth marked by the gradual loss of attachment of the periodontal tissues, usually resulting from untreated marginal gingivitis.

PERIOSTEUM—Pain center of the bone.

PERIPHERAL—Outward part or surface.

PERSISTENT—Stubborn; persevering.

PERSONAL PROTECTIVE EQUIPMENT (PPE)—Protect equipment such as masks, goggles, gloves, and gowns worn by medical professionals to avoid exposure to infection and disease and prevent the spread of infection and disease to other patients.

PESTS—Undesirable organisms (insects, rodents, snakes, etc.) that adversely affect military operations and the well-being of man and animal; they attack real property, supplies, and equipment.

PETECHIA (pl. petechiae)—Around pinpoint, non-raised, purplish red spot caused by hemorrhage in the skin.

pH—Scale measuring the acidity or alkalinity of a solution.

PHAGOCYTOSIS—The ingestion and destruction by phagocytes of cells, microorganisms, and other foreign matter in the blood or tissue.

PHARMACOGNOSY—The branch of pharmacology dealing with biological, biochemical, and economic features of natural medications and their constituents.

PHYSIOLOGICAL—Characteristic of or appropriate to an organism’s functioning.

PLAGUE—An infectious disease to humans and animals caused by Yersinia pestis.

PLEXUS—Network.

POISON—A substance in solid, liquid, or gaseous form that, when introduced to the body through ingestion, inhalation, absorption, or injection produces a harmful effect on normal body structures or functions.

PORTAL OF ENTRY—The avenue by which the infectious agent enters the susceptible host.

PORTAL OF EXIT—The avenue by which the infectious agent leaves its reservoir.

POSOLOGY—The study of dosage and the criteria that influences it.

POSTEXTRACTION ALVEOLAR OSTEITIS—Commonly referred to as “dry socket,” occurs when a blood clot fails to form or washes out of the socket of a recently extracted tooth.

PRECIPITATION—The quality or state of being separated from solution or suspension by chemical or physical change, usually as an insoluble amorphous or crystalline solid.

PRIAPISM—A painful medical condition in which the penis or clitoris does not return to a normal flaccid state within four hours.

PRONE—Lying face down.
PROPHYLACTIC—The prevention of disease; preventive treatment.
PROPHYLACTIC IMMUNIZATIONS—Vaccines with effective and reliable immunizing agents used to protect the Navy and Marine Corps personnel against serious diseases prior to exposure.
PROPORTION—Two equal ratios considered simultaneously.
PROSTRATION—Total exhaustion or weakness.
PROTIENS—Commonly referred to as the “building blocks” of the body, 4 calories per gram.
PROTOZOA—Single-celled animals without a rigid cell wall that may cause parasitic disease; the majority are harmless and live on dead organic matter or bacteria.
PRURITIS—Intense itching.
PSYCHOLOGICAL—Belonging to or of the nature of psychology; the mental process.
PULPALGIA—Pain in the dental pulp that commonly occurs after a restoration has been placed in the tooth.
PULPITIS—An inflammation of the dental pulp.
PULSE OXIMETER—A medical device that measures the oxygen saturation of a patient’s blood and changes blood volume in the skin, producing a photoplethysmonograph (measured changes in light absorption).
PURULENT—Pus filled or containing pus.
PUSTULE—A small, inflamed elevation of the skin containing pus.
QUADRAPLEGIA—Loss of motion and sensation below the neck.
RALES—An abnormal sound, either moist or dry, classified by location (e.g., bronchial rales, laryngeal rales).
RATIO—The relationship of one quantity to another of like units.
RECURRENT APHTHOUS STOMATITIS—Also known as canker sores, or painful ulcerations found in the vestibular and buccal mucosa, tongue, soft palate, and in the floor of the mouth.
REGULATED WASTE—Medical items that should be handled with extreme care to prevent any unintentional injury or the spread of blood borne diseases.
RESERVOIR—A carrier on which an infectious agent depends primarily for survival. Reservoirs can be man, plant, animal, or soil.
RESISTANCE—The sum total of body mechanisms that provide barriers to the invasion of infectious agents or their toxic products.
RHABDOMYOLYSIS—the rapid break down of muscle due to injury of muscle tissue.
RHINORRHEA—The free discharge of a thin nasal mucus.
RHONCHUS—(pl. rhoncii) A rattling throat sound due to partial obstruction; a dry coarse rale in the bronchial tubes.
ROOT CANAL—A dental operative procedure performed in order to save a tooth by removing the contents of its root canal and filling the cavity with a protective substance.
SACRUM—Triangular bone just below the lumbar vertebrae.
SANITATION—the hygienic means of promoting health through prevention of human contact with the hazards of waste; the process of cleaning with soap and water or boiling to reduce the number of organisms to a safe level.

SEPSIS—the growth of pathogens in living tissue.

SEROLOGY—procedures by which antigens and reacting serum globulin antibodies may be measured qualitatively and quantitatively.

SERUM—(pl. serums or sera) the watery portion of an animal fluid remaining after coagulation; plasma minus the clotting proteins and clotting cells.

SHOCK—collapse of the cardiovascular system, characterized by circulatory deficiency and depression of vital functions.

SIGN—what you observe upon examination of the patient.

SMALLPOX—a serious, contagious, and sometimes fatal infectious disease caused by variola virus, that could prove to be an agent of bioterrorism.

SOLUBILITY—the ability of a solid to dissolve in a given amount of solvent.

SPIRITS—alcoholic or hydroalcoholic solutions of volatile substances.

SPECIFIC GRAVITY—the density of a solution compared to an equal volume of distilled water which usually varies directly with the amount of solids dissolved in the urine, and normally ranges from 1.015 to 1.030 during a 24-hour period.

SPONSOR—the active duty service member ultimately responsible for authorization the care of dependent family members.

SPORE—a microorganism in a resting or dormant state that renders it highly resistant to destruction.

SPRAIN—injury to the ligaments and soft tissues that support a joint.

STATIC ZONE—between 11 to 2 o’clock; a designated non-traffic area where equipment, such as nitrous oxide, can be placed with the top extending into the assistant’s zone.

STERILE, STERILITY—free of all living organisms.

STERILE FIELD—a specified area, such as within a tray or on a sterile towel that is considered free of micro-organisms.

STERILIZATION—the process of destroying all organisms on a substance or article by exposure to physical or chemical agents; the process by which all organisms, including spores, are destroyed.

STERNUTATORS—vomiting agents.

STERTOROUS—snoring-type breathing sound.

STOMATITIS—inflammation of the oral mucosa.

STRAIN—forcible overstretching or tearing of a muscle or tendon.

STRIATED—striped or streaked.

STRIDOR—a harsh, high-pitched respirator y sound such as the aspiratory sound often heard in acute laryngeal obstruction.

SUBCUTANEOUS—under the skin.
SUBLINGUAL—Under the tongue.
SUPERFICIAL—Of or pertaining to the surface, lying on, not penetrating below.
SUPINE—Lying on the back.
SURGICAL ASEPSTIC TECHNIQUE—The practice that renders and keeps objects and areas free from all organisms.
SURGICALLY CLEAN—Clean but not sterile.
SUSCEPTIBLE—Not resistant. A person or animal who may acquire an infection or disease when exposed to a specific agent, because his or her resistance to the agent is lacking or reduced.
SUSCEPTIBLE HOST—Man or another living organism that affords an infectious agent nourishment or protection to survive and multiply.
SUSPECT—A person who may have acquired a communicable disease; it is indicated by the medical history and clinical presentation.
SUSPENSION—A coarse dispersion of finely divided insoluble material suspended in a liquid medium.
SYMPTOM—What the patient tells you about his or her disease or injury upon examination.
SYNCOPE—Faintness or actual fainting.
SYNERGIST—A medicine that aids or cooperates with another.
SYRUP—Concentrated aqueous solutions of sucrose, containing flavoring or medicinal substances.
TACHYCARDIA—Excessively rapid heartbeat, usually over 100.
TACHYPNEA—Breathing too fast; Abnormally high breathing rate.
TACTICAL COMBAT CASUALTY CARE (TCCC)—Care for patients during combat centered around blunt trauma and tactical variables, primarily based around three definitive phases – care under fire, tactical field care, and tactical evacuation care.
TACTICAL TRIAGE—Military style triage with the primary purpose of keeping the largest number of patients in battle.
TAENIAFUGE—A drug that expels tapeworms without necessarily killing them.
TENDON—A fibrous cord by which a muscle is attached to the skeleton.
TERMINAL—Done after a patient has been discharged or transferred.
THERAPEUTIC DOSE—The normal adult dose, usual dose, or average dose.
THORACIC—Pertaining to or affecting the chest.
THROMBUS—A plug or clot in a blood vessel or in one of the cavities of the heart, formed by coagulation of the blood. It remains where it was formed.
TINCTURE—Usually an alcoholic solution of animal or vegetable drugs.
TINNITUS—Ringing in the ears.
TOXEMIA—Poisonous products in the blood.
TOXICOLOGY—The science of poisons.
TOXINS—Poisons; Harmful substances produced by a variety of living organisms, like bacteria, plants, and animals that are not man-made, non-volatile, and usually not dermally active.

TRACHEOSTOMY—Surgically creating an opening into the trachea.

TRANSFER ZONE—Between 4 and 8 o’clock; instruments are passed and received in this zone over the chest and at the chin of the patient.

TRIAGE—Sorting casualties to determine priority of treatment.

TRITURATION—A process of reducing a solid to a very fine powder by grinding in a mortar and pestle.

TULAREMIA—Also known as “rabbit fever,” a disease caused by the bacterium Francisella tularensis, typically found in animals, especially rodents, rabbits, hares, and ticks.

ULCER—A disruption of the superficial covering of the mucosa or skin.

UNIT DOSE—The quality of materials or supplies required to treat a single patient.

UREMIA—A condition resulting from waste products not being removed efficiently by the kidneys so that they remain in the blood.

URTICARIA—Hives or welts.

VASCULAR—Pertaining to blood vessels.

VASOCONSTRICTOR—An agent that constricts the blood vessels.

VASODILATOR—An agent that dilates the blood vessels.

VECTOR—Any animal capable of transmitting pathogens or producing human or animal discomfort or injury.

VENIPUNCTURE—The puncture of a vein for drawing blood.

VERMICIDE—A drug that expels worms without necessarily killing them.

VERTIGO—Dizziness.

VESICLES—A small elevation that contains fluid.

VESICANT—A blistering drug or agent.

VESICATION—The process of blistering.

VESICLE—A small blister.

VIRULENCE—The degree of pathogenicity of a microorganism or its ability to invade the tissues of the host.

VIRUSES—Disease causing micro-organisms that cannot live long or reproduce outside of a living body; they are much smaller than bacteria, variable in size, and can usually be cured by immersion in boiling water and antibiotics.

VITAMINS—Essential, non-calorie containing compounds found in food and needed in the body in small amounts; vitamins mainly act as enzymes or catalysts and they assist in making necessary chemical reactions occur in the body.

WOUND—An injury that causes break in the skin, underlying soft tissue structures, or body membranes.
WORK PRACTICE CONTROLS—Controls that reduce the likelihood of exposure by altering the way one performs a task such as having patients brush their teeth or using antiseptic mouthwash before beginning a procedure.

YOUNG’S RULE—The rule governing pediatric doses based on age; age of the child in years is the numerator, and the age plus 12 is the denominator. This fraction is then multiplied by the normal adult dose.
# APPENDIX II

## COMMONLY USED ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA</td>
<td>Alcoholics Anonymous</td>
</tr>
<tr>
<td>ABCs</td>
<td>airway, breathing, and circulation</td>
</tr>
<tr>
<td>ACTH</td>
<td>adrenocorticotropin hormone</td>
</tr>
<tr>
<td>ADAL</td>
<td>authorized dental allowance list</td>
</tr>
<tr>
<td>ADH</td>
<td>Anti-diuretic hormone</td>
</tr>
<tr>
<td>AHLTA</td>
<td>Armed Forces Health Longitudinal Technology Application</td>
</tr>
<tr>
<td>AIDS</td>
<td>Acquired Immunodeficiency Syndrome</td>
</tr>
<tr>
<td>AMAL</td>
<td>authorized medical allowance list</td>
</tr>
<tr>
<td>B-cells</td>
<td>lymphocytes produced in the bone marrow</td>
</tr>
<tr>
<td>Ba</td>
<td>barium</td>
</tr>
<tr>
<td>BAS</td>
<td>Battalion Aid Station</td>
</tr>
<tr>
<td>BCA</td>
<td>Body Composition Assessment</td>
</tr>
<tr>
<td>BDS</td>
<td>Battle Dressing Station</td>
</tr>
<tr>
<td>BID</td>
<td>two times per day</td>
</tr>
<tr>
<td>BP</td>
<td>blood pressure</td>
</tr>
<tr>
<td>BRAC</td>
<td>Base Realignment and Closure</td>
</tr>
<tr>
<td>BUMED</td>
<td>Bureau of Medicine and Surgery</td>
</tr>
<tr>
<td>BUN</td>
<td>blood, urea, nitrogen (test of kidney function)</td>
</tr>
<tr>
<td>BUPERS</td>
<td>Bureau of Naval Personnel</td>
</tr>
<tr>
<td>°C</td>
<td>Celsius (centigrade)</td>
</tr>
<tr>
<td>Ca</td>
<td>calcium</td>
</tr>
<tr>
<td>CAAC</td>
<td>Counseling and Assistance Center</td>
</tr>
<tr>
<td>CASEVAC</td>
<td>casualty evacuation</td>
</tr>
<tr>
<td>CBC</td>
<td>complete blood count</td>
</tr>
<tr>
<td>CBR</td>
<td>chemical, biological, and radiological (warfare)</td>
</tr>
<tr>
<td>CCU</td>
<td>coronary/critical care unit</td>
</tr>
<tr>
<td>CDC</td>
<td>The Centers for Disease Control and Prevention</td>
</tr>
<tr>
<td>CEJ</td>
<td>cementoenamel junction</td>
</tr>
<tr>
<td>CHAMPUS</td>
<td>Civilian Health and Medical Program of the Uniformed Services</td>
</tr>
<tr>
<td>CHCS</td>
<td>Composite Health Computer System</td>
</tr>
<tr>
<td>CHF</td>
<td>congestive heart failure</td>
</tr>
<tr>
<td>Cl</td>
<td>chlorine</td>
</tr>
<tr>
<td>CMEO</td>
<td>Command Managed Equal Opportunity</td>
</tr>
<tr>
<td>CNS</td>
<td>central nervous system</td>
</tr>
<tr>
<td>CO2</td>
<td>carbon dioxide</td>
</tr>
<tr>
<td>COPD</td>
<td>chronic obstructive pulmonary disease</td>
</tr>
<tr>
<td>CSF</td>
<td>cerebrospinal fluid</td>
</tr>
<tr>
<td>CSR</td>
<td>central sterilization room</td>
</tr>
<tr>
<td>CVA</td>
<td>cerebrovascular accident</td>
</tr>
<tr>
<td>DAPA</td>
<td>Drug and Alcohol Program Advisor</td>
</tr>
<tr>
<td>D&amp;C</td>
<td>dilation and curettage</td>
</tr>
<tr>
<td>DC</td>
<td>Dental Corps</td>
</tr>
<tr>
<td>DEERS</td>
<td>Defense Enrollment Eligibility Reporting System</td>
</tr>
<tr>
<td>DHS</td>
<td>Department of Homeland Security</td>
</tr>
<tr>
<td>Diff</td>
<td>differential blood count</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<td>--------------</td>
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<tr>
<td>DLA</td>
<td>Defense Logistics Agency</td>
</tr>
<tr>
<td>DME</td>
<td>diving medical examination</td>
</tr>
<tr>
<td>DMLSS</td>
<td>Defense Medical Logistics Standard Support</td>
</tr>
<tr>
<td>DNA</td>
<td>deoxyribonucleic acid</td>
</tr>
<tr>
<td>DOB</td>
<td>date of birth</td>
</tr>
<tr>
<td>DoD</td>
<td>Department of Defense</td>
</tr>
<tr>
<td>DTs</td>
<td>delirium tremens (confusions and incoherence brought on by withdrawal from alcohol)</td>
</tr>
<tr>
<td>DTF</td>
<td>Dental Treatment Facility</td>
</tr>
<tr>
<td>DTR</td>
<td>dental treatment room</td>
</tr>
<tr>
<td>Dx</td>
<td>diagnosis</td>
</tr>
<tr>
<td>Ea</td>
<td>each</td>
</tr>
<tr>
<td>ECG/EKG</td>
<td>electrocardiogram</td>
</tr>
<tr>
<td>EM</td>
<td>electron microscope</td>
</tr>
<tr>
<td>EMF</td>
<td>Expeditionary Medical Facility</td>
</tr>
<tr>
<td>ENT</td>
<td>ear, nose, and throat</td>
</tr>
<tr>
<td>EPA</td>
<td>Environmental Protection Agency</td>
</tr>
<tr>
<td>°F</td>
<td>Fahrenheit</td>
</tr>
<tr>
<td>FAC</td>
<td>free available chlorine</td>
</tr>
<tr>
<td>FBS</td>
<td>fasting blood sugar</td>
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<tr>
<td>FDA</td>
<td>Food and Drug Administration</td>
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<tr>
<td>Fe</td>
<td>iron</td>
</tr>
<tr>
<td>FOIA</td>
<td>Freedom of Information Act</td>
</tr>
<tr>
<td>FSC</td>
<td>Federal Supply Catalog</td>
</tr>
<tr>
<td>FSH</td>
<td>follicle-stimulating hormone</td>
</tr>
<tr>
<td>g/gm</td>
<td>gram</td>
</tr>
<tr>
<td>GI</td>
<td>gastrointestinal</td>
</tr>
<tr>
<td>GMO</td>
<td>General Medical Officer</td>
</tr>
<tr>
<td>GMT</td>
<td>general military training</td>
</tr>
<tr>
<td>Gr</td>
<td>grain</td>
</tr>
<tr>
<td>gtt/gtts</td>
<td>drop/drops</td>
</tr>
<tr>
<td>GTT</td>
<td>glucose tolerance test</td>
</tr>
<tr>
<td>GU</td>
<td>genitourinary</td>
</tr>
<tr>
<td>h.s.</td>
<td>at bedtime (hora somni)</td>
</tr>
<tr>
<td>Hb/Hgb</td>
<td>hemoglobin</td>
</tr>
<tr>
<td>HBV</td>
<td>hepatitis B virus</td>
</tr>
<tr>
<td>HCG</td>
<td>human chorionic gonadotropin</td>
</tr>
<tr>
<td>Hct</td>
<td>hematocrit</td>
</tr>
<tr>
<td>Hg</td>
<td>mercury</td>
</tr>
<tr>
<td>HHS</td>
<td>Department of Health and Human Services</td>
</tr>
<tr>
<td>HIPAA</td>
<td>Health Information Portability and Accountability Act</td>
</tr>
<tr>
<td>HIV</td>
<td>human immunodeficiency virus</td>
</tr>
<tr>
<td>Hpf</td>
<td>high-power field (microscope)</td>
</tr>
<tr>
<td>HSV</td>
<td>herpes simplex virus</td>
</tr>
<tr>
<td>HVE</td>
<td>high-volume excavator</td>
</tr>
<tr>
<td>I</td>
<td>iodine</td>
</tr>
<tr>
<td>I&amp;O</td>
<td>intake and output</td>
</tr>
<tr>
<td>IAW</td>
<td>in accordance with</td>
</tr>
<tr>
<td>ICP</td>
<td>intracranial pressure</td>
</tr>
<tr>
<td>ICU</td>
<td>intensive care unit</td>
</tr>
<tr>
<td>IDC</td>
<td>independent duty corpsman</td>
</tr>
<tr>
<td>IM</td>
<td>intramuscular</td>
</tr>
<tr>
<td>IPPB</td>
<td>intermittent positive-pressure breathing (asthma and emphysema)</td>
</tr>
<tr>
<td>IUD</td>
<td>intrauterine device</td>
</tr>
<tr>
<td>IV</td>
<td>intravenous</td>
</tr>
<tr>
<td>IVP</td>
<td>intravenous pyelogram</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Definition</td>
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<tr>
<td>--------------</td>
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<tr>
<td>OBA</td>
<td>oxygen breathing apparatus</td>
</tr>
<tr>
<td>OD</td>
<td>right eye (oculus dexter)</td>
</tr>
<tr>
<td>OJT</td>
<td>on-the-job training</td>
</tr>
<tr>
<td>OPNAV</td>
<td>Office of the Chief of Naval Operations</td>
</tr>
<tr>
<td>OPTAR</td>
<td>operating targets</td>
</tr>
<tr>
<td>OR</td>
<td>operating room</td>
</tr>
<tr>
<td>OS</td>
<td>left eye (oculus sinister)</td>
</tr>
<tr>
<td>OSHA</td>
<td>Occupational Safety &amp; Health Administration</td>
</tr>
<tr>
<td>oz</td>
<td>ounce</td>
</tr>
<tr>
<td>P</td>
<td>phosphorus</td>
</tr>
<tr>
<td>PAYPERSMAN</td>
<td>Pay and Personnel Procedures Manual</td>
</tr>
<tr>
<td>pc</td>
<td>after meals (post cibum)</td>
</tr>
<tr>
<td>PDB</td>
<td>paradichlorobenzene</td>
</tr>
<tr>
<td>PDHA</td>
<td>pre-deployment health assessment</td>
</tr>
<tr>
<td>PDHRA</td>
<td>post-deployment health re-assessment</td>
</tr>
<tr>
<td>PDR</td>
<td>Physician’s Desk Reference</td>
</tr>
<tr>
<td>pH</td>
<td>percentage of hydrogen ion concentration (alkalinity and acidity measurement)</td>
</tr>
<tr>
<td>PHA</td>
<td>periodic health assessment</td>
</tr>
<tr>
<td>PHI</td>
<td>protected health information</td>
</tr>
<tr>
<td>PID</td>
<td>pelvic inflammatory disease</td>
</tr>
<tr>
<td>PO</td>
<td>orally (per os)</td>
</tr>
<tr>
<td>Poly</td>
<td>segmented neutrophil (seg)</td>
</tr>
<tr>
<td>post-op</td>
<td>post-operative</td>
</tr>
<tr>
<td>ppd</td>
<td>purified protein derivative</td>
</tr>
<tr>
<td>PPE</td>
<td>personal protective equipment</td>
</tr>
<tr>
<td>ppb</td>
<td>parts per billion</td>
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<tr>
<td>ppm</td>
<td>parts per million</td>
</tr>
<tr>
<td>pre-op</td>
<td>pre-operative</td>
</tr>
<tr>
<td>prn</td>
<td>as required (pro re nata)</td>
</tr>
<tr>
<td>PRT</td>
<td>physical readiness test</td>
</tr>
<tr>
<td>PSD</td>
<td>Personnel Support Detachment</td>
</tr>
<tr>
<td>PVC</td>
<td>premature ventricular contraction</td>
</tr>
<tr>
<td>q4h</td>
<td>every 4 hours</td>
</tr>
<tr>
<td>q6h</td>
<td>every 6 hours</td>
</tr>
<tr>
<td>qd</td>
<td>every day</td>
</tr>
<tr>
<td>qh</td>
<td>every hour</td>
</tr>
<tr>
<td>qid</td>
<td>4 times a day</td>
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<tr>
<td>qns</td>
<td>quantity not sufficient</td>
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<tr>
<td>qt</td>
<td>quart</td>
</tr>
<tr>
<td>Ra</td>
<td>radium</td>
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<tr>
<td>RBC</td>
<td>red blood cell</td>
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<tr>
<td>RCF</td>
<td>root canal filling</td>
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<tr>
<td>Rh</td>
<td>Rh factor (antigen in blood of some individuals)</td>
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<tr>
<td>RLQ</td>
<td>right lower quadrant</td>
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<tr>
<td>RUQ</td>
<td>right upper quadrant</td>
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<tr>
<td>R₃</td>
<td>take (prescription)</td>
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<tr>
<td>SAVI</td>
<td>Sexual Assault Victim Intervention</td>
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<tr>
<td>sc/sub-q</td>
<td>subcutaneous</td>
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<tr>
<td>SECNAV</td>
<td>Secretary of the Navy</td>
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<tr>
<td>SMDR</td>
<td>Senior Medical Department Representative</td>
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<tr>
<td>SMO</td>
<td>Senior Medical Officer</td>
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<tr>
<td>SOAP notes</td>
<td>the only accepted method of medical record entries for the military. (Subjective; Objective; Assessment; Plan)</td>
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<tr>
<td>SOB</td>
<td>shortness of breath</td>
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</tbody>
</table>
SPRINT ......................... Special Psychiatric Rapid Intervention Team

Stat  ......................... immediately

STD  ......................... sexually transmitted disease

T-cells  ....................... lymphocytes produced in the thymus gland

TAD/TEMADD ............. temporary additional duty

TB  ......................... tuberculosis

Tbsp  ....................... tablespoon

TJC  ......................... The Joint Commission (formerly known as JCAHO)

TID  ......................... 3 times a day

TPR  ......................... temperature, pulse, and respiration

TSH  ......................... thyroid-stimulating hormone

tsp  ......................... teaspoon

TST  ......................... tuberculin skin test

UCMJ  ....................... Uniformed Code Military Justice

UIC  ......................... unit identification code

URI  ......................... upper respiratory infection

USP-NF ..................... United States Pharmopeia-National Formulary

UTI  ......................... Urinary Tract Infection

VA  ......................... Veterans Administration

VDRL  ....................... Venereal Disease Research Laboratory

vs  ........................... vital signs

WBC  ......................... white blood cell

WHO  ......................... World Health Organization

YOB  ......................... year of birth
APPENDIX III

PREFIXES AND SUFFIXES USED IN MEDICAL TERMINOLOGY

Medical terminology uses components (i.e., prefixes and suffixes) to build words that represent medical conditions and procedures. These words can often seem intimidating until you learn how to break them down in their component parts.

Examples of Combinations of Prefixes and Suffixes

**cholecystitis** = chole + cyst + it is (inflammation of the gallbladder)
- chole = gall
- cyst = bladder
- itis = inflammation

**cholelithiasis** = chole + lith + iasis (condition resulting from gallstones)
- chole = gall
- lith = stone
- iatis = condition (resulting from)

**odontalgia** = odont + algia (tooth pain; tooth ache)
- odont = tooth
- algia = pain

**rhinoplasty** = rhino + plasty
- rhino = nose
- plasty = to form or to build

The following are some of the more common prefixes and suffixes used by healthcare providers to describe body conditions and procedures.
## PREFIXES

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Meaning</th>
<th>Example</th>
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<tr>
<td>a-/an-</td>
<td>lacking; absence of</td>
<td>chrom/o</td>
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<td>ab-</td>
<td>away from</td>
<td>chron/o</td>
</tr>
<tr>
<td>acr/o</td>
<td>extremities</td>
<td>cib/o</td>
</tr>
<tr>
<td>ad-</td>
<td>towards; addition of</td>
<td>con-</td>
</tr>
<tr>
<td>adip/o</td>
<td>fat</td>
<td>contra</td>
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<tr>
<td>aer/o</td>
<td>air</td>
<td>coron/o</td>
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<tr>
<td>amphi</td>
<td>on both sides</td>
<td>cortic/o</td>
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<td>amyl/o</td>
<td>starch</td>
<td>cost/o</td>
</tr>
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<td>andr/o</td>
<td>male</td>
<td>crani/o</td>
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<tr>
<td>angi/o</td>
<td>vessel</td>
<td>cry/o</td>
</tr>
<tr>
<td>ankyl/o</td>
<td>crooked; bent; stiff</td>
<td>crypt</td>
</tr>
<tr>
<td>ante-</td>
<td>before</td>
<td>cutane/o</td>
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<tr>
<td>anter/o</td>
<td>front</td>
<td>cyan/o</td>
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<td>anti-</td>
<td>against</td>
<td>cyst/o</td>
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<td>aque/o</td>
<td>water</td>
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<td>de-</td>
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<td>hearing</td>
<td>dent/i</td>
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<td>aur/i</td>
<td>ear</td>
<td>derm/o; dermat/o</td>
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<td>self</td>
<td>derm/o</td>
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<td>axill/o</td>
<td>armpit</td>
<td>derm/o; dermat/o</td>
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<td>bacteri/o</td>
<td>bacteria</td>
<td>diaphrag/o</td>
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<td>bene-</td>
<td>good</td>
<td>dist/o</td>
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<td>bi/o</td>
<td>life</td>
<td>dory/o; dermat/o</td>
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<td>bi-</td>
<td>two</td>
<td>dyst</td>
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<td>bil/i</td>
<td>gall; bile</td>
<td>cec-; ecto</td>
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<td>brach/o</td>
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<td>en</td>
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<td>capit/o</td>
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<td>heart</td>
<td>erg/o</td>
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<td>cata-</td>
<td>down</td>
<td>erythr/o</td>
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<tr>
<td>caud/o</td>
<td>tail; lower part of body</td>
<td>eso-</td>
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<td>caus/o</td>
<td>burn</td>
<td>estr/o</td>
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<tr>
<td>caut/o</td>
<td>heat; burn</td>
<td>eti/o</td>
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<tr>
<td>celi/o</td>
<td>belly; abdomen</td>
<td>eu-</td>
</tr>
<tr>
<td>cephal/o</td>
<td>head</td>
<td>ex-</td>
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<td>cerebell/o</td>
<td>cerebellum</td>
<td>exo</td>
</tr>
<tr>
<td>cerebr/o</td>
<td>brain; cerebrum</td>
<td>fibr/o</td>
</tr>
<tr>
<td>cervic/o</td>
<td>neck; cervix</td>
<td>gastr/o</td>
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<tr>
<td>chem/o</td>
<td>drug; chemical</td>
<td>gen/o</td>
</tr>
<tr>
<td>chol/e</td>
<td>gall</td>
<td>germ/o</td>
</tr>
<tr>
<td>chondr/o</td>
<td>cartilage</td>
<td>gingiv/o</td>
</tr>
</tbody>
</table>

AIII-2
gloss ......................................................... tongue
gluc/o;glyc/o ............................................ sugar
gnos/o ..................................................... knowledge
gravid/o .................................................... pregnancy
gynec/o .................................................. woman; female
hem/o;hemat/o ........................................ blood
hemi- ............................................................... half
hepat/o ....................................................... liver
hidr/o ............................................................. sweet
hist/o;histi/o ............................................... tissuse
home/o .......................................................... same; constant; unchanged
hydr/o ............................................................. water
hyper- ............................................................. above; increase
hynp/o ............................................................. sleep
hypo ............................................................. under; below
hyster/o ......................................................... uterus; womb
immune/o .................................................... safe; protection
in- ................................................................. not; in
infra- ............................................................. below; inferior
inter- ............................................................. between
intra- ............................................................. within
is/o ................................................................. same; equal
kary/o ............................................................ nucleus
kerat/o ............................................................ horny; hard; cornea
kinesi/o .......................................................... movement
labio/o ............................................................ lips
lacrim/o ........................................................ tear; tear duct
lact/o .............................................................. milk
lapar/o ........................................................... abdomen
laryng/o ........................................................ larynx; voice box
later/o ............................................................ side
leuk/o ............................................................. white
lingu/o ............................................................ tongue
lip/o ................................................................. fat
lumb/o ............................................................ lower back; loins
macro ............................................................. large
mal- ................................................................. faulty; poor
mamm/o ........................................................ breast
medi/o ............................................................ middle
melan/o .......................................................... black
meso .............................................................. middle
meta- ............................................................... beyond; near; change
metr/o;metri/o ............................................... uterus
micro/o .......................................................... small
mit/o ................................................................. thread
mon/o ............................................................. one; single
morph/o .......................................................... shape; form
mort/o ............................................................. death
myel/o ............................................................ spinal cord; bone
myos/o ........................................................... muscle
narc/o ............................................................ stupor; numbness
nas/o ............................................................. nose
nat/i .............................................................. birth
necr/o ............................................................. death
neo- .............................................................. new
nephr/o ........................................................... kidney
neur/o ............................................................. nerve
ocul/o; ophthalm/o .......................................... eye
odont/o ........................................................... tooth
olig/o ............................................................. few; scanty
onc/o ............................................................. mass; tumor
or/o .............................................................. mouth
orth/o ............................................................ straight
oste/o ............................................................ bone
ot/o ............................................................... ear
ov/o .............................................................. egg
pachy/o ........................................................ heavy; thick
pan ................................................................. all
para .............................................................. beside; near; abnormal
path/o ........................................................... disease
per ............................................................... through
peri- ............................................................. around
phag/o ........................................................ eat; swallow
pharyng/o ..................................................... throat
phil/o ............................................................. like; love; attraction
to
phleb/o ........................................................ vein
phob/o ........................................................ fear
phot/o ........................................................ light
physic/o ........................................................ nature
pne ............................................................ breathing; breath
pneum/o ......................................................... lung
poly- ........................................................... many; much
post- ........................................................... after; behind
pre- ............................................................. before
proct/o ........................................................ rectum
prot/o .......................................................... first
proxim/o ........................................................ near
pseudo/o ....................................................... false
psych/o ........................................................ mind
py/o ............................................................. pus
pyr/o .......................................................... heat; temperature
re- ............................................................. back
rect/o ............................................................. rectum
ren/o ........................................................... kidney
retro- ........................................................... behind
rhin/o ........................................................... nose
rib/o..................................... sugar
toentgen/o ........................... x-rays
sarc/o..................................... flesh(connective
tissue)
scop/o .................................. examination
(usually visual)
semi...................................... half
seps/o ................................... infection
somn/o ................................... sleep
son/o...................................... sound
sphere/o............................... round; globe-shape
sphygm/o.............................. pluse
spondyl/o.............................. vertebrae
(stomach)
sub-...................................... under; below
supra.................................... above
sym-;syn- ............................ together; with
tachy- ................................. fast
tele/o .................................... far; distant
thorae/o................................ chest
top/o...................................... position; location;
place
tox/o; toxic/o........................... poison
trans-.................................... across
ultra...................................... beyond; excess
vas/o...................................... vessel; duct
ven/o..................................... vein
ventr/o................................... belly side of body
vir/o...................................... virus; poison
viscer/o................................ internal organs
vit/a;vit/o.............................. life
xanth/o................................... yellow
xer/o...................................... dry
### SUFFIXES

<table>
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<tr>
<th>Suffix</th>
<th>Definition</th>
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<tr>
<td>-ac; -al; -ar; -ary</td>
<td>pertaining to</td>
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<tr>
<td>-algia</td>
<td>pain</td>
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<tr>
<td>-ase</td>
<td>enzyme</td>
</tr>
<tr>
<td>-asthenia</td>
<td>lack of strength</td>
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<td>-blast</td>
<td>immature; embryonic</td>
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<td>-capnia</td>
<td>carbon dioxide</td>
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<td>-cele</td>
<td>tumor; hernia</td>
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<td>-cidal</td>
<td>killing</td>
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<td>-clast</td>
<td>break</td>
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<td>-coccus (pl. –cocci)</td>
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<td>-crine</td>
<td>secrete; separate</td>
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<td>-crit</td>
<td>separate</td>
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<td>-desis</td>
<td>binding</td>
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<td>dilation; stretching</td>
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<td>-ectomy</td>
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<td>-emia</td>
<td>blood</td>
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<td>-genesis</td>
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<td>protein</td>
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<td>-ia</td>
<td>condition; process</td>
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<td>destruction</td>
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<td>resembling</td>
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<td>-ole</td>
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<td>-ology</td>
<td>study of</td>
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<td>-oma</td>
<td>growth; tumor</td>
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<td>-opia</td>
<td>vision</td>
</tr>
<tr>
<td>-opsy</td>
<td>view</td>
</tr>
<tr>
<td>-or</td>
<td>one who</td>
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</table>
APPENDIX IV

TRADEMARK COMPANIES

The following is a list of trademarks used in this manual:

ACE® ........................................ Bechtol Dickson and Company
Achromycin® .............................. Lederle Labs
Actifed® .................................. Warner-Lambert Co.
Adrenalin Chloride® ................ JHP Pharmaceuticals
Afrin® .................................... Schering-Plough
Aftate® ................................... Schering-Plough
Ambien® .................................. Sanofi-Aventis
Amoxil® .................................. GlaxoSmithKline
Amphojel® ............................... Wyeth Pharmaceuticals
Amytal® ................................... Ranbaxy Pharmaceuticals Inc.
Anaprox® ................................ Roche Laboratories
Antiminth® ................................ Pfizer
Antivert® .................................. Pfizer
Aralen® .................................. Sanofi-Aventis
Atarax® .................................. Pfizer
Bactrim® .................................. Roche Laboratories
Benadryl® ................................ Parke-Davis
Betadine® ................................ Purdue Pharmaceutical Products
Betapen-VK® ............................ Mead Johnson
Bicillin* .................................. Wyeth-Averst
Bleph-10® ................................ Allergan Optical
Bonine® .................................... Pfizer
Burow’s Solution® ..................... Humco Laboratories
Cardizem® ................................ Biocraft Laboratories
C.A.T.® ................................... Phil Durango, LLC Limited Liability Company Colorado
Ceftin® .................................... GlaxoSmithKline
Chlor-Trimeton® ....................... Schering-Plough
CIDEX® .................................. Johnson & Johnson Medical, Inc.
Cleocin® .................................. Pharmacia & Upjohn

Combitube® .............................. Tyco Healthcare Group LP SWD HOLDING, INC.
Compazine® .............................. Evoke Pharmaceuticals
Coumadin® ................................ Bristol-Myers Squibb
Cefdin® .................................... Sanofi Winthrop
Desenex® ................................ Novartis
Dexedrine® ............................... GlaxoSmithKline
Diamox® .................................. Lederle Labs
Dilantin® .................................. Parke-Davis
Domeboro® ................................ Bayer Corporation
Dramamine® .............................. Upjohn
Dulcolax® ................................. Boehringer-Ingeheim
Dyazide® ................................. GlaxoSmithKline
Dycal® .................................... L.D. Caulk
Dynapen® ................................ Bristol-Myers Squibb
Dyrenium® ............................... GlaxoSmithKline
E-Mycin® .................................. Knoll Laboratories
Ecotrin® .................................. GlaxoSmithKline
Elavil® .................................... AstraZeneca
Alimite® .................................. Allergan Pharmaceuticals
Enulose® .................................. Alpharma
Ergotract® Maleate..................... Eli Lilly
Eryc® ...................................... Mayne Pharma International
Esidrix® .................................. Novartis
Eskalith® .................................. GlaxoSmithKline
Feldene® .................................. Pfizer
Flagyl® .................................... Searle
Flexeril® .................................. ALZA Corporation
Flouthane® ............................... Wyeth Pharmaceuticals
Fulvicin® .................................. Schering
Gantrex® .................................. Roche Laboratories
Garamycin® ............................. Schering
Gris-PEG® ................................ Pedinol Pharmaceutical
Haldol® ................................ Ortho-McNeil Pharmaceutical
Hextend® ............................. BioTime, Inc.
Hygroton® ........................... Aventis Pharmaceuticals
Ilotycin® .............................. Dista
Indocin® .............................. Merck
Innovar® .............................. Janssen
IRM® ................................... Dentists’ Supply Company of New York
Isoptin® ............................... Knoll
Isordil® ................................ Wyeth Pharmaceuticals
Keflex®................................ Middle Brook Pharmaceuticals
Kefzol®................................ Eli Lilly
Ketalar®............................... JHP Pharmaceuticals
KTD™ ................................ Kendrick EMS
Lanoxin® ............................. Glaxosmithkline
Lasix® ................................ Aventis Pharmaceuticals
Librium® ............................. Roche Products
Lithonate® ............................ Solovay Pharmaceuticals
Lotrimin® ............................ Schering-Plough
Luminal ................................ Hospira, Inc.
Maalox® .............................. Novartis Consumer Healther
Marinol®.............................. Loders Croklaan B.V. Corporation Netherlands
Maxzide®................................ Mylan Pharmaceuticals
Mellaril®.............................. Novartis Pharmaceuticals
Metamucil® ......................... Proctor & Gamble Company
Mitacin* .............................. Wellspring Pharmaceutical
Mintezol® ............................. Merck
Mobic® ................................. Boehringer-Ingelheim Pharma
Monistat® ......................... Johnson & Johnson
Monosticon DRI-DOT® .. Organon Teknika Corporation
Motrin® ............................... Johnson & Johnson
MS Contin® .......................... Purdue Pharmaceutical Products
Mucinex® .............................. Reckitt Benckiser Inc.
Bayer® Multistix® ............... Bayer Healthcare
Mycelex .............................. Bayer Healthcare
Mycifradin® Sulfate............. Pharmacia & Upjohn
Mycostatin ........................... Bristol-Myers Squibb
Naprosyn® ............................ Syntex Pharmaceuticals
Nebcin® ............................... Eli Lilly
Nembutal® ......................... Abbott Laboratories
Neo-Synephrine® ............... Bayer Healthcare
Nitro-Bid® ........................... Nycomed US Inc.
Nitrostat® ........................... Warner Lambert Company
NIX® ................................... Insight Pharmaceutical
Novocain® ......................... Hospira, Inc
Nupercaina®...................... Novartis
Ophthaine® ......................... Bristol-Myers Squibb
Ophthetic® ........................... Allergan Optical
Orectic® ............................... Abbott Laboratories
PCE DisperTab® ................ Abbott Laboratories
Pen-Vee K® ........................... Wyeth Pharmaceuticals
Persantine® ......................... Boehringer-Ingelheim
pHisohex® ........................... Sanofi-Aventis
Pitocin® .............................. JHP Pharmaceuticals
Polycillin® ........................... Bristol-Myers Squibb
Pmaquine® Phosphate........ Winthrop Pharmaceuticals
Procan SR® ........................... Parke-Davis
Pronestyl® ............................ Bristol-Myers Squibb
Prozac® .............................. Eli Lilly
Ritalin® ............................... Novartis
Robaxin® ............................ Wyeth Corporation
Robitussin DM® ................. Wyeth Corporation
Robitussin AC® ................. Wyeth Corporation
Roxanol® .............................. Xanodyne Pharmaceuticals
Sager® Splint....................... Sager® Emergency Traction Splints
SAM® Splint ........................ SAM Medical Products
Sayer® Extractor™ ......... Sawyer® Products

AIV-2
<table>
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<th>Brand Name</th>
<th>Manufacturer</th>
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APPENDIX V

REFERENCES

REFERENCE LINK DISCLAIMER

The pages contained within this section and throughout the manual include web address reference links to source information created and maintained by other public and private organizations. The U.S. Navy does not control or guarantee the accuracy, timeliness, or completeness of any outside links or information from non U.S. Navy websites. Links to non U.S. Navy websites are not intended to endorse or recommend any views expressed or products and services offered on these sites and are provided for reference only. All links were complete and active at time of reference content update.
REFERENCES: CONTENT UPDATE

APPENDIX V-A


24. NAVMED 6470.23 series, *Medical management of non-ionizing radiation casualties*.


REFERENCES: DIRECTIVES AND INSTRUCTIONS

APPENDIX V-B

1. BUMEDINST 1300.2 series, *Suitability Screening, Medical Assignment Screening, and Exceptional Family Member Program (EFMP) Identification and Enrollment*

2. BUMEDINST 4010.3 series, *Precious Metals Recovery Program*

3. BUMEDINST 5210.9 series, *Forms and Reports Management Program*

4. BUMEDINST 6010.13 series, *Quality Assurance Program*

5. BUMEDINST 6010.21 series, *Risk Management Program*

6. BUMEDINST 6200.12 series, *Tobacco Use in Navy Medical Department Activities*

7. BUMEDINST 6220.12 series, *Medical Event Report*

8. BUMEDINST 6220.8 series, *Streptococcal Infection Control Program*

9. BUMEDINST 6220.9 series, *Nosocomial Infection Control Program*

10. BUMEDINST 6224.8 series, *Tuberculosis Control Program*

11. BUMEDINST 6230.15 series, *Immunizations and Chemoprophylaxis*

12. BUMEDINST 6240.1 series, *Standards for Potable Water*

13. BUMEDINST 6260.30 series, *Mercury Control Program for Dental Treatment Facilities*

14. BUMEDINST 6280.1 series, *Management of Infectious Waste*

15. BUMEDINST 6300.10 series, *Health Care Relations Program*

16. BUMEDINST 6300.3 series, *Inpatient Data System*

17. BUMEDINST 6320.70 series, *Family Advocacy Program*

18. BUMEDINST 6320.83 series, *Provisions of Standbys During Medical Examinations*

19. BUMEDINST 6440.5 series, *Health Services Augmentation Program (HSAP)*

20. BUMEDINST 6570.2 series, *Morphia Dosage and Casualty Marking*

21. BUMEDINST 6600.10 series, *Dental Infection Control Program*
22. BUMEDINST 6710.62 series, *Management and Disposal of Dated Medical and Dental Materiel*

23. BUMEDINST 6710.63 series, *Reporting of Defective, Unsafe, or Unsatisfactory Medical and Dental Material*

24. BUMEDINST 6710.70 series, *Controlled Substances Inventory Boards*

25. BUPERSINST 1770.1 series, *The Navy Casualty Assistance Calls Program (CACP) Manual*

26. CINCPACINST 5360.1 series, *Geographic Responsibilities for Mortuary Operations*

27. COMNAVSURFORINST 6000.1 series, Shipboard Medical Procedures Manual


31. DODINST 6050.5 series, *Hazardous Materials Information System (HMIS)*

32. DODINST 8580.02-R series, *DoD Health Information Security Regulation*

33. DODINST 6130.4 series, *Medical Standards for Appointment, Enlistment, or Induction in the Armed Forces*


36. Health Information Portability and Accountability Act (HIPAA) Health Insurance Portability And Accountability Act Of 1996 Public Law 104-191

37. JAGINST 5800.7 series, *Manual of the Judge Advocate General (JAGMAN)*

38. MANMED P-117, *Manual of the Medical Department*


40. Medical, Environmental, Diagnosis, Intelligence and Counter-measure (MEDIC) CD-ROM
41. NAVEDTRA 14504, *Military Requirements for Petty Officer Third and Second Class*

42. NAVMED P-5010, *Manual of Naval Preventive Medicine*

43. NAVMED P-5020, *Resources Management Handbook*

44. NAVMED P-5038, *Control of Communicable Diseases of Man*

45. NAVMED P-5055, *Radiation Health Protection Manual*

46. NAVMED P-5132, *Bureau of Medicine and Surgery, Equipment Management Manual*

47. NAVMED 6470.23 series, *Medical management of non-ionizing radiation casualties.*

48. NAVMEDCOMINST 1300.2 series, *Medical, Dental, and Educational Suitability Screening and Exceptional Family Member Program (EFMP) Enrollment*

49. NAVMEDCOMINST 6260.5 series, *Occupational Noise Control and Hearing Conservation*

50. NAVMEDCOMINST 6310.3 series, *Management of Alleged or Suspected Sexual Assault and Rape Cases*

51. NAVMEDCOMINST 6320.3 series, *Medical and Dental Care for Eligible Persons at Navy Medical Department Facilities*

52. NAVPERS 15560 series, *Naval Military Personnel Manual (MILPERSMAN)*

53. NAVPERS 18068 series, *Navy Enlisted Occupational Standards*


56. NAVSUP P-486, *Food Service Management General Messes*

57. NEHC-TM89-2, *Nosocomial Infection Control Manual for Ambulatory Care Facilities*

58. OPNAV P-45-113-93, *Afloat Medical Waste Management Guide/Management of Infectious Waste*

59. OPNAVINST 1750.2 series, *Defense Enrollment Eligibility Reporting System*

60. OPNAVINST 1752.1 series, *Sexual Assault Victim Intervention (SAVI) Program*

61. OPNAVINST 4080.11 series, *Navy War Reserve Material Management*
62. OPNAVINST 4614.1 series, *Uniform Material Movement and Issue Priority System (UMMIPS)*
63. OPNAVINST 4790.4 series, *Ship's Maintenance and Material Management (3-M) System Policy*
64. OPNAVINST 5090.1 series, *Environmental Readiness Program Manual*
65. OPNAVINST 5100.19 series, *NAVOSH Program Manual for Forces Afloat*
66. OPNAVINST 5100.23 series, *Navy Occupational Safety and Health (NAVOSH) Program*
67. OPNAVINST 5102.1 series, *Navy & Marine Corps Mishap and Safety Investigation, Reporting, and Record Keeping*
68. OPNAVINST 5215.17 series, *Navy Directives Issuance System*
69. OPNAVINST 5350.4 series, *Drug and Alcohol Abuse Prevention and Control*
70. OPNAVINST 5360.1 series, *Decedent Affairs Manual*
71. OPNAVINST 6110.1 series, *Physical Readiness Program*
72. OPNAVINST 6320.7 series, *Health Care Quality Insurance Policies for Operating Forces*
74. SECNAV M-5510.36 series, *Department of the Navy Information Security Program*
75. SECNAVINST 1752.3 series, *Family Advocacy Program (FAP)*
76. SECNAVINST 1770.3 series, *Management and Disposition of Incapacitation and Incapacitation Benefits for Members of Navy and Marine Corps Reserve Components*
77. SECNAVINST 1850.4 series, *Department of the Navy Disability Evaluation Manual*
78. SECNAVINST 4061.1 series, *Food Service Training Program*
79. SECNAVINST 4355.18 series, *Reporting of Item and Packaging Discrepancies*
80. SECNAVINST 5210.11 series, *Department of the Navy Standard Subject Identification Codes*
81. SECNAVINST 5210.8 series, *Department of the Navy Records Management Program*
82. SECNAVINST 5211.5 series, *Department of the Navy Privacy Act Program (PAP)*
83. SECNAVINST 5212.5 series, *Navy and Marine Corps Records Disposition Manual*

84. SECNAVINST 5216.5 series, *Department of the Navy Correspondence Manual*

85. SECNAVINST 5800.11 series, *Victim and Witness Program*

86. SECNAVINST 6120.3 series, *Periodic Health Assessment for Individual Medical Readiness*

87. SECNAVINST 6230.4 series, *Department of Navy (DoN) Anthrax Vaccination Implementation Program (AVIP)*

88. SECNAVINST 7320.10, *Department of the Navy (DoN) Personal Property Policies and Procedures*


ASSIGNMENT 1

Book Assignment: “Heritage of the Hospital Corpsman,” pages 1-1 to 1-9

1-1. Which of the following is the key to service with distinction?

1. Honor and Courage
2. Customer Service
3. Professional ethics
4. Stellar performance

1-2. The importance of having medical care onboard naval vessels was reinforced on ______.

1. June 16, 1776
2. March 2, 1799
3. October 13, 1975
4. November 13, 1984

1-3. The area called the sick bay today was originally referred to as what?

1. Cockpit
2. Sickcall
3. MTF
4. Ward

1-4. The first member of the Hospital Corps to be awarded the Medal of Honor was?

1. Hospital Apprentice Eugene Soucy
2. Hospital Apprentice Robert Stanley
3. Loblolly Boy Russ
4. Pharmacist Mate Carl C. Moore

1-5. The foundation for the current system of rank structure came in what year?

1. 1924
2. 1935
3. 1920
4. 1916

1-6. The first Hospital Corps School for Women Accepted for Volunteer Emergency Service was commissioned where?

1. Hospital Corps School, Great Lakes, IL
2. U. S. Naval Hospital Pensacola, FL
3. National Naval Medical Center, Bethesda, MD
4. U. S. Naval Hospital, San Diego, CA

1-7. The Honorable James Forrestal was serving in what position when he publically thanked the Hospital Corps for its service and contributions during World War II?

1. Secretary of Defense
2. Secretary of War
3. Secretary of the Navy
4. Secretary of State

1-8. What was the original rating insignia of the Hospital Corps?

1. Caduceus
2. Red Cross
3. Gold Oak Leaf
4. Blue Cross

1-9. Shock Trauma Platoons (STP) were first deployed during the Afghanistan phase of the War on Terror.

1. True
2. False

1-10. Soft Power was first articulated as a possible military policy in 1911 by President Theodore Roosevelt.

1. True
2. False
1-11. The Dental Technician rating was established ___________.

1. 12 January 1944
2. 02 April 1948
3. 07 December 1941
4. 12 December 1947

1-12. Most of the Navy’s medical enlisted training will be relocated to ________ along with the Army and Air Force as of 2011.

1. Wichita Falls, TX
2. San Diego, CA
3. San Antonio, TX
4. Ft. Bragg, NC

1-13. What percentage of all Department of the Navy Medals of Honor has been earned by Hospital Corpsmen?

1. 50%
2. 20%
3. 40%
4. 65%
ASSIGNMENT 2

Book Assignment: “Expeditionary Medicine Administration,” pages 2-1 to 2-9

2-1. The following should be reported to the OOD for inclusion into the duty log.

1. Bacteria in the potable water
2. Functioning equipment
3. Service member with a broken leg
4. Hygiene class for food service personnel
5. Answers 1 and 3

2-2. SAMS is an administrative management tool that tracks:

1. Sick Call Log
2. Potable Water Testing Results
3. Medical Training
4. All of the above
5. Answers 1 and 2

2-3. What specific 3-M system regulates scheduled equipment maintenance?

1. Planned Maintenance Schedule
2. Preventative Maintenance System
3. Navy Maintenance and Material Management System
4. Planned Maintenance System

2-4. Which type of directive regulates policy?

1. Permanent
2. Notice
3. Instruction
4. Temporary

2-5. Change transmittals should be filed with ________ on top?

1. Change 3
2. Most current change
3. Original instruction
4. Change 1

2-6. The Department of the Navy Information Security Program gives direction on how to prepare naval correspondence.

1. True
2. False

2-7. The 5000 series of correspondence relates to ________.

1. Military Personnel
2. General Administration and Management
3. General Material
4. Financial Material

2-8. What is the process called that is used to determine the correct subject group under which documents should be filed?

1. Classifying
2. Grouping
3. Coding
4. Cross-referencing

2-9. HMs should use their best judgment to dispose of questionable directives.

1. True
2. False
2-10. Medical and dental personnel must be aware of planned operations so they can ______.

   1. Plan for supplies
   2. Plan for possible injuries
   3. Plan for extended work hours
   4. All of the above

2-11. Which element of medical readiness is used to correct individual medical readiness deficiencies?

   1. Dental Readiness
   2. Immunizations
   3. Deployment Limiting Conditions
   4. Periodic Health Assessment

2-12. Personnel in these dental classifications go to the head of the line for treatment prior to deployment.

   1. Class 1 and 2
   2. Class 1 and 4
   3. Class 3 and 4
   4. Class 2 and 3

2-13. A patient in Class 2 dental status means?

   1. Return for evaluation in one year
   2. Service member is deployable
   3. Oral conditions are unknown
   4. Conditions exist requiring immediate treatment

2-14. The primary mission of the FMF medical battalion is to provide:

   1. Specialized surgery
   2. Triage
   3. Long term hospitalization
   4. Preventive medicine

2-15. FMF dental units maintain dental readiness during all of the following EXCEPT:

   1. Deployments
   2. Exercises
   3. Emergency Environments
   4. Combat Operations

2-16. Fleet Hospital mission and personnel requirements are set by ______________.

   1. Chief of Naval Operations (CNO)
   2. Combatant Commander (COCOM)
   3. Type Commander (TYCOM)
   4. Chairman, Joint Chiefs of Staff (CJCS)

2-17. Fleet hospitals are used in operations that are less than 60 days in duration.

   1. True
   2. False

2-18. Who directs the actions of the Naval Mobile Construction Battalion when responding to a natural disaster, i.e. Hurricane Katrina?

   1. Cognizant Authority
   2. Senior Naval Officer on scene
   3. Commanding Officer
   4. FEMA Coordinator on site

2-19. A warfare qualification signifies ______.

   1. The HM is competent
   2. The command has confidence in the individual wearing it
   3. The HM is an integral part of the unit
   4. The HM understands the unit’s specific mission
3-1. Which of the following is not a HM administrative responsibility during the operations of a medical clinic?

1. Greeting the patient entering the clinic or inpatient floor
2. Opening the clinic and making coffee
3. Providing initial clinical documentation
4. Assisting with the referral process

3-2. Which system was implemented to assist in the projection and allocation of cost for healthcare programs?

1. DEERS
2. DIRS
3. ALHTA
4. DENCAS

3-3. Instances where the beneficiary has a valid ID card and DEERS shows the individual ineligible, or not in the database, eligibility verification by ID Card overrides DEERS.

1. True
2. False

3-4. In cases where a patient presents without a valid ID card and does not appear in DEERS, non-emergent care will still be rendered.

1. True
2. False

3-5. How many days after receiving treatment does a patient have to present a valid ID card before being billed as a Civilian Humanitarian Non-indigent?

1. 15
2. 30
3. 45
4. 60

3-6. Who may delay billing on a patient not presenting with a valid ID?

1. Commanding Officer
2. Personnel Officer
3. Third Party Collections
4. Patient Billing

3-7. What is the length of time a newborn can be treated without presenting a valid ID card?

1. 60 days
2. 90 days
3. 6 months
4. 1 year

3-8. Which of the following Foreign Military Personnel are not eligible for care at Naval MTF’s?

1. NATO personnel stationed in the U.S.
2. Crew of visiting aircraft
3. Crew of NATO ships in port
4. Foreign military on vacation in the U.S.
3-9. Which of the following is not a type of dental care?

1. Routine
2. Special
3. Emergency
4. Elective

3-10. Treatment that is necessary to relieve pain, control bleeding, and manage septic conditions falls under Special Types of dental care.

1. True
2. False

3-11. Of the following, who will be the first to receive dental care?

1. Active duty - routine
2. Member of Senior Training Corp - special
3. Civilian - elective
4. Family member of active duty - emergency

3-12. What program is used to evaluate the degree of excellence in care delivered and its results for future improvement?

1. Quality Issuance
2. Quality Improvement
3. Quality Assurance
4. Quality Result

3-13. Medical care rendered by healthcare providers to Navy beneficiaries is sometimes considered subpar due to what fact?

1. Lack of medical skills
2. Lack of interpersonal relationship skills
3. Lack of access to care
4. Lack of healthcare providers

3-14. The Patient Relations Program is the only program that strives to enhance channels of communication between the hospital, staff, and patient populations.

1. True
2. False

3-15. Which program allows patients to voice their satisfactory or unsatisfactory complaints, including those concerning treatment?

1. Health Care Relations Program
2. Patient Relations Program
3. Quality Assurance Program
4. Patient Contact Point Program

3-16. Where would the HM look to find more information in the area of Medical Treatment Records?

1. MANMED Chapter 16
2. BUMEDINST 5210.8
3. MANMED Chapter 6
4. MANMED Chapter 17

3-17. The Family Advocacy Program identifies, treats, and monitors Navy personnel engaging in which types of behavior?

1. Spousal abuse
2. Child abuse
3. Sexual abuse
4. All of the above
3-18. Physical readiness testing is required to be conducted by subordinate commands, who’s medical departments are responsible for all of the following **EXCEPT**?

1. Providing technical assistance to BUPERS
2. Conducting lifestyle, fitness, and obesity research
3. Assisting in the development of exercise prescriptions
4. Process waivers for completing the PRT

3-19. Failure to obtain consent prior to initiation of medical treatment may result in medical malpractice and/or assault and battery.

1. True
2. False

3-20. Who is obligated to provide the patient with all necessary information to make a knowledgeable decision on a proposed medical procedure?

1. Hospital Corpsman
2. Medical Provider
3. Patient Administration Officer
4. Nurse Corps Officer

3-21. Consent prior to initiation of medical treatment is required in all routine, emergency, and elective procedures.

1. True
2. False

3-22. What legal doctrine serves as the final authority over and determines the control of substitute consent?

1. Hospital Rules
2. Federal Law
3. State Law
4. The Joint Commission

3-23. Who is recommended to act as a witness when the patient is consenting to a medical procedure?

1. Family Member
2. Staff member not involved in the procedure
3. Staff member involved in the procedure
4. Another medical provider

3-24. Under the Freedom of Information Act the Navy must make all documents available **EXCEPT** those that are exempt.

1. True
2. False

3-25. Which policy was established to provide a balance between the public and the privacy of an individual?

1. Privacy Act of 1974
2. Freedom of Information Act
3. HIPPA Privacy Rule
4. DODINST 6025.18

3-26. The HIPAA Privacy Rule allows for disclosure of what information?

1. Name and Social
2. Medical Treatment Rendered
3. Protected Health Information
4. Dental Treatment Rendered

3-27. Personal Health Information is required to be disclosed for all of the following reasons **EXCEPT**?

1. Treatment
2. Security
3. Payment
4. Health Care Operations
3-28. Under what act is it unlawful for the United States military to be used as an enforcer or to assist in the enforcement of federal or state law?

1. Privacy Act
2. HIPPA Security Act
3. Freedom of Information Act
4. Posse Comitatus Act

3-29. Who is authorized to deliver an Active Duty member to federal law enforcement authorities and based upon what actions?

1. Commanding Officer, presentation of a federal warrant
2. Medical Officer, presentation of a federal warrant
3. Executive Officer, presentation of a federal warrant
4. Commanding Officer, presentation of an accusation

3-30. Prisoners as patients categorized under all of the following categories EXCEPT?

1. Family member prisoners
2. Enemy POW and other detained personnel
3. Non-military federal prisoners
4. Military prisoners

3-32. All military prisoners with active sentences are allowed to receive medical care.

1. True
2. False

3-33. Where can the HM locate guidance on care, evaluation, and medico-legal documentation for a victim alleged of rape or sexual assault?

1. NCIS
2. OPNAVINST 1752.1
3. SECNAVINST 5800.11
4. NAVMEDCOMINST 6310.3

3-34. What is the reason many legal battles are lost?

1. Victim refuses to speak out
2. Improper documentation of medical treatment
3. Failure to adhere to proper administrative procedures
4. The many mistakes made by Hospital Corpsman, nurses, and medical providers
ASSIGNMENT 4

Book Assignment: “Medical Records,” pages 4-1 to 4-38

4-1. Custody of health records is generally vested in the medical department. On ships without a medical department representative, an individual retains custody of the record until which of the following times, if any?

1. Transfer
2. Transfer with verification every 6 months
3. Transfer with annual verification
4. Never

4-2. When a member is hospitalized in a foreign nation and the ship departs port, the health record is?

1. Retained on board
2. Turned over to the hospital
3. Forwarded to the nearest U.S. consulate or embassy
4. Turned over to another U.S. vessel in port

4-3. The health record jacket of PO3 Walter T. Door, 333-44-5555, would be what color?

1. Blue
2. Almond
3. Orange
4. Pink

4-4. The health jackets of flag or general officers should be annotated to reflect their rank.

1. True
2. False

4-5. When a HREC is opened on a service member, the member should be directed to read and sign the Privacy Act Statement inside the back cover of the HREC.

1. True
2. False

4-6. Entries to the Chronological Record of Medical Care, SF 600, when not typewritten, should be made in which color(s) of ink?

1. Blue
2. Black or blue-black
3. Red
4. Ink color is irrelevant

4-7. What is the preferred form on which to record admission to the hospital?

1. SF 509, Medical Record-Progress Report
2. SF 600, Chronological Record of Medical Care
3. NAVMED 6150/4, Abstract of Service and Medical History
4. NAVMED 6150/20, Summary of Care

4-8. A health record is opened in which of the following cases?

1. When a member returns to active duty from the retired list
2. When the original record has been lost
3. When first becoming a member of the naval service
4. In all the above cases
4-9.  A well known research group requests medical information to use as part of the basis of a study it is performing. What action, if any, should be taken prior to release?

1. None; an individual’s medical information may not be released
2. Commanding officer of the MTF should release information immediately
3. Commanding officer of the MTF should check with the Judge Advocate General for advice
4. Commanding officer of the MTF should forward the request to BUMED for guidance

4-10. In which of the following circumstances should the health record be verified?

1. Reporting to a new command
2. When transferring
3. Annually
4. All of the above

4-11. Under which of the following circumstances would a member’s health record **NOT** be closed?

1. Transfers to a new duty station
2. Transfers to the Fleet Reserve
3. Placed on the retired list
4. Declared missing in action

4-12. On which of the following documents would a notation be made concerning a member’s status as a deserter?

1. SF600
2. NAVMED 6100/1
3. NAVMED 6150/2
4. Both 1 and 3

4-13. A member separated for disability should receive a copy of the HREC to present to the VA so that the member’s claim can be processed expeditiously.

1. True
2. False

4-14. Which of the following FMP codes will be placed in the two diamonds preceding the SSN for an active duty member?

1. 01
2. 20
3. 30
4. 60

4-15. Which of the following phrases is written in the lower portion of the patient’s identification box for retired 0-7 and above personnel?

1. “VIP”
2. “ADMIRAL”
3. “FLAG/GENERAL OFFICER”
4. “ATTENTION ON DECK”

4-16. Which of the following symbols and which color of felt-tip pen is used in the alert box if the patient has an allergy or sensitivity?

1. “A/S” Black
2. "X” Red
3. “A/S” Red
4. “X” Black
4-17. Which, if any, of the following color felt-tip pens is used to mark the annual verification section on the right-hand side of the dental record jacket?

1. Red
2. Blue
3. Black
4. None of the above

4-18. The form printed on the inside of the front jacket cover should be completed in what type of writing utensil?

1. Pen
2. Pencil
3. Crayon
4. Felt tip pen

4-19. Where is the DD 2005, Privacy Act Statement located in the NAVMED 6150/21-30?

1. Back cover
2. Back of front page (Part I)
3. Back of center page (Part III)
4. Front of center page (Part II)

4-20. Where is the Disclosure Accounting Record located in the NAVMED 6150/21-30?

1. Back cover
2. Back of front page (Part I)
3. Back of center page (Part III)
4. Front of center page (Part II)

For questions 4-21 through 4-29, use the following diagram:

A. SF 600  
B. PHS-731  
C. DD 2766  
D. SF 513  
E. DD 771  
F. EZ603A  
G. EZ603  
H. NAVMED 6600/3  
I. SF 509

4-21. Dental Heath Questionnaire

1. A  
2. D  
3. E  
4. H

4-22. Routinely used for inpatient admission and filed in the IREC.

1. I  
2. B  
3. F  
4. H

4-23. Primary form for all outpatient care

1. G  
2. A  
3. B  
4. C
4-24. Adult Preventive and Chronic Care Flow Sheet
1. I
2. C
3. E
4. F

4-25. Eyewear Prescription
1. E
2. F
3. G
4. A

4-26. Consultation Sheet
1. D
2. B
3. E
4. I

4-27. A member's personal record of immunization
1. A
2. I
3. B
4. C

4-28. Dental Exam Form
1. F
2. G
3. H
4. I

4-29. Dental Treatment Form
1. A
2. C
3. G
4. F

4-30. Dental Exam Forms should be filed in which section of the NAVMED 6150/21-30?
1. Back of center page (Part III)
2. Front of center page (Part II)
3. Inside back cover (Part IV)
4. Inside front cover (Part I)

4-31. Where is the Forensic Examination form located in the NAVMED 6150/21-30?
1. Inside back cover (Part IV)
2. Back of front page (Part I)
3. Back of center page (Part III)
4. Front of center page (Part II)

4-32. The most current Dental Treatment Form, EZ603A is filed in which section of the NAVMED 6150/21?
1. Back cover
2. Front cover
3. Inside back cover (Part IV)
4. Inside front cover (Part I)

4-33. When using the terminal digit filing system, how many equal sections are the central files divided into?
1. 100
2. 200
3. 300
4. 50

4-34. All forms documenting patient care placed in the NAVMED 6150-21/30 will contain which of the following patient information?
1. FMP and sponsor’s SSN
2. Name- last, first, middle initial
3. Sponsor’s branch of service and status
4. All of the above
4-35. Which of the following NAVMED Forms is the Health Record Receipt?

1. NAVMED 6150/1
2. NAVMED 6150/6
3. NAVMED 6150/7
4. NAVMED 6150/8

4-36. Sequential bitewing radiographs should be filed in which section of the NAVMED 6150/21-30?

1. Back of center page (Part III)
2. Front of center pager (Part II)
3. Inside back cover (Part IV)
4. Inside front cover (Part I)

4-37. What is the maximum time allowed for the retention of loose treatment forms?

1. 3 months
2. 6 months
3. 1 year
4. 2 years
ASSIGNMENT 5

Book Assignment: “Medical Logistics,” pages 5-1 to 5-30

5-1. Where would the HM locate the policies and guidance for operating and managing procedures of supply departments and activities?

1. NAVSUP 485
2. OPNAVINST P-485
3. NAVMEDCOMINST 4850
4. NAVSUP P-485

5-2. The agreement to a contract with a vendor without the appropriate level of authority is also known as?

1. Commitment
2. Obligation
3. Unauthorized commitment
4. Ratification

5-3. When a requisition exceeds the current competitive threshold, the HM must receive quotes from how many additional vendors?

1. 1
2. 2
3. 3
4. 4

5-4. Any item that has an application and appears on APL, SNSL, ISL, or Naval Ship Systems Command is known as what?

1. Consumable
2. Non-consumable
3. Repair part
4. Standard stock item

5-5. How many digits are included in the Federal Supply Classification?

1. 4
2. 3
3. 2
4. 1

For questions 5-6 and 5-7 use the following diagram:

<table>
<thead>
<tr>
<th>6515</th>
<th>—</th>
<th>00</th>
<th>—</th>
<th>123</th>
<th>—</th>
<th>4567</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Select from the diagram above the numbers that best fits the classification.

5-6. Federal Supply Classification

1. A
2. B
3. C
4. D

5-7. National Codification Bureau Code

1. A
2. B
3. C
4. D

5-8. The sum total of the operating level and safety level is also known as what?

1. Requisitioning objective
2. Supply Level
3. Stockage objective
4. Operating level

5-9. A Controlled Substance Inventory is conducted how often?

1. Weekly
2. Monthly
3. Annually
4. Bi-annually
5-10. The end user must complete all of the following EXCEPT upon receipt of items?

   1. Sign
   2. Date
   3. Circle Amount
   4. Place a check by each item received

5-11. What is the most common receipt document that is encountered?

   1. DD 200
   2. DD 1348
   3. DD 1348-1
   4. DD 1200

5-12. When the HM encounters a shipping or packaging discrepancy on behalf of the shipper, the HM should submit a?

   1. Discrepancy report
   2. DD 365
   3. Report of Discrepancy
   4. DD 374

5-13. A ROD is submitted on what form?

   1. DD 364
   2. NAVMED 3640
   3. NAVSUP 364
   4. SF 364

5-14. The first in, first out method is the process of issuing items to the first person that arrives.

   1. True
   2. False

5-15. The first in, first out method is most important when dealing with items that have a shelf life or expiration code.

   1. True
   2. False
ASSIGNMENT 6

Book Assignment: “Human Anatomy and Physiology,” pages 6-1 to 6-122

6-1. When the body is in the anatomical position, the thumbs point?
   1. Medially
   2. Laterally
   3. Anteriorly
   4. Posteriorly

6-2. A person lying on his/her back is in what position?
   1. Prone
   2. Erect
   3. Supine
   4. Lateral recumbent

6-3. The physical and chemical breakdown of the food we eat is called?
   1. Metabolism
   2. Digestion
   3. Anabolism
   4. Catabolism

6-4. The transfer of fluids across the plasma membrane of a cell from an area of higher concentration to an area of lower concentration is a process known as?
   1. Infusion
   2. Diffusion
   3. Perfusion
   4. Osmosis

6-5. Homeostasis is defined as?
   1. Control of bleeding
   2. Absorption, storage, and use of food products
   3. Self-regulated control of the body’s internal environment
   4. The power of voluntary movement

6-6. That portion of a cell containing all the genetic material important in the cell’s reproduction is called the?
   1. Plasma membrane
   2. Nucleus
   3. Cytoplasm
   4. Reticulated endothelium

6-7. The secretion of digestive fluids and the absorption of digested foods and liquids is the chief function of which tissue?
   1. Columnar
   2. Osseus
   3. Sercus
   4. Squamous

6-8. The body’s primary thermo-regulatory action is a function of dilating and contracting blood vessels and the?
   1. Stratum germinativum
   2. Sweat glands
   3. Sebacceous glands
   4. Melanin

6-9. Which of the following are the two most prominent mineral elements of bone?
   1. Ossein and calcium
   2. Phosphorus and calcium
   3. Sodium and phosphorus
   4. Periostium and ossein

6-10. The bones of the wrist are classified as which of the following bones?
   1. Long
   2. Short
   3. Flat
   4. Irregular
6-11. Bones of the cranium include which of the following?
   1. Maxilla
   2. Occipital
   3. Atlas and Axis
   4. All of the above

6-12. The axial skeleton is composed of which two regions of the skeletal system?
   1. Skull and vertebral column
   2. Thorax and upper extremities
   3. Pelvis and thorax
   4. Upper and lower extremities

6-13. The upper three ribs on each side are known as which of the following types?
   1. True
   2. False
   3. Floating
   4. Sternal

6-14. The concavity into which the head of the humerus articulates is called the?
   1. Scapula
   2. Acetabulum
   3. Glenoid fossa
   4. Epicondyle

6-15. The innominate bone is composed of three parts that are united in adults to form a cuplike structure called the?
   1. Glenoid fossa
   2. Acetabulum
   3. Symphysis pubis
   4. Obturator Foramen

6-16. The prominence easily felt on the inner and outer aspects of the ankle are called?
   1. Medial and lateral malleolus
   2. Medial and lateral condyle
   3. Greater and lesser tuberosities
   4. Greater and lesser trochanters

6-17. Bones that develop within a tendon are known as which of the following?
   1. Condyloid
   2. Sesamoid
   3. Veriform
   4. Fasiform

6-18. Moving an extremity away from the body is called?
   1. Flexion
   2. Extension
   3. Abduction
   4. Adduction

6-19. The act of straightening a limb in known as?
   1. Flexion
   2. Extension
   3. Abduction
   4. Adduction
6-20. The primary function of the muscles includes all of the following EXCEPT?

1. Providing heat during activity
2. Maintaining body posture
3. Producing red blood cells
4. Providing movement

6-21. Which of the following properties describes the ability of muscles to respond to a stimulus?

1. Contractility
2. Irritability
3. Extensibility
4. Tonicity

6-22. The ability of muscles to regain their original form when stretched is known as?

1. Contractility
2. Elasticity
3. Extensibility
4. Tonicity

6-23. Actin and myosin are two protein substances involved in?

1. Muscle recovery
2. Muscle nourishment
3. Muscle contraction
4. Rigor mortis

6-24. If a generally sedentary person in less than good physical health enters a marathon with the intent to complete the race, which of the following outcomes can he/she be expected to encounter?

1. If the day is cool, there will be no significant risk
2. Any physical deficiency can be overcome with a carbohydrate-rich diet before the race
3. If stretching exercises are performed before the race, he/she will be ok
4. He/she runs the risk of muscle damage

6-25. Intramuscular injections are frequently given in which of the following muscles?

1. Trapezius
2. Pectoralis majoris
3. Deltoid
4. All of the above

6-26. Intramuscular injections are usually given in which of the following muscles?

1. Quadriceps
2. Sartorius
3. Gastrocnemius
4. Gluteus maximus

6-27. The total blood volume in the average adult is in what range?

1. 3 to 4 liters
2. 4 to 5 liters
3. 5 to 6 liters
4. 6 to 7 liters
6-28. A decreased red blood cell (RBC) count could be the result of a medical condition affecting the?

1. Compact bone
2. Periosteum
3. Yellow marrow
4. Red marrow

6-29. A white blood cell (WBC) count of 18,000 may indicate what condition?

1. Leukocytosis
2. Normalcy
3. Infection
4. Vetiligo

6-30. In an accident victim suffering from a fibrinogen deficiency, the rescuer may have difficulty performing which of the actions listed below?

1. Controlling hemorrhage
2. Immobilizing a fracture
3. Supporting respiratory function
4. Reducing a dislocation

6-31. In addition to preventing excessive blood loss, the formation of a blood clot serves which, if any, of the following purposes?

1. To convert fibrinogen into blood serum to aid healing
2. To form the foundation for new tissue growth
3. To manufacture leukocytes
4. None of the above

6-32. The valves of the heart include all of the following EXCEPT?

1. Atrial
2. Mitral
3. Vagus
4. Pulmonary

6-33. Oxygenated blood is carried by which of the following vein(s)?

1. Inferior vena cava
2. Superior vena cava
3. Portal
4. Pulmonary

6-34. The contraction phase of the heart is?

1. Systole
2. Tension
3. Diastole
4. Active

6-35. The pulse pressure is the difference between which of the following measurement?

1. Venous and arterial pressure
2. Resting and active pulse rate
3. Arterial and ventricle pressure
4. Systole and diastole

6-36. The venous system that carries digested materials from the intestinal tract is called the?

1. Portal
2. Pulmonary
3. Abdominal
4. Pelvic

6-37. Lymph nodes participate in all of the following functions EXCEPT?

1. Manufacture of the white blood cells
2. Filtration of bacterial debris
3. Production of hormones
4. Collection of large protein molecules
6-38. Windpipe is another term for?
1. Nares
2. Larynx
3. Trachea
4. Pharynx

6-39. The primary muscle of respiration is known as the?
1. Pleura
2. Alveolus
3. Diaphragm
4. Mediastinum

6-40. Of the following nerves, which, if any, controls the larynx during the process of breathing?
1. Phrenic
2. Intercostal
3. Vagus
4. None of the above

6-41. A nerve, cell, or neuron is composed of all of the following EXCEPT a/an?
1. Synapse
2. Axon
3. Perikaryon
4. Dendrite

6-42. The impulse receptors of a nerve are called?
1. Dendrites
2. Schwann cells
3. Ganglia
4. Neurons

6-43. The space through which a nerve impulse passes from one neuron to another is called a/an?
1. Myelin sheath
2. Synapse
3. Axon
4. Ganglion

6-44. Balance, coordination or movement, and harmony of motion are functions of what part of the brain?
1. Cerebral cortex
2. Cerebellum
3. Pons
4. Temporal lobe

6-45. Circulation and respiration are controlled primarily from what area of the brain?
1. Medulla
2. Pons
3. Cerebral cortex
4. Cerebellum

6-46. The meninges, which cover the outer portion of the brain and spinal cord are composed of all the following EXCEPT?
1. Dura mater
2. Pia mater
3. Arachnoid membrane
4. Foramen magnum

6-47. In what part of the body is cerebral spinal fluid produced?
1. Central Ventracles
2. Spinal cord
3. Meninges
4. Medulla Oblongota
6-48. The 12 pairs of cranial and 31 pairs spinal nerves form what nervous system?

   1. Peripheral
   2. Central
   3. Autonomic
   4. Sympathetic

6-51. This nerve receives sensory input from the face.

   1. E
   2. F
   3. J
   4. K

6-52. The autonomic nervous system is composed of two main divisions.

   1. Pons and medulla oblongata
   2. Voluntary and involuntary systems
   3. Sympathetic and parasympathetic systems
   4. Central and peripheral systems

6-53. Conservation and restoration of energy are the result of nerve impulses arising from which, if any, of the following nervous systems?

   1. Sympathetic
   2. Parasympathetic
   3. Voluntary
   4. None of the above

6-49. This nerve controls the muscles of the tongue.

   1. E
   2. F
   3. I
   4. L

6-54. Increased heart rate.

   1. A
   2. B
   3. C
   4. D

6-50. This nerve allows you to stick out your tongue.

   1. D
   2. G
   3. J
   4. L

6-55. Select the cranial nerve that that performs the function given.

   For questions 6-50 through 6-52, use the following diagram:

   A. Olfactory
   B. Occulor
   C. Occulomotor
   D. Troclear
   E. Trigeminal
   F. Abduens
   G. Facial
   H. Vastibulocochlear
   I. Glossopharyngeal
   J. Vagus
   K. Spinal Accessory
   L. Hypoglossal

   Select the cranial nerve that that performs the function given.

   6-49. This nerve controls the muscles of the tongue.

       1. E
       2. F
       3. I
       4. L

   6-50. This nerve allows you to stick out your tongue.

       1. D
       2. G
       3. J
       4. L
6-55. Visual Acuity
   1. A  
   2. B  
   3. C  
   4. D

6-56. Decreases heart rate to within normal limits
   1. A  
   2. B  
   3. C  
   4. D

6-57. Reflex arc
   1. A  
   2. B  
   3. C  
   4. D

6-58. Hormones secreted by the endocrine system are?
   1. Secreted directly into the gland, tissue, or organ it influences 
   2. Directed to the gland, tissue, or organ by a duct system 
   3. Secreted into the circulatory system 
   4. Typically produced in large quantities

6-59. The overproduction of which hormone leads to acromegaly?
   1. Somatotropin  
   2. Oxytocin  
   3. Gonadotropin 
   4. Thyroxin

6-60. Which of the following diseases is characterized by a deficiency of the antidiuretic hormone?
   1. Myxedema  
   2. Diabetes insipidus 
   3. Hyperthyroidism  
   4. Addison’s disease

6-61. An insufficient secretion of thyroxin is characterized by all of the following EXCEPT?
   1. Weight gain 
   2. Fatigue  
   3. Profuse sweating  
   4. Slowed heart rate

6-62. Calcium levels in the blood are controlled by which of the following hormones?
   1. Thyroxin  
   2. Vasopressin 
   3. Oxytocin 
   4. Parathormone

6-63. Electrolyte balance is a function of the hormone produced by the?
   1. Posterior lobe of the pituitary gland 
   2. Anterior lobe of the pituitary gland 
   3. Cortex of the adrenal gland 
   4. Medulla of the adrenal gland

6-64. A metabolic response to epinephrine includes which, if any, of the symptoms listed below?
   1. Decreased heart rate  
   2. Increased blood pressure  
   3. Respiratory distress  
   4. None of the above
6-65. What hormone is produced by the alpha cells of the islands of Langerhans in the pancreas?

1. Glucagon
2. Insulin
3. Norepinephrine
4. Androgens

6-66. The cornea is part of the protective outer layer of the eye called the?

1. Sclera
2. Conjunctiva
3. Choroid
4. Crystalline body

6-67. The inner part of the eye derives its dimensional nourishment primarily from what vascular tissue?

1. Conjunctiva
2. Sclera
3. Vitreous humor
4. Choroid

6-68. Dilation of the pupil, a muscular response of the iris, normally occurs as a result of what?

1. Increased intensity of light
2. Decreased intensity of light
3. Irritation to the sclera
4. Irritation to the conjunctiva

6-69. Of the elements listed below, which makes seeing in the dark possible?

1. Rods
2. Cones
3. Iris
4. Choroid

6-70. By what process is three-dimensional vision produced?

1. Accommodation
2. Convergence
3. Refraction
4. Stimulation

6-71. The mechanical transmission of sound from the tympanic membrane to the inner ear is a function of which of the following?

1. Auditory ossicles
2. Eustachian tubes
3. Bony labyrinth
4. Organ of corti

6-72. What structure(s) of the inner ear provide(s) neural stimuli used to maintain equilibrium?

1. Fenestra rotunda
2. Fenestra ovalis
3. Semicircular canals
4. Organ of corti

6-73. The conversion of mechanical impulses (sound waves) to neural impulses that can be interpreted by the brain is a function of the ______?

1. Endolymph
2. Semicircular canals
3. Organ of Corti
4. Fenestra ovalis

6-74. The enzymatic action of amylase results in the chemical breakdown of ______?

1. fats to fatty acids
2. starches to fats
3. starches to complex sugars
4. proteins to complex sugars
6-75. Absorption of food occurs predominantly in which of the following areas of the intestines?

1. Small intestines
2. Large intestines
3. Mouth
4. Stomach

6-76. Of these listed below, which function as the accessory organs of digestion for the small intestines?

1. Pancreas, liver, and villae
2. Spleen, liver, and gallbladder
3. Pancreas, pylorus, and spleen
4. Pancreas, liver, and gallbladder

6-77. The gallbladder performs which of the following purposes?

1. Stimulates the production of insulin
2. Stores bile
3. Metabolizes sugars
4. Produces antibodies

6-78. The functional unit of the kidney is called the?

1. Nephron
2. Malpighian body
3. Glomerulus
4. Loop of Henle

6-79. Which of the following is/are (a) function(s) of the kidneys?

1. To maintain acid-base balance
2. To remove excess waste from the blood
3. Formation of urine
4. All of the above

6-80. What is the approximate total capacity of the adult bladder?

1. 250 ml
2. 300 ml
3. 600 ml
4. 750 ml

6-81. Testosterone production is a function of which of the following glands?

1. Cowper’s
2. Prostate
3. Testes
4. Bulbourethral

6-82. Which of the following is/are considered the primary female reproductive organs?

1. Ovaries
2. Fallopian tubes
3. Uterus
4. Endometrium

6-83. Fertilization of an ovum normally takes place in the?

1. Ovaries
2. Fallopian tubes
3. Uterus
4. Vagina

6-84. The limitations imposed upon a healthcare provider are based on local regulations and which of the following elements?

1. The rating’s occupational standards
2. The rate training manual
3. The provider’s training and experience
4. All of the above
<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
</table>
| 7-1. Dental development usually begins in which week of prenatal life?  | 1. Fourth  
2. Fifth  
3. Sixth  
4. Either 2 or 3                                    |
| 7-2. How many total tooth buds are present in the prenatal maxillary and mandibular arch? | 1. 32  
2. 20  
3. 15  
4. 10                                    |
| 7-3. What is the name of the last period of tooth growth?              | 1. Histodifferentiation  
2. Morphodifferentiation  
3. Eruptodifferentiation  
4. Both 2 and 3                                    |
| 7-4. How many years does it take permanent teeth to emerge after crown completion? | 1. One  
2. Two  
3. Three  
4. Four                                    |
| 7-5. When primary teeth get ready to fall out and make way for the eruption of permanent teeth, what is the name of this process? | 1. Exposure  
2. Histology  
3. Infoliation  
4. Exfoliation                                    |
| 7-6. The part of the crown that is visible in the mouth is known by which of the following terms? | 1. Clinical crown  
2. Clinical tooth  
3. Clinical enamel  
4. Clinical exposure                                    |
| 7-7. What is the name of the region where the roots separate?          | 1. Apex  
2. Furcation  
3. Bifurcated  
4. Trifurcated                                    |
| 7-8. The tip of each root is known by which of the following terms?    | 1. End  
2. Arch  
3. Angle  
4. Apex                                    |
| 7-9. When there is a slight indentation that encircles the tooth and marks the junction of the crown with the root, it is known by which of the following terms? | 1. Bifurcation  
2. Cervical line  
3. Clinical line  
4. Junction line                                    |
| 7-10. Enamel is formed by what type of epithelial cells?               | 1. Ameloblasts  
2. Dentinoenamel  
3. Petticoat  
4. Enamel                                    |
7-11. What is the chief function of the pulp?
1. Provides feeling to the tooth
2. Formation of cementum
3. Formation of dentin
4. Formation of enamel

7-12. What portion of the maxilla and mandible are teeth embedded?
1. Alveolar process
2. Alveolus
3. Socket
4. Root

7-13. When viewed by a radiograph, the trabecular bone will have what type of an appearance?
1. Spongy-like
2. Wavy-like
3. Plate-like
4. Web-like

7-14. A tooth is suspended in its socket by what ligament?
1. Lamina dura
2. Masticatory
3. Periodontal
4. Alveolar

7-15. The oral mucosa consists of how many total types of mucosa?
1. One
2. Two
3. Three
4. Four

7-16. The hard palate is covered with what type of mucosa?
1. Masticatory
2. Specialized
3. Lining
4. Rugae

7-17. What is the term given to the portion of gingiva that extends from the gingival crest to the crest of the bone?
1. Gingival margin
2. Unattached gingiva
3. Attached gingiva
4. Gingival sulcus

7-18. What area is the first to show symptoms of gingivitis?
1. Interdental papilla
2. Muco-gingival junction
3. Epithelial attachment
4. Gingival margin

7-19. What area prevents food from packing between the teeth?
1. Interdental papilla
2. Muco-gingival junction
3. Epithelial attachment
4. Gingival margin

7-20. What type of tissue is found on the inside of the lips, cheeks, vestibule, soft palate, and under the tongue?
1. Lining mucosa
2. Inter mucosa
3. Soft mucosa
4. Gingiva
7-21. How many dental quadrants are in the mouth?

1. One
2. Two
3. Three
4. Four

7-22. How many primary teeth are there in a normal deciduous mouth?

1. 30
2. 20
3. 16
4. 12

7-23. Which of the following reasons affect how teeth are formed?

1. Cutting
2. Tearing
3. Grinding
4. All of the above

7-24. What type of shape does the lingual surface of an incisor have?

1. Axe
2. Rake
3. Shovel
4. Angled

7-25. Cuspids are designed to perform what type of function?

1. Cutting and tearing
2. Cutting and grinding
3. Crushing and holding
4. Chewing and grinding

7-26. What is the name of the system that is used by the armed forces to identify teeth?

1. Universal location
2. Universal positioning
3. Universal numbering
4. Universal selection

7-27. Primary teeth are identified by which letters of the alphabet?

1. A to W
2. A to V
3. A to U
4. A to T

7-28. The mesial surface of a tooth is located in which area?

1. Closest to midline of the arch
2. Toward the cheeks
3. Toward the tongue
4. Away from the midline of the arch

7-29. The distal surface of a tooth is located in which area?

1. Closest to the midline of the arch
2. Toward the cheeks
3. Toward the tongue
4. Away from the midline of the arch

7-30. A tooth has how many proximal surfaces?

1. One
2. Two
3. Three
4. Four
7-31. **The inter-proximal space is occupied by what type of anatomy?**
1. Embrane
2. Interdental klingons
3. Interdental papilla
4. Interdental contact

7-32. **The anteroposterior curve is referred to by what term?**
1. Curve of Koffax
2. Curve of Wilson
3. Curve of Splee
4. Curve of Spee

7-33. **If a patient’s profile is characterized as “normal,” it is a class ____ Angle.**
1. I
2. II
3. III
4. IV

7-34. **The mesial margin of a maxillary central incisor meets the incisal edge at almost what degree angle?**
1. 30
2. 90
3. 110
4. 180

7-35. **What are the first permanent teeth to erupt?**
1. Maxillary lateral incisor
2. Maxillary central incisor
3. Mandibular lateral incisor
4. Mandibular central incisor

7-36. **What is the term used to describe the appearance of a mandibular first bicuspid?**
1. Bell-ringer
2. Bell-crowned
3. Bell-cusp
4. Bell-shaped

7-37. **What tooth will have a fifth cusp on it?**
1. Maxillary first molar
2. Maxillary second molar
3. Mandibular first molar
4. Mandibular second molar

7-38. **What dental anatomy has a rounded or angular depression of varying sizes found on the surface of a tooth?**
1. Groove
2. Fossa
3. Cusp
4. Pit

7-39. **What is the name of the dental anatomy that has small, rounded projections of enamel from the incisal edges of newly erupted anterior teeth?**
1. Oblique ridge
2. Cusp ridge
3. Groove
4. Mamelons
ASSIGNMENT 8
Book Assignment: “Oral Pathology,” pages 8-1 to 8-14

8-1. Which of the following conditions does the science of Oral Pathology **NOT** treat?

1. Nature of the disease
2. Surgical procedures
3. Causes of the disease
4. Development of the disease

8-2. Who is responsible for informing a patient when an oral disease is found?

1. Dental Technician
2. Advanced Dental Technician
3. Dental Officer
4. Both 2 and 3

8-3. About how many milliliters (ml) of saliva do the salivary glands secrete on a daily basis?

1. 150 ml
2. 750 ml
3. 1500 ml
4. 1750 ml

8-5. May be caused by biting, denture irritation, toothbrush injury, viruses, or other irritants.

1. C
2. D
3. E
4. G

8-6. A round pinpoint non-raised, lesion with purplish-red spots.

1. C
2. E
3. F
4. G

8-7. A local collection of blood that escaped from blood vessels because of trauma.

1. A
2. E
3. F
4. G

8-8. A small elevation that contains fluid.

1. A
2. B
3. C
4. D

8-9. Large, purplish-red areas caused by blood under the skin or mucosa.

1. A
2. E
3. F
4. G

For questions 8-4 through 8-10, use the following diagram:

A. Abscess
B. Cyst
C. Ulcers
D. Vesicles
E. Hematoma
F. Petechiae
G. Ecchymoses

8-4. An enclosed pouch or sac that contains fluid or semi-solid material.

1. A
2. B
3. C
4. E
8-10. Commonly caused by a bacterial infection.

1. A
2. C
3. E
4. F

8-11. When dental caries first appear on enamel, what is that appearance?

1. A chalky white spot
2. A small brown spot
3. A hollowed out hole
4. All of the above

8-12. What type of bacteria has been linked to tooth decay?

1. Staphylococcus
2. Proteus
3. Streptococci
4. Micrococcus

8-13. Recurrent caries will occur in a tooth in which of the following circumstances?

1. Trapped air pockets
2. Sealed margins
3. Leaky margins
4. All of the above

8-14. Pit and fissure caries develop in what area of a tooth?

1. Depressions
2. Pulp chamber
3. Smooth surfaces
4. Proximal surfaces

8-15. Smooth surface caries develop in what area of a tooth?

1. Depressions
2. Pulp chamber
3. Incisal third
4. Proximal surfaces

8-16. Pulpalgia commonly occurs after which of the following procedures has been performed on a tooth?

1. Extraction
2. After a restoration
3. Before a restoration
4. After placement of gutta-percha

8-17. Which of the following definitions best describes pulpitis?

1. Restoration of the dental pulp
2. Inflammation of the restoration
3. Inflammation of the dental pulp
4. Periapical abscess of the dental pulp

8-18. If a periapical abscess is left untreated, in what area of a tooth will bone loss occur?

1. Apex
2. Pulp
3. Crown
4. Both 2 and 3

8-19. Dead pulpal tissue will decompose and produce which of the following results?

1. Secondary dentin
2. Secondary pulp tissue
3. Toxins
4. Fistula
8-20. What chronic disease is the most prevalent in mankind?

1. Periapical
2. Periodontal
3. AIDS
4. HIV

8-21. Marginal gingivitis usually starts in which of the following areas?

1. Sulcus
2. Front teeth
3. Periodontal pockets
4. Tips of the papillae

8-22. The ulceration of the gingival crest in NUG results in what type of an appearance?

1. Punched-out
2. Stippling
3. Swollen
4. Torn

8-23. When periodontitis progresses, the gingival tissues will appear as what color?

1. Dark red
2. Bluish red
3. Bluish yellow
4. Grayish white

8-24. During pocket formation, what type of projections of calculus form between the teeth?

1. Shelf-like
2. Bone-like
3. Crystal-like
4. Smooth-like

8-25. The gingiva surrounding a periodontal abscess will have which of the following appearances?

1. Red and hard
2. Hollow and swollen
3. Bleeding and swollen
4. Inflamed and swollen

8-26. Recurrent aphthous stomatitis are lesions of what type?

1. Ulcers
2. Abscesses
3. Blisters
4. Neoplasms

8-27. What type of herpes simplex virus is most commonly diagnosed in oral pathology?

1. HSV-1
2. HSV-2
3. HSV-3
4. HSV-4

8-28. Recurrent herpes simplex lesions that affect routine dental treatment should be rescheduled for what period of time?

1. 2-3 days
2. 3-6 days
3. After the active phase
4. Before the active phase

8-29. Which of the following oral manifestations are a sign of HIV infection?

1. Candidiasis
2. Hairy leukoplakia
3. Kaposi’s sarcoma
4. All of the above
8-30. What are the two types of neoplasms that can be diagnosed in oral cancer?

1. Neo-carcinoma and malignant
2. Benign and malignant
3. Benign and neo-carcinoma
4. HSV-1 and HSV-2

8-31. The growth or spread of malignant tumors from one area to another is known by which of the following conditions?

1. Transdermal
2. Transfusion
3. Transferism
4. Metastasis

8-32. The area where the user of smokeless tobacco develops an oral precancerous lesion, is defined as what type of pathology?

1. Sportsman’s dipper keratosis
2. Snuff-dipper’s keratosis
3. Farmers lesions
4. Leuko-keratosis

8-33. When does a congenital disorder occur?

1. At death
2. After birth
3. At birth
4. Before birth

8-34. What condition must exist for an impaction to occur?

1. Missing deciduous teeth
2. Abnormal position
3. Physical barrier
4. All of the above

8-35. Which of the following conditions causes attrition?

1. Breakdown of enamel, dentin, and cementum
2. Wear involving teeth against teeth
3. Large tooth crowns
4. Bulimia

8-36. Which disorder affects patients with Bulimia?

1. Erosion
2. Attrition
3. Abrasion
4. Impaction
9-1. A ____ is any animal capable of transmitting pathogens or producing human or animal discomfort or injury.

1. Pest
2. Pathogen
3. Vector
4. Virus

9-2. The findings of food-service inspections are documented on what form?

1. NAVMED P-5010
2. NAVMED 6240/1
3. SECNAVINST 4060.1
4. NAVMED P-5038

9-3. What instruction sets the standard for drinking water for U.S. Naval establishments both ashore and afloat?

1. NAVMED P-5010
2. BUMEDINST 6280.A
3. NAVMED P-117
4. BUMEDINST 6240.1

9-4. The medical departments aboard ships are not required to include ice samples in any bacteriological analyses performed on water.

1. True
2. False

9-5. ____ are instruments that frequently contact mucous membranes, but cannot be sterilized because of their design or inability to withstand heat.

1. Semicritical items
2. Unit Dose
3. Pre Vacuum Sterilizer
4. Critical items

9-6. Spray-Wipe-Spray is ____.

1. A way to sterilize instruments
2. Proper dinner etiquette
3. An acceptable method of cleaning and disinfecting
4. How to apply insect repellant

9-7. When should the HM wash his/her hands?

1. At the beginning of the day
2. Before handling food
3. Between patients
4. All of the above

9-8. What is NOT a characteristic of resident flora?

1. Can survive and multiply on the skin
2. Can be cultured repeatedly from the skin
3. Are not firmly attached to the skin
4. Are usually of low virulence

9-9. What type of hand washing agent usually has 4 percent isopropyl alcohol in a sudsy base?

1. Idophors
2. Bleach
3. Chlorhexidine Gluconate
4. Chlorine
9-10. When the HM is preparing for a surgical case, what is the maximum length of the fingernail?

1. ¼ inch
2. 1 ½ inches
3. No longer than the tips of the fingers
4. The cuticle

9-11. What type of gloves are the highest quality and best fitting?

1. Examination gloves
2. Nitrile gloves
3. Procedural gloves
4. Sterile gloves

9-12. Where can clinical apparel be worn?

1. In the MTF/DTF only
2. Can go into stores for gas and emergency situations
3. Only on base
4. Can be worn home only if they are washed every night

9-13. Protective eyewear must have slotted splash shields to provide maximum protection.

1. True
2. False


1. Airborne
2. Droplet
3. Contact
4. All the above

9-15. What type of mask should be worn when in contact with a patient diagnosed with Tuberculosis?

1. Surgical mask
2. Cone mask
3. N95 respirator
4. M-15 Gas mask w/ canister

9-16. What Transmission-based Precaution requires a negative air pressure room?

1. Airborne
2. Droplet
3. Contact
4. All the above

9-17. What does the acronym MRSA stand for?

1. Methaline Resilient Sterilizer Antiseptic
2. Methicillin-Resistant Staphylococcus Aureus
3. Myopic Rutherford’s Sanitation Amalgam
4. Medical Really Sounds Awesome

9-18. What personal protective equipment item is not necessarily worn while treating a patient under Contact Precautions?

1. Gloves
2. Disposable gown
3. Mask
4. None of the above

9-19. What Transmission-based Precaution requires limited transport **EXCEPT** for essential purposes?

1. Airborne
2. Droplet
3. Contact
4. All the Above
9-20. What are daily measures taken to control the spread of pathogenic organisms?

1. Portal of exit
2. Concurrent Disinfection
3. Reservoir of infectious agents
4. Susceptible host

9-21. In a DTR, at the beginning of the day, the unit water lines and hoses should be flushed for how long?

1. 5 minutes
2. 1 hour
3. 1 minute
4. 30 seconds

9-22. For equipment that is difficult to clean, what should be done before using it on a patient?

1. Spray-Wipe Spray
2. A sterile or clean drape
3. Sterilize
4. Wet-vac

9-23. To perform hand piece maintenance on dental hand pieces the HM should remove hand pieces, lubricate, and then run them for how long?

1. 3 minutes
2. 1 minute
3. 30 seconds
4. 5 minutes

9-24. Which one of these choices should be placed in a Biohazardous waste receptacle?

1. Wet towel
2. Urine soaked sheets
3. Used I.V. catheter
4. Sterile gear wrapper

9-25. While in the process of doing a minor procedure the HM’s glove is punctured by a suture and it breaks the skin, should the HM report it to occupational health?

1. No, because it’s a minor procedure
2. Yes, any puncture injury with possible contaminated fluid should be reported
3. No, because the patient says he doesn’t have anything
4. Maybe, if I bleed a lot

9-26. Needles, scalpels and sutures should be disposed of in what container?

1. Thick red bag with Biohazard symbol
2. Cardboard box
3. Linen bag
4. Rigid, puncture resistant, red container with a biohazard symbol

9-27. Bed linens, towels, smocks, trousers, and other protective attire are classified as what?

1. Biohazards
2. Ordinary laundry
3. Contaminated laundry
4. OPIM

9-28. What is the term used to describe the sterilization, storage and handling of articles to keep them free of pathogenic organisms?

1. Surgical aseptic technique
2. Spray-wipe-spray
3. Medical asepsis
4. Isolation technique
9-29. What gear must be worn to enter a surgical suite?

1. Scrubs
2. Hair cover
3. Mask
4. All the above

9-30. If a sterile item’s sterility is in question the HM should_____.

1. Keep it if the packages looks undamaged
2. Not use it if there is any question about the sterility
3. Use it on the next patient if the sterility indicator has changed
4. None of the above

9-31. If the surgeon asks for a specific kind of suture in the middle of a surgical case, who should retrieve it?

1. The scrub tech
2. The most junior corpsman
3. The surgeon
4. The circulator

9-32. While gowning the surgeon who is responsible for tying the gown?

1. Scrub tech
2. Circulator
3. Surgeon
4. All of the above
ASSIGNMENT 10

Book Assignment: “Disinfection and Sterilization,” pages 10-1 to 10-22

10-1. Disinfection is a more lethal process than sterilization.
   1. True
   2. False

10-2. Which of the following levels of disinfectants are classified by the EPA?
   1. Low, middle, and high
   2. Low, high, and medium
   3. Maximum, low, and high
   4. Intermediate, high, and low

10-3. What two types of micro-organisms are killed by all three levels of disinfection?
   1. Bacterial spores and nonlipid viruses
   2. Tubercle bacillus and lipid viruses
   3. Lipid viruses and vegetative spores
   4. Lipid viruses and vegetative bacteria

10-4. What are the three factors that influence germicidal procedures?
   1. Bioburden, nature of the material, and organic debris present
   2. Organic debris present, type of sterilizer, and bioburden
   3. Nature of the material, bioburden, and packaging
   4. Bioburden, packaging, and type of sterilizer

10-5. What levels of a glutaraldehyde-based solution are FDA registered?
   1. 2.0-3.2
   2. 2.3-2.0
   3. 1.0-2.0
   4. 2.5-2.6

10-6. What level of a disinfectant and sterilant are glutaraldehyde-based solutions classified?
   1. Medium
   2. High
   3. Low
   4. Both 2 and 3 above

10-7. Which of the following is a disadvantage when using chlorine dioxide-based solutions?
   1. Has a 24-day use life as a sterilant
   2. Does not readily penetrate inorganic debris
   3. Must be discarded daily
   4. All of the above

10-8. Protective eyewear and gloves are not required when using chemical agents.
   1. True
   2. False

10-9. The biocidal activity of iodophors is accomplished with how many minutes of exposure?
   1. 1 to 25
   2. 10 to 25
   3. 15 to 25
   4. 20 to 25

10-10. What level of disinfection are iodophors and phenolics classified?
   1. Intermediate
   2. High
   3. Middle
   4. Low
10-11. All semi-critical category items should receive what level of disinfection?

1. Intermediate
2. High
3. Middle
4. Low

10-12. All noncritical category items require at least what level of disinfection?

1. Intermediate
2. Middle
3. High
4. Low

10-13. What area of the treatment facility is designed for receiving, cleaning, processing, sterilizing, storing, and issuing instruments and equipment?

1. CRS
2. SRC
3. CSR
4. CPR

10-14. Which chart tells CSR personnel the specific order equipment, instruments, and materials are to be processed?

1. Figure eight
2. Functional area
3. Functional flow
4. Functional system

10-15. In what area of the CSR will the disinfection, cleaning, and lubrication of dental handpieces take place?

1. Receiving and cleaning
2. Sterilization
3. Processing
4. Issue

10-16. In what area of the CSR will the HM take contaminated instruments after completion of a patient’s treatment?

1. Issue
2. Receiving
3. Processing
4. Sterile storage

10-17. What cleaning process is safer and more effective than manual scrubbing?

1. Dip tank only
2. Ultrasonic only
3. Automated processor
4. Both 2 and 3 above

10-18. How many sinks are needed to allow personnel to perform the manual scrubbing method?

1. One
2. Two
3. Three
4. Four

10-19. What type of cleaning effect does an ultrasonic cleaner provide?

1. Cavitation
2. Positive
3. Gravity
4. Ion

10-20. For proper operation, the ultrasonic reservoir should be filled to what level with an ultrasonic solution?

1. 2” from the bottom
2. 2” from the top
3. 1/4 to 3/4’s full
4. 1/2 to 3/4’s full
10-21. How often must ultrasonic solutions be changed?

1. Daily only
2. When visibly contaminated only
3. Both 1 or 2 above
4. Monthly

10-22. You should remove instruments from the ultrasonic unit by which of the following means?

1. Your hands
2. Mesh basket
3. Instrument tongs
4. Ultrasonic retriever

10-23. After drying the instrument, what is the next step in the sterilization process?

1. Inspection
2. Packaging
3. Wrapping
4. Storing

10-24. How are hinged instruments arranged during packaging?

1. Top to bottom
2. Open
3. Closed
4. Sideways

10-25. To allow steam to circulate freely, how should packs be wrapped?

1. Open
2. Tight
3. Loosely
4. Together

10-26. The period during which sterilized items are considered safe for use is known by which of the following terms?

1. Safe zone
2. Event-rotated shelf life
3. Expiration date only
4. Both 2 and 3 above

10-27. What type of related shelf life presumes continued sterility until the package is damaged, wet, or torn?

1. Pack
2. Time
3. Event
4. Damaged

10-28. What type of related shelf life presumes that after the expiration date the item is considered outdated and should not be used?

1. Pack
2. Time
3. Event
4. Damaged

10-29. What is the shelf life for nonwoven blue wrap using the time-related method?

1. Indefinite
2. 635 days
3. 365 days
4. 30 days

10-30. What occurs when freshly sterilized items are placed on metal or cold surfaces?

1. Contamination
2. Become oily
3. Nothing
4. Stick
10-31. When storing sterilized items, how should they be arranged?
   1. Alphabetically
   2. Expiration, with later dates toward the front
   3. Expiration, with later dates toward the rear
   4. Contents only, with later dates toward the front

10-32. At what temperature are all known organisms killed?
   1. 150°F
   2. 121°F
   3. 220°F
   4. 250°F

10-33. A steam sterilizer may be referred to by what other name?
   1. Old rusty
   2. Autoclave
   3. Autosteam
   4. Dry heat

10-34. When placing packages in a sterilizer, how are they placed?
   1. On the edges
   2. On the top
   3. In middle
   4. On the bottom

10-35. What type of sterilizer was designed to overcome the trapping of air in the chamber?
   1. Air-free
   2. Dry heat
   3. Chemical vapor
   4. Prevacuum steam

10-36. What is the least expensive form of heat sterilization?
   1. Air free
   2. Dry heat
   3. Chemical
   4. Gravity displacement

10-37. All Navy prevacuum sterilizers will be tested how often using a Bowie- Dick type test?
   1. Quarterly
   2. Monthly
   3. Weekly
   4. Daily

10-38. How often is the interior of a steam sterilizer cleaned before heating?
   1. After each use
   2. Daily
   3. Monthly
   4. After every 5 cycles

10-39. What is the typical standard dry heat cycle?
   1. 90 minutes at 320 - 345°F
   2. 90 minutes at 345°C
   3. 90 minutes at 300°F
   4. 90 minutes at 375°F

10-40. What percent of water content, if any, occurs with chemical vapor sterilization?
   1. 10
   2. 15
   3. 30
   4. None of the above
10-41. Instruments being sterilized in the STERRAD do not need to be completely dry.

1. True
2. False

10-42. What type of sterilization is STERRAD?

1. Prevacuum
2. Gravity
3. Sterris
4. Plasma

10-43. What type of sterilization indicator will change color upon short exposure to sterilizing conditions such as steam, dry heat, or chemical vapor?

1. Internal
2. Incubator type
3. Biological
4. Both 1 and 2

10-44. What type of sterilization monitor will assess whether sterilization actually occurred?

1. Internal
2. External
3. Universal
4. Biological

10-45. What is the first step to be performed when positive biological monitoring occurs?

1. Notify biomedical repair personnel
2. Notify commanding officer
3. Notify ICO
4. Notify CO
ASSIGNMENT 11

Book Assignment: “Fundamentals of Patient Care,” pages 11-1 to 11-14

11-1. The concepts of health include?
   1. The absence of disease or disability
   2. Soundness of mind, body, and spirit
   3. Both 1 and 2 above
   4. A feeling of euphoria

11-2. Patient rights and responsibilities are standards addressed by what organization?
   1. Commander, Navy Medical Command (formerly Bureau of Medicine and Surgery)
   2. American Medical Association (AMA)
   3. The Joint Commission (TJC)
   4. National League of Nursing (NLN)

11-3. The standard of practice limitations imposed upon a healthcare provider are based on local regulations and which of the following elements?
   1. The rating’s occupational standards
   2. The rate training manual
   3. The provider’s training and experience
   4. All of the above

11-4. In the healthcare field, accountability means that providers ________.
   1. Are held responsible for their actions
   2. Must continue their education in the healthcare field
   3. Provide the best healthcare possible
   4. All the above

11-5. A patient requests the HM’s advice concerning the care they are undergoing. Which, if any, of the following is the appropriate response?
   1. Answer honestly, to the best ability possible
   2. Refer the patient to the nurse or physician responsible for the care
   3. Say, “I will ask the supervisor”
   4. None of the above

11-6. Personal and medical information learned about a patient as the result of the HM position is privileged and must not be shared with unauthorized individuals.
   1. True
   2. False

For questions 11-7 through 11-9, use the following diagram:

A. Learned and shared behavior patterns and standards
B. How one responds and regards others
C. Inherited characteristics
D. Belief system

Select the Statement that most accurately describes the terms given in the question. Not all statements will be used.

11-7. Interpersonal relations
   1. A
   2. B
   3. C
   4. D
11-8. Culture

1. A
2. B
3. C
4. D

11-9. Race

1. A
2. B
3. C
4. D

11-10. A patient who is a professed atheist is placed on the Very Serious List (VSL) with a poor prognosis for recovery. All of the following actions by the staff are considered appropriate and ethical EXCEPT?

1. Informing the rest of the staff of the patient’s nonreligious beliefs
2. Informing the rest of the staff of the patient’s condition
3. Informing pastoral services (chaplain) of the patient’s condition and nonreligious beliefs
4. Attempting to convince the patient to accept a religious belief

11-11. The communication process takes place only through the written or spoken word.

1. True
2. False

11-12. Communication barriers inhibit the flow of information and may consist of which of the following factors?

1. Hearing impairment
2. Age
3. Education
4. All the above

11-13. The most common cause of ineffective communication and the most difficult obstacle to identify is which of the following barriers?

1. Psychological
2. Physical
3. Psychosocial
4. Spiritual or religious

11-14. In the communication process, listening is a critical skill and can be improved by developing which, if any, of the following attitudes and behaviors?

1. Anticipating what the patient will say
2. Managing distractions
3. Taking notes
4. None of the above

11-15. The purpose of therapeutic communication includes all of the following EXCEPT?

1. Assessing behavior and modifying if appropriate
2. Educating a patient regarding health and health care
3. Providing information on the appropriate clinic for treatment
4. Obtaining information to determine a patient’s illness
For questions 11-16 through 11-19, use the following diagram:

A. Contact point communication
B. Therapeutic communication

Select the term that most aptly applies to the requirement presented.

   1. A
   2. B

11-17. Explaining the necessities and methods of personal hygiene to the parent of a young patient
   1. A
   2. B

   1. A
   2. B

11-19. Directing the patient to the pharmacy to fill a prescription.
   1. A
   2. B

11-20. Which of the following are goals of patient health education?
   1. Promoting patient self-care
   2. Promoting behavior modification
   3. Influencing a patient’s attitude toward health and disease
   4. All the above

11-21. Patient education is the responsibility of ______.
   1. The members of the command education and training department
   2. Only the physician and nurses for the patient
   3. All members of the healthcare team
   4. The outpatient staff and clinic supervisor only

For questions 11-22 through 11-26, use the following diagram:

A. Subjective observations only
B. Objective observations only
C. Both subjective and objective observations

Select the type(s) of observation(s) that most accurately apply(s) to the scenario described in the question.

11-22. In the emergency room, the HM is examining a patient who suddenly vomits and states that he has been feeling nauseous for the past several hours.
   1. A
   2. B
   3. C

11-23. A patient claims to have swallowed many respiratory problems pills and complains of sleepiness and nausea.
   1. A
   2. B
   3. C

11-24. A patient complains of chest pain and has difficulty breathing.
   1. A
   2. B
   3. C
11-25. When picking up a patient’s dinner tray, the HM notices that only the liquids have been consumed at this meal, although the patient has normally eaten full meals before this.

   1. A
   2. B
   3. C

11-26. An EKG performed on a patient is interpreted as normal and the patient’s breathing improves with oxygen therapy

   1. A
   2. B
   3. C
ASSIGNMENT 12

Book Assignment: “Inpatient Care,” pages 12-1 to 12-29

12-1. A medical patient is prescribed therapeutic bed rest primarily for what reason?

1. To inhibit the development of circulatory problems
2. To prevent depression and apathy
3. To prevent further damage to body systems
4. To inhibit the development of respiratory problems

12-2. A health care provider can reasonably expect that all patients admitted for surgical procedures will exhibit which of the following characteristics?

1. Be very demanding
2. Be apathetic and passive
3. Exhibit violent behavior
4. Be fearful and anxious

12-3. SF 522, Request for Administration of Anesthesia and for Performance of Operations and other Procedures, is normally signed by a parent, legal guardian, or spouse EXCEPT when?

1. The patient is able to do so
2. Over 16 years of age but under 18
3. Over 18 years of age but under 21
4. A member of the Armed Forces

12-4. When a regional anesthetic is administered, the patient can expect what effect?

1. Motor, but not sensory perception will diminish
2. Pain will be reduced or eliminated in the body part injected or swabbed
3. Level of consciousness will decline
4. The entire body will become numb

12-5. In general anesthesia, a stimulation of vital signs is evidence of what level of anesthesia induction?

1. Stage 1
2. Stage 2
3. Stage 3
4. Stage 4

12-6. Dropping a metal basin on the operating room floor may cause a violent response from a general anesthesia patient in what stage of anesthesia?

1. Stage 1
2. Stage 2
3. Stage 3
4. Stage 4

12-7. In the immediate postoperative recovery phase, a patient’s skin color may be indicative of all of the following EXCEPT what?

1. The patient’s ability to recover from the anesthetic agent
2. Postoperative hemorrhage
3. Degradation of respiratory function
4. The development of shock

12-8. When permitted, postoperative patients should be encouraged to ambulate to improve the functions of which of the following physiologic systems?

1. Renal system
2. Digestive system
3. Lymphatic system
4. All of the above
12-9. When caring for a young, otherwise healthy orthopedic patient requiring immobilization, the HM can anticipate all of the following **EXCEPT** what?

1. Symptoms of emotional stress
2. Frequent complaints of sore or aching pain
3. Periods of dizziness associated with disorientation
4. Elevated levels of pain

12-10. Unless otherwise directed by the physician, when one is applying a cast to an arm, the patient’s wrists is generally in which of the following positions?

1. Extended about 10 degrees
2. In the neutral position
3. Flexed about 30 degrees
4. In any of the above; specific position is immaterial

12-11. Cane height is measured from the floor to the ______.

1. Hand
2. Hip
3. Top of the femur
4. Wrist

12-12. The cane is used on the unaffected side of the body.

1. True
2. False

12-13. Auxiliary crutches should be fitted so that the patient’s elbows are maintained with a ______ to ______ degree bend.

1. 15 to 30
2. 20 to 30
3. 15 to 25
4. 30 to 45

12-14. When climbing stairs the patient should be taught to go “up with the bad and down with the good.”

1. True
2. False

12-15. Which of the following are safe to walk on with crutches without much thought to safety?

1. Uneven sidewalk
2. Thick carpet
3. Hardwood floor with throw rugs
4. None of the above

12-16. Which ambulatory device provides the most stability?

1. Walkers
2. Canes
3. Quad Cane
4. Crutches

12-17. A patient who has been fitted with a cast should be instructed to return to the medical treatment facility as soon as possible under which of the following circumstances?

1. The cast becomes soiled
2. The extremity affected by the cast is numb
3. The itching becomes unbearable
4. The cast gets wet

12-18. In the theory of death and dying, it is suggested that most people exhibit five stages. The stage where the terminal patient becomes concerned about the state of his or her affairs and family members is known as the stage of ______.

1. Denial
2. Acceptance
3. Bargaining
4. Depression
12-19. Patient falls may be avoided by taking which of the following preventive measures?

1. Proper use of bed/gurney side rails
2. Keeping floors dry and uncluttered
3. Instructing patients on the proper use of walking aids (crutches, canes, etc.)
4. All of the above

12-20. Electrical and electronic equipment poses significant injury hazards. Of the following, which is the authorized means of reducing this hazard?

1. Repairing frayed cords with electrical tape to prevent shock
2. Using personal electronics if the look in good repair
3. Having medical repair perform electrical safety checks on all new equipment
4. Using only two-prong, non-grounded electrical plugs

12-21. Skin contact burns can be caused by ice bags or hypothermia blankets.

1. True
2. False

12-22. During a fire evacuation, which of the following procedures is **NOT** considered appropriate?

1. Immediately remove patients to safety without obtaining proper authority
2. Close all windows and doors
3. Turn off all oxygen equipment not necessary to sustain life
4. Clear all possible exits

12-23. Environmental hygiene is directed toward producing a healthy environment and includes such practices as maintaining unit cleanliness and _______.

1. Providing for adequate ventilation
2. Limiting noise levels
3. Proper disposal of soiled articles
4. All of the above
13-1. What is the leading cause of nutrition related diseases in the environment in which humans live?
   1. Energy balance
   2. Weight gain
   3. Excess calories
   4. Weight loss

13-2. Which of the following is NOT one of the six essential nutrients needed for the growth and maintenance of the body?
   1. Water
   2. Protein
   3. Niacin
   4. Fat

13-3. What are the three nutrients used by the body that contain calories?
   1. Carbohydrates, proteins, and fats
   2. Vitamins, fats, and vitamins
   3. Water, vitamins, and protein
   4. Protein, minerals, and fats

13-4. Water is the medium in which all chemical reactions in the body take place.
   1. True
   2. False

13-5. What is total amount of water that a male needs to consume on a daily basis?
   1. 3 liters
   2. 3.7 liters
   3. 2 liters
   4. 2.7 liters

13-6. What is total amount of water that a female needs to consume on a daily basis?
   1. 3 liters
   2. 3.7 liters
   3. 2 liters
   4. 2.7 liters

13-7. After consuming food a male needs to consume an average of how much free water?
   1. 3 liters
   2. 3.7 liters
   3. 2 liters
   4. 2.7 liters

13-8. What percentage loss of body water will cause heat injury or death?
   1. 60%
   2. 1 to 2%
   3. 3 to 5%
   4. 5 to 7%

13-9. Mono saccharides contain how many carbon molecules?
   1. 1
   2. 2
   3. 3
   4. 4

13-10. Disaccharides contain how many carbon molecules?
      1. 1
       2. 2
       3. 3
       4. 4
13-11. Some polysaccharides are known to contain up to how many carbon molecules?

1. 10
2. Hundreds
3. Thousands
4. Trillions

13-12. What is the simplest type of sugar?

1. Sucrose
2. Glucose
3. Powdered
4. Starch

13-16. Glucose

1. A
2. B
3. C

13-17. Lactose

1. A
2. B
3. C

13-18. Glycogen is the storage form of glucose for humans.

1. True
2. False

13-19. The recommended fiber intake for women is?

1. 17 grams
2. 25 grams
3. 27 grams
4. 35 grams

13-20. The recommended fiber intake for males is?

1. 17 grams
2. 25 grams
3. 27 grams
4. 37 grams

13-21. Dextrose, which is a commonly used carbohydrate, is normally used in what form?

1. Intravenous
2. Oral
3. Subcutaneous
4. Intramuscular
13-22. Proteins contain what amount of calories per gram?

1. 2
2. 3
3. 4
4. 5

13-23. There are 20 amino acids that make up all the proteins the body needs, how many of those are considered essential amino acids not made by the body?

1. 8
2. 9
3. 10
4. 11

13-24. For a person who weighs 185 lbs, what is the recommended amount of protein that should be consumed daily?

1. 67 grams
2. 68 grams
3. 69 grams
4. 70 grams

13-25. Infants and children require a greater daily protein intake then adults.

1. True
2. False

13-26. The main role of fats is to?

1. Aid in the absorption of carbohydrates
2. Collect unused salts
3. Supply energy to the body
4. Fats have no role

13-27. What vitamins are fat soluble?

1. A, B, C, and E
2. A, D, E, and K
3. B6, B12, A, and D
4. D, E, K, and B6

13-28. Trans fats are naturally occurring fats and are generally not considered a healthy fat.

1. True
2. False

13-29. Omega-3 fatty acids have been linked to lessening the risk of heart disease.

1. True
2. False

13-30. The most common phospholipids is bile; where is it produced?

1. Liver
2. Stomach
3. Spleen
4. Pancreas

13-31. Which of the following is not a water soluble vitamin?

1. C
2. B6
3. A
4. B12

13-32. Which vitamin interferes with anti-clotting medications such as warfarin?

1. K
2. A
3. B6
4. Niacin
13-33. Surgical patients should eat cantaloupe and strawberries containing Vitamin _____ in order to support wound healing.
1. Folic Acid
2. B12
3. Riboflavin
4. C

13-34. Which of the following is not considered a major mineral?
1. Fluoride
2. Sodium
3. Chloride
4. Potassium

13-35. Which of the following is not considered a trace mineral?
1. Manganese
2. Fluoride
3. Iron
4. Calcium

13-36. Infusing too much _____ in an intravenous line can cause death.
1. Potassium
2. Magnesium
3. Selenium
4. Sodium

13-37. Surgical patients who do not consume enough of _____ mineral found in shellfish could have poor wound healing.
1. Iodine
2. Zinc
3. Copper
4. Iron

13-38. What type of diet is normally ordered for an individual who has not eaten for a few days or recovering from surgery?
1. Cardiac diet
2. Dental liquid diet
3. Clear liquid diet
4. Regular diet

13-39. Which of the following diets is NOT nutritionally complete?
1. Cardiac diet
2. Soft diet
3. Regular diet
4. Clear liquid diet

13-40. A dental liquid diet is usually indicated for a patient who?
1. Had oral surgery
2. Recently had a filling placed
3. Has mouth wired shut
4. Has oral cancer

13-41. Which of the following diets is usually lower in fiber?
1. Pureed diet
2. Calorie restricted diet
3. Cardiac diet
4. Protein restricted diet

13-42. Calorie restricted diets should be at least how many calories per day?
1. 1000
2. 1100
3. 1200
4. 1300
13-43. What type of diet is indicative of renal or hepatic disease?

1. Calorie restricted diet
2. Cardiac diet
3. Protein restricted diet
4. Fiber restricted diet

13-44. A person on a cholesterol restriction of 300 mg per day should have no more than how many whole eggs per day?

1. None
2. Half
3. 1
4. 2

13-45. What is the most aggressive type of nutritional therapy?

1. Enteral
2. Parenteral
3. Oral
4. All of the above

13-46. Which of the following provides a way for enteral nutritional therapy?

1. NG Tube
2. J Tube
3. Both 1 and 2
4. ET Tube

13-47. The base of a good healthy diet always begins with?

1. Breakfast
2. Lunch
3. Dinner
4. Food Pyramid
ASSIGNMENT 14

Book Assignment: “Physical Examinations,” pages 14-1 to 14-20

14-1. What two agencies have established uniform physical standards for entry into military service?

1. SECNAV and BUMED
2. DoD and DON
3. SECDEF and BUPERS
4. DoD and BUMED

14-2. After a physical exam has been performed and documented by an IDC, who is required to countersign the exam?

1. Physician Assistant
2. Accredited General Medical Officer
3. Nurse Practitioner
4. Certified Registered Nurse Anesthetist

14-3. Where is the original documentation from a completed physical examination permanently filed?

1. Service Record
2. Dental Record
3. Health Record
4. Clinical Record

14-4. According to SECNAVINST 6120.3 series a Periodic Health Assessment (PHA) shall be conducted _____ on each service member.

1. Twice a year
2. Not less than every 2 years
3. As needed
4. Annually

14-5. A member separating after serving 30 or less consecutive days on active duty, being found unfit for continued service, which of following may be appropriate?

1. Memorandum for Understanding
2. Notice of Eligibility
3. Letter of Intent
4. Cited MEBR

14-6. Who is given the authority to perform special duty examinations?

1. Licensed General Medical Officer
2. DoD Civilians
3. Both 1 and 2
4. Hospital Corpsman

14-7. In accordance with BUMEDINST 1300.2 series, after receipt of orders an overseas/operation suitability screening must be completed within how many days?

1. 30
2. 45
3. 60
4. 90

14-8. Which of the following publications contains further guidance on the Medical Surveillance Program?

1. BUMEDINST 1300.2
2. NAVMEDCOMINST 6260.5
3. OPNAVINST 5100.23
4. BUMEDINST 5100.23
14-9. Who is responsible for reviewing the Abbreviated Medical Board Report for accuracy in content and processing time?

1. Patient Administration Officer
2. Service Member
3. MTF
4. LIMDU Coordinator

14-10. What medical forms are used as documentation of a routine physical examination?

1. DD 2808 and DD 2807
2. DD 2697 and DD 2808
3. NAVMED 1300/1 and DD 2808
4. NAVMED 6100/5 and DD 2707

14-11. What form is used in the submission of a Medical Evaluation Board (MEB)?

1. DD 2808
2. NAVMED 6100/5
3. NAVMED 1300/1
4. DD 2697

14-12. Patients should be instructed to do all of the following when they return for a visual acuity examination EXCEPT?

1. Arrive 15 minutes early
2. Don’t wear contact lenses
3. Bring in contact lenses
4. Bring in glasses

14-13. Which of the following is the preferred method for the testing of distant visual acuity?

1. Snellen Chart
2. Jaeger Cards
3. Farnsworth Lantern
4. Armed Forces Vision Tester

14-14. The Armed Forces Vision Tester, is used to for which type of vision test?

1. Distant
2. Near
3. Binocular
4. Both 1 and 2

14-15. What is the preferred method when testing color discrimination of an active duty service member?

1. Pseudoisochromatic Plates (PIP)
2. AFVT
3. Snellen Chart
4. FALANT

14-16. Personnel who have received a color vision discrimination test on PIP must be retested as soon as a FALANT is available.

1. True
2. False

14-17. Audiometric testing may be performed by any uncertified healthcare provider (i.e. Hospital Corpsman, Nurse) that is available to perform the test.

1. True
2. False

14-18. How many leads are used in a 12-lead EKG?

1. 12
2. 8
3. 10
4. 14
14-19. Along what plane do the precordial leads record the heart’s electrical conduction?

1. Vertical
2. Transverse
3. Sagittal
4. Horizontal

14-20. Along what intercostals space are leads $V_4$, $V_5$, and $V_6$ placed?

1. 5th
2. 3rd
3. 4th
4. 7th
ASSIGNMENT 15

Book Assignment: “Dental Examinations,” pages 15-1 to 15-30

15-1. Which of the following procedures is one of the basic professional services provided on an annual basis to Sailors by the Navy dental team?

1. Dental examination
2. Medical screening
3. Prosthetic treatment
4. Orthodontic treatment

15-5. What type of examination is a comprehensive hard and soft tissue examination routinely done with study models?

1. Type 1
2. Type 2
3. Type 3
4. Type 4

15-2. When seating the patient for a dental exam, where should the dental light be positioned to avoid shining the light in the patient’s eye?

1. Above the patient’s mouth
2. Beneath the patient’s chin
3. Above the patient’s forehead
4. Beneath the patient’s chest

15-6. Which of the following personnel may perform a Type 4 dental screening evaluation?

1. A dental officer
2. A dental hygienist
3. A qualified dental assistant
4. All of the above

15-3. What is the primary purpose for conducting annual dental examinations?

1. To qualify personnel for special pay
2. To qualify personnel for special duty
3. To qualify personnel for special programs
4. To access the readiness status of active duty personnel

15-7. What form should be used to document the findings of a dental examination for overseas screening?

1. NAVMED 1050/3
2. NAVMED 1300/1
3. NAVMED 6000/2
4. NAVMED 6600/10

15-4. Dental examinations are classified by what total number of examination types?

1. One
2. Two
3. Three
4. Four

15-8. A member’s commanding officer can approve a member for overseas assignment even when the dental officer recommends disapproval.

1. True
2. False
15-9. What dental classification indicates that the patient’s dental condition, if not treated or followed up, could have the potential, but is not expected to, result in dental emergencies within the next 12 months?

1. Class 1  
2. Class 2  
3. Class 3  
4. Class 4

15-10. When recording the use of copal varnish in the dental treatment record, which of the following abbreviations should be used?

1. CV  
2. Cop  
3. Copal  
4. Cop Var

15-11. What abbreviation should be used when recording the patient was informed of examination findings and treatment plan?

1. PTINF  
2. PTINFTX  
3. PTINFTXPL  
4. Pt info tx plan

15-12. When identifying and locating caries or existing restorations, how should an 8-MID designation be written out?

1. Distal, incisal, mesial aspects of a left maxillary central incisor  
2. Distal, incisal, mesial aspects of a left mandibular incisor  
3. Mesial, incisal, distal aspects of a right maxillary central incisor  
4. Mesial, incisal, distal aspects of a right mandibular incisor

15-13. When charting the top section of the Forensic Examination form, what symbol should be used to indicate missing teeth or teeth not visible in the patient’s mouth?

1. O  
2. //  
3. X  
4. =

15-14. Which of the following terms is often used when referring to a double occlusal restoration?

1. Ace  
2. Duce  
3. Snake eyes  
4. Double ace

15-15. Drawing an arcing line through the long axis of the tooth is an example of a partially erupted tooth.

1. True  
2. False

15-16. Nonmetallic restorations are made of which of the following types of materials?

1. Acrylic resin  
2. Glass ionomer  
3. Fissure sealant  
4. All of the above

15-17. A nonmetallic restoration is annotated by drawing an outline of the restoration showing size, location, shape, and inscribing vertical lines within the outline.

1. True  
2. False
15-18. When charting a Forensic Examination, what method, if any, should be used to describe the differences between gold and other alloy restorations?

1. Indicate in the “Remarks” section the specific restoration alloy
2. Inscribe horizontal lines in the chrome alloy
3. Black
4. None of the above

15-19. When charting, how should it be indicated that gold material was used in a fixed partial denture?

1. Inscribe vertical lines
2. Inscribe horizontal lines
3. Inscribe diagonal parallel lines
4. Outline each aspect of the FPD

15-20. What procedure should be used to chart the presence of supernumerary teeth?

1. Insert a “D” in the location on the tooth number line
2. Insert a “S” in the location on the tooth number line
3. Draw an outline of the tooth in its approximate location
4. Both 2 and 3

15-21. The remarks section of the Forensic Dental Examination is used to differentiate between which of the following types of dental materials?

1. Sealants
2. Temporaries
3. Composites
4. All of the above

15-22. What number of Angle classifications could be used on the Forensic Examination form?

1. One
2. Two
3. Three
4. Four

15-23. On the Forensic Examination, what method should be used to indicate that a patient does NOT have a soft tissue condition?

1. Write “none” in the Soft Tissue Remarks section
2. Write “none” in the Hard Tissue Remarks section
3. Write “no existing conditions” in the Soft Tissue Remarks section
4. Leave blank if a condition does not exist

15-24. Where in the occlusion section of the Forensic Examination should the HM document and record any other occlusal conditions not listed?

1. Section A
2. Section B
3. Remarks
4. Hard Tissue Remarks

15-25. Which of the following non-pathologic findings should be annotated in the “Hard Tissue Remarks” section on the Forensic Examination form?

1. Tori
2. Rotated teeth
3. Intrinsic staining
4. All of the above
15-26. What procedure should be used when a patient requires the completion of a new Current Status form?

1. Complete Box 1 of the Current Status form
2. Complete Boxes 1 and 2 of the Current Status form
3. Transfer the information from the previous forms to the new form
4. A patient’s Current Status form should not need to be replaced

15-27. Which of the following conditions should be annotated in pencil in Box 1 of the Current Status form?

1. Carious lesions
2. Periridicular lesions
3. Indications for root canal treatment
4. All of the above

15-28. What does an even line drawn on the root of the tooth indicate?

1. Fractured tooth
2. Underfilled root canal
3. Resoprtion of the root
4. Periapical radiolucency

15-29. Pencil entries are authorized for the use in Box 2 of the Current Status form.

1. True
2. False

15-30. If a medical alert exists, the word “ALERT” is written or stamped in Box 3 of the Current Status form in large red letters with a brief explanation.

1. True
2. False

15-31. Which dental form provides a record of initial accession exam and all subsequent periodic, annual, recall, and separation exams?

1. SF 87
2. SF 603
3. EZ 603
4. EZ 600

15-32. What part of the S.O.A.P includes the reason for the visit and a statement of the chief complaint?

1. Subjective
2. Objective
3. Assessment
4. Plan

15-33. What part of the S.O.A.P is generally used by the examiner to make a diagnosis?

1. Subjective
2. Objective
3. Assessment
4. Plan

15-34. Which part of the S.O.A.P includes the patient’s treatment needs?

1. Subjective
2. Objective
3. Assessment
4. Plan

15-35. Which of the following references should be used to complete the Dental Examination form?

1. MANMED, Chapter 6
2. MANMED, Chapter 16
3. BUMEDINST 6100.1
4. NAVMEDCOM 6600.1
15-36. The back of the EZ 603 may be overprinted with a command specific format.

1. True
2. False

15-37. Which of the following forms should be used to document dental treatment completed from the treatment plan, dental emergencies, and any other narrative dental findings?

1. DD 2808
2. SF 513
3. EZ600
4. EZ603A

15-38. What color ink should be used for the medical alert entry on the EZ603A?

1. Red
2. Blue
3. Black
4. Green

15-39. Which form should be used to record the dental examination completed in conjunction with a medical physical?

1. DD 2808
2. SF 513
3. SF 600
4. EZ 603

15-40. Which of the following entries should be annotated in Box 44 on the report of the Medical Examination form?

1. Dental Classification
2. Type of dental exam
3. Qualified “YES” or “NO”
4. Patient’s dental defects

15-41. Which form should be used to refer a patient to another specialist or to medical for further evaluation or treatment?

1. SF 2808
2. SF 513
3. SF 515
4. EZ603

15-42. Which section of the Consultation Sheet should be left blank for the person receiving the form to document his or her findings?

1. Reason for request
2. Provisional diagnosis
3. Consultation report
4. Place of consultation

15-43. The dental chair should be placed in which of the following positions to dismiss the patient?

1. Arm raised, lowest, down right position
2. Arm raised, lowest, upright position
3. Arm lowered, lowest, down right position
4. Arm lowered, lowest, upright position

15-44. When patients complete their dental examination, they should be directed to make future dental appointments at which of the following departments?

1. Front desk
2. Operative
3. Oral surgery
4. Oral diagnosis
16-1. Operative dentistry is concerned with the prevention and treatment of defects of what tooth surfaces?

1. Enamel and cementum
2. Enamel and dentin
3. Dentin and cementum
4. Cementum only

16-2. Which of the following instruments is used primarily to remove debris from tooth cavities?

1. Hoes
2. Chisels
3. Hatches
4. Spoon excavators

16-3. An even-numbered gingival margin trimmer is designed for use on which of the following tooth surfaces?

1. Mesial
2. Distal
3. Facial
4. Lingual

16-4. An odd-numbered gingival margin trimmer is designated for use on which of the following tooth surfaces?

1. Mesial
2. Distal
3. Facial
4. Lingual

16-5. What type of working end does an amalgam carrier have for transportation?

1. Solid
2. Layered
3. Pointed
4. Hollow

16-6. An amalgam condenser is often referred to as which of the following instruments?

1. Carvers
2. Burnishers
3. Pluggers
4. Carriers

16-7. Which of the following instruments is designed for carving all interproximal tooth surfaces?

1. Tanner #5
2. Hollenback #1/2
3. Frahm 2/3
4. Cleoid-discoid

16-8. What is an advantage of using a plastic instrument for placing composite restorations?

1. Will not discolor
2. Will not bend
3. Will not melt
4. Will not break

16-9. What number spatula is used to mix small quantities of cement?

1. #313
2. #322
3. #324
4. #324A

16-10. What length needle, measured in inches, is normally used for mandibular injections?

1. 1-1/4
2. 1-3/4
3. 1-7/8
4. 1-13/16
16-11. The working end of a rubber dam punch is designed with which of the following mechanisms?

1. Plunger and spindle
2. Plunger and wheel
3. Wheel and spindle
4. Spindle and clamp

16-12. A “W” prefix on a rubber dam clamp indicates which of the following designs?

1. Without clamp
2. Without wrapper
3. Without slipping
4. Without wings

16-13. Which of the following rubber dam frames is the most popular?

1. “A” Frame
2. Young
3. Wizard
4. Woodbury

16-14. What type of material is always tied around a rubber dam clamp before placement in the mouth?

1. Dental floss
2. Dental ligature
3. Rubber latex
4. Clamp retriever

16-15. Which of the following types of matrix bands is most commonly used in restorative dentistry?

1. Wide #2
2. Junior #13
3. Precontoured
4. Straight #1

16-16. Extensions on the wide #2 matrix bands are known by which term?

1. Bumps
2. Aprons
3. Wings
4. Circles

16-17. Which of the following is the most commonly used matrix retainer?

1. Universal #1
2. Universal adult
3. Universal straight
4. Universal contra-angled

16-18. Wood or clear plastic wedges measure about how long in length?

1. 1 inch
2. ½ inch
3. ¾ inch
4. ¼ inch

16-19. The operator’s zone for a right handed dentist is located between which positions?

1. 1 and 3 o’clock
2. 2 and 4 o’clock
3. 5 and 8 o’clock
4. 8 and 11 o’clock

16-20. The assistant’s zone for a right handed dentist is located between which positions?

1. 1 and 3 o’clock
2. 2 and 4 o’clock
3. 5 and 8 o’clock
4. 8 and 11 o’clock
16-21. The transfer zone is located between which positions?
   1. 8 and 11 o’clock
   2. 2 and 4 o’clock
   3. 3 and 6 o’clock
   4. 4 and 8 o’clock

16-22. The static zone is located between which positions?
   1. 8 and 11 o’clock
   2. 11 and 1 o’clock
   3. 11 and 2 o’clock
   4. 4 and 8 o’clock

16-23. How many inches should the dentist’s eye be away from the treatment site if the patient is properly positioned?
   1. 5 to 12
   2. 14 to 16
   3. 18 to 36
   4. None of the above

16-24. In what zone will the instrument exchange between the dentist and the assistant take place?
   1. Operator
   2. Assistant
   3. Transfer
   4. Static

16-25. Dental material is exchanged between the dentist and the assistant in what zone?
   1. Operator
   2. Assistant
   3. Transfer
   4. Static

16-26. The needle end of a carpule is sealed with a rubber membrane held in place by what type of material?
   1. Metal band
   2. Rubber band
   3. Copper band
   4. Plastic band

16-27. If you must recap a needle, what technique should be used?
   1. One handed scoop
   2. Two handed scoop
   3. Twist and turn scoop
   4. None of the above

16-28. What device is used to remove blood, pus, saliva, and debris from the oral cavity?
   1. Low volume ejector
   2. High volume ejector
   3. High volume evacuator
   4. Low volume aspirator

16-29. What type of cavity is present when three or more surfaces are involved?
   1. Large
   2. Small
   3. Medium
   4. Complex

16-30. When the dentist has finished removing the tooth structure in a cavity preparation, what type of feeling will the dentin have when felt by an explorer?
   1. Firm
   2. Loose
   3. Brittle
   4. Semi-hard
16-31. What is the last cutting step in the preparation of a cavity?

1. Finishing the tooth walls
2. Finishing the dentin walls
3. Finishing the enamel walls
4. Finishing the occlusal walls

16-32. Stubborn particles of debris may be removed from a cavity preparation by which of the following materials dampened with water or hydrogen peroxide?

1. Alcohol
2. 2x2 gauze
3. 4x4 gauze
4. Small cotton pellet

16-33. What two materials are used in a cavity preparation to protect the pulp?

1. Bases and resin
2. Fluoride and amalgam
3. Bases and cavity liners
4. Cavity liners and amalgam

16-34. What material is used to seal the dentinal tubules to help prevent microleakage in a cavity preparation?

1. Bases
2. Cements
3. Amalgam
4. Cavity Varnish

16-35. What instrument will the dentist use to bring any excess mercury from the amalgam to the top of the restoration?

1. Carver
2. Hatchet
3. Burnisher
4. Mouth mirror

16-36. What BUMED instruction contains information of the Mercury Control Program (MCP)?

1. 6260.30
2. 6260.20
3. 6360.30
4. 6360.20

16-37. Which of the following materials may be used to remove roughness or overhanging amalgam in the proximal area?

1. Dental tape
2. Dental floss
3. Metal filing strip
4. Plastic filing strip

16-38. Which of the following composite resins is available for use in operative dentistry?

1. Hybrid
2. Microfilled
3. Macrofilled
4. All of the above

16-39. What composite shade will appear if the tooth becomes dehydrated?

1. Darker
2. Lighter
3. Transparent
4. Chalky white

16-40. What type of matrix may be placed on the tooth before the acid procedure begins?

1. Wood
2. Metal
3. Rubber
4. Celluoid
16-41. Glass ionomer cement will bond directly with which of the following tooth surfaces?

1. Enamel
2. Dentin
3. Cementum
4. All of the above
17-1. Which scientist first discovered X-Rays?

1. Wilhelm Konrad Roentgen
2. Doctor H. G. Gama
3. Doctor Otto Proton
4. Raymond Cathode

17-2. What is the name of the tube that was discovered in 1895?

1. Crooke’s tube
2. Roentgen’s tube
3. Walkoff tube
4. Evacuating tube

17-3. Which of the following is NOT a characteristic property of X-Rays?

1. They travel in straight lines
2. They travel at the speed of sound
3. They cause irritation to living cells
4. They cause certain substances to fluoresce

17-4. The rule that applies to the principle of radiation safety is?

1. ALARA
2. SAMS
3. CORPS
4. SAFETY

17-5. When taking radiographs, always drape the patient with a lead apron.

1. True
2. False

17-6. The time setting on the X-Ray machine is measured by using which of the following methods?

1. Minutes or impulses
2. Minutes or milliamperes
3. Fractions of a second or milliamperes
4. Fractions of a second or impulses

17-7. Which of the following instruction is most important when ordering radiographs for female patients?

1. Have the patient remove her eyeglasses
2. Have the patient remove her earrings
3. Ask the patient if she has any type of denture
4. Ask the patient if she is pregnant

17-8. The film badge should be placed behind the lead-lined barrier at least what number of feet from the tube head?

1. 10
2. 6
3. 8
4. 4

17-9. Which of the following is NOT a safety precaution for taking radiographs?

1. Always stand behind a lead screen during an exposure
2. Never stand in the path of the central X-Ray beam during exposure
3. Never hold the tube head or the tube head cylinder of the X-Ray machine during exposure
4. Hold the film packet in the patient’s mouth during exposure if necessary
17-10. Which of the following personnel are authorized to order and diagnostically interpret dental radiographs?

1. Dental X-Ray technician
2. Front desk personnel
3. Dental officers
4. Dental technicians

17-11. How often should the surfaces in the dark room be disinfected?

1. Daily
2. Weekly
3. Bi-weekly
4. Monthly

17-12. Of the following personnel who is NOT allowed to order radiographs?

1. IDC
2. HM
3. PA
4. MO

17-13. All of the following are indications for a PA of the chest, EXCEPT?

1. Pain with respiration
2. Chronic cough
3. Asbestos
4. Rash and streaking

17-14. Which of the following organs will not be seen in a KUB radiograph?

1. Kidney
2. Liver
3. Ureters
4. Bladder

17-15. Which of the following structures will be seen in the AP projection of the cervical spine?

1. C1-T3
2. C2-T4
3. C3-T1
4. C4-T2

17-16. A patient presenting with chronic cervical spine pain should be ordered what type of radiograph?

1. KUB
2. AP Cervical Spine
3. Pelvic
4. Chest PA

17-17. At approximately what angle should the ankle be when taking an oblique radiograph?

1. 30
2. 45
3. 60
4. 90

17-18. What should be shielded when you are taking an X-ray?

1. Hypothalamus
2. Heart
3. Reproductive organs
4. Scrotum

17-19. The paralleling device consists of which of the following parts?

1. A locator ring
2. An indicator rod
3. A bite-block
4. All of the above
17-20. The bisecting angle technique is the preferred method and recommended for routine use when taking periapical radiographs.

1. True
2. False

17-21. When taking radiographs, which of the following factors should you consider before using the bisecting-angle technique?

1. There are no paralleling devices available
2. The patient cannot close mouth on bite-block
3. The patient has a rubber dam in place
4. All of the above

17-22. What landmark is used when exposing the maxillary bicuspid area?

1. Tip of the nose
2. Beside the ala of the nose
3. Below the pupil of the eye
4. Below the out angle of the eye and below the zygomatic bone

17-23. The position of the patient’s mid-sagittal plane must be perpendicular to the floor when exposing a periapical radiograph using the bisecting-angle technique.

1. True
2. False


1. True
2. False

17-25. What X-Ray machine settings should you use when exposing a maxillary occlusal radiograph on an adult?

1. 10 mA, 87kVp, and 60 impulses
2. 12 mA, 90kVp, and 60 impulses
3. 10 mA, 90kVp, and 60 impulses
4. 12 mA, 87kVp, and 40 impulses

17-26. What vertical angulation setting should you use when exposing a maxillary anterior occlusal radiograph?

1. +50 degrees
2. +55 degrees
3. +60 degrees
4. +65 degrees

17-27. When exposing a maxillary posterior occlusal radiograph, you should use what vertical angulation setting?

1. +75 degrees
2. +70 degrees
3. +65 degrees
4. +60 degrees

17-28. When exposing a mandibular anterior occlusal radiograph, what vertical angulation should you use?

1. -10 degrees
2. 5 degrees
3. 0 degrees
4. +5 degrees

17-29. A safe light is the only safe source of illumination used in the darkroom when processing radiographs.

1. True
2. False
17-30. When checking for light leaks in the darkroom, you should leave the penny on the X-Ray film for at least what number of minutes?

1. One  
2. Five  
3. Three  
4. Seven

17-31. Which of the following methods is most commonly used to process dental radiographs in the Navy?

1. Laser processing  
2. Manual processing  
3. Computer processing  
4. Automatic processing

17-32. Which of the following procedures should be included in the daily maintenance of the X-Ray machine?

1. Dusting  
2. Cleaning with a cloth moistened with water  
3. Both 1 and 2  
4. Cleaning with a cloth moistened with solvent

17-33. You should wait what number of seconds between films before inserting another film into the automatic processor?

1. 10  
2. 12  
3. 15  
4. 30

17-34. The developer and fixer solutions in the automatic processor should be changed at what minimum frequencies?

1. Daily  
2. Weekly  
3. Biweekly  
4. Every 3 to 4 weeks

17-35. The processing solutions used in the automatic processor are the same as those used in the manual processing procedure.

1. True  
2. False

17-36. The cleaning of the roller transports and the solutions in the automatic processor are accomplished at what minimum intervals?

1. Twice a day  
2. Daily  
3. Weekly  
4. Monthly

17-37. Which teeth can be identified radiographically by a large white region caused by the bone of the nasal septum?

1. Mandibular incisors  
2. Mandibular cuspids/bicuspids  
3. Maxillary incisors  
4. Maxillary incisors and bicuspids

17-38. When mounting radiographs, the raised dimple should be facing you.

1. True  
2. False

17-39. You should attempt to complete all X-Ray repairs yourself.

1. True  
2. False
18-1. Pharmacology is a basic medical science that deals with the study of which specialty?

1. Drugs  
2. Diseases  
3. Compounds  
4. Pharmacy operations

18-2. The branch of pharmacology that deals with the preparation, dispensing, and proper use of medications is?

1. Toxicology  
2. Pharmacy  
3. Pharmacognosy  
4. Therapeutics

18-3. The actual title of the “blue bible” of pharmacology is?

1. The Physicians’ Desk Reference  
2. The United States Pharmacopoeia and National Formulary (USP-NF)  
3. The Pharmacological Basis of Therapeutics  
4. Remington’s The Science and Practice of Pharmacy

18-4. The amount of medication administered is referred to as which of the following?

1. Pill  
2. Dose  
3. Unit amount  
4. Average amount

18-5. The minimum and maximum amount of a drug required to produce the desired effect is referred to by what term?

1. Dosage factor  
2. Dosage range  
3. Dosage drug  
4. Dosage age

18-6. What dose refers to the least amount of a drug that can cause death?

1. Toxic  
2. Minimum toxic  
3. Minimum lethal  
4. Maximum lethal

18-7. The most common factor influencing the amount of drug given to a patient is?

1. Weight  
2. Gender  
3. Age  
4. Route of administration

18-8. What two primary factors, if any, determine a dose?

1. Sex and age  
2. Age and weight  
3. Weight and sex  
4. None

18-9. What is the proper dose in milliliters of ampicillin for an 8-year old child if the adult dose is 15 ml?

1. 2  
2. 6  
3. 9  
4. 15

18-10. What is the name of the rule used to determine appropriate dosage of medication based on a child’s weight?

1. Clark’s Rule  
2. Young’s Rule  
3. Rule of Nines  
4. Fried’s Rule
18-11. Determine the appropriate dose in milligrams of medication for a child weighing 30 pounds if the average dose for an adult is 600 mg.

1. 50
2. 100
3. 120
4. 150

18-12. In computing the amount of drug to be given to an underweight female, what adjustments to the normal dosage would ordinarily be made?

1. Increase the dosage because of her weight and further increase because of her sex
2. Increase of dosage because of her weight but decrease because of her sex
3. Decrease of dosage because of her sex and further decrease because of her weight
4. Decrease of dosage because of her sex but an increase because of her weight

18-13. A drug given continuously to a patient often has to be increased in dosage to maintain the desired effect. The need for a larger dose is probably caused by?

1. An acquired tolerance from habitual use
2. An abnormal sensitivity
3. A cumulative effect from habitual use
4. An individual idiosyncrasy

18-14. The most common method of administering medications is ________.

1. Orally
2. Parentally
3. Topically
4. Intravenously

18-15. What term is used to define a medication that is placed under the tongue?

1. Suboral
2. Submandibular
3. Subcavity
4. Sublingual

18-16. Which of the following is an example of a drug injected intradermally?

1. Insulin
2. Procaine hydrochloride
3. Purified protein derivative
4. 2 or 3 above

18-17. What technique introduces a drug directly into a vein?

1. Intravenous
2. Infiltration
3. Intramuscular
4. Intradermal

18-18. In what form are medications introduced into the body through inhalation?

1. Gas
2. Oral
3. Topical
4. All of the above

18-19. Normally, how many names do medications have?

1. One
2. Two
3. Three
4. Four
18-20. Which of the following is NOT a way in which drugs are grouped?

1. By chemical characteristics
2. By their brand names
3. By their source
4. By their action on the body

18-21. Aluminum acetate, an astringent, is often used to treat which of the following conditions?

1. Athlete’s foot
2. External otitis
3. Poison ivy
4. All of the above

18-22. Which of the following is a bronchomutropic agent?

1. Petrolatum
2. Guaifenesin
3. Benzoate
4. Phenol

18-23. Which of the following is a characteristic side effect of antihistamines?

1. Nausea
2. Drowsiness
3. Uricaria
4. Tinnitis

18-24. Which of the following medications is administered to control motion sickness?

1. Cimetidine
2. Meclizine hydrochloride
3. Chlorpheniramine maleate
4. Diphenhydramine hydrochloride

18-25. In conjunction with antacids, which of the following is used to treat duodenal ulcers?

1. Dimenhydrinate
2. Diphenhydramine hydrochloride
3. Ranitidine
4. Pseudoephedrine hydrochloride

18-26. The drug group most often used to treat dyspepsia is?

1. Emollients
2. Astringents
3. Antacids
4. Adsorbents

18-27. In addition to being an antacid, magnesium hydroxide may be used as a/an?

1. Emollient
2. Laxative
3. Demulcent
4. Astringent

18-28. The standard by which all other antiseptics are measured is?

1. Povidine-iodine
2. Phenol
3. Isopropyl alcohol
4. Hexachlorophene

18-29. The primary pharmacological action of sulfonamides is?

1. Viricidal
2. Parasiticidal
3. Bacteriostatic
4. Fungistatic
18-30. The most common use for systemic sulfonamides is in the treatment of which of the conditions listed below?

1. Respiratory infections
2. Urinary tract infections
3. Viral infections
4. Furunculosis

18-31. Silver sulfadiazine is used almost exclusively in the treatment of?

1. Surgical wounds
2. Burns
3. Prostatitis
4. Furunculosis

18-32. The drug of choice for uncomplicated group A beta-hemolytic streptococcal pharyngitis is?

1. Penicillin V Potassium
2. Nafcillin
3. Ampicillin
4. Dicloxicillin

18-33. Patients sensitive to penicillin may also exhibit sensitivity to cephalosporins.

1. True
2. False

18-34. Milk or milk products may interfere with the absorption of which of the following drugs?

1. Cephalexin (Keflex)
2. Tetracycline hydrochloride
3. Streptomycin sulfate
4. Erythromycin

18-35. Macrolides are effective against which of the following organisms?

1. Gram-positive cocci
2. Dermatophytes
3. Parasites
4. Gram-negative

18-36. Which of the following is an appropriate substitute for penicillin when penicillin is contraindicated?

1. Doxycycline
2. Cephalexin
3. Erythromycin
4. Streptomycin

18-37. Undeclyenic acid is used as a/an?

1. Disinfectant
2. Antipyretic
3. Analgesic
4. Antifungal

18-38. Supplemental potassium may be required with which of the following categories of drugs?

1. Anti-inflammatories
2. Antidiarrheals
3. Antipyretics
4. Diuretics
18-39. The drug of choice for the treatment and management of grand mal seizures is?

1. Methylphenidate hydrochloride
2. Phenobarbital
3. Phenytoin sodium
4. Any psychotropic agent

18-40. Prochlorperizine is used mainly to?

1. Treat symptoms of nausea and vomiting
2. Alleviate symptoms of tension, agitation, and psychosis
3. Counteract the effects of alcohol withdrawal
4. Relieve respiratory distress

18-41. Muscle relaxants include all of the following EXCEPT?

1. Methocarbamol
2. Diazepam
3. Cyclobenzaprine
4. Methylphenidate

18-42. Water-soluble vitamins are not excreted in the urine and are stored in the body in moderate amounts.

1. True
2. False

18-43. The vitamin deficiency associated with night blindness is?

1. Vitamin A
2. Vitamin B6
3. Vitamin B12
4. Vitamin K

18-44. The agent used to treat pernicious anemia is?

1. Cyanocobalamin
2. Ascorbic acid
3. Vitamin D
4. Vitamin K

18-45. Which of the following is the vitamin involved in absorption and use of calcium and phosphorus?

1. Vitamin A
2. Vitamin B1
3. Vitamin C
4. Vitamin D

18-46. The correct abbreviations for the metric systems of primary units of measure for weight, volume, and linear dimensions are?

1. gr, l, cm
2. gr, ml, m
3. g, l, m
4. g, l, cm

18-47. Which of the following is equal to one one-hundredth of a liter?

1. Dekaliter
2. Deciliter
3. Centiliter
4. Milliliter

18-48. A prescription requires two ounces of a substance supplied in liters. How many milliliters are required to fill the prescription?

1. 0.03 ml
2. 0.06 ml
3. 30 ml
4. 60 ml
18-49. You have 360 grams of a compound. If 54 grams of the compound is silver nitrate, what is the percentage strength of silver nitrate?

1. 12.5%
2. 15%
3. 17.5%
4. 20%

18-50. All pharmacies that dispense prescriptions are required to have what Class balance?

1. A
2. B
3. C
4. D

18-51. What drug incompatibility occurs when agents antagonistic to one another are prescribed together?

1. Therapeutic
2. Physical
3. Chemical
4. 1 and 3 above

18-52. Eutexia is an example of what type of drug incompatibility manifestation?

1. Chemical
2. Physical
3. Therapeutic
4. 2 and 3 above

18-53. A properly administered drug dosage that has an unintended or harmful effect on the patient is the definition of which of the following terms?

1. Contraindication
2. Drug interaction
3. Adverse reaction
4. Therapeutic incompatibility

18-54. What chapter of The Manual of the Medical Department gives guidance on pharmacy operations and drug control?

1. 6
2. 9
3. 15
4. 21

18-55. What DD form is used to prescribe controlled and noncontrolled medications?

1. 6710
2. 1289
3. 1210
4. 1209

18-56. In the prescription block of DD Form 1289, what part lists the name and quantity of the ingredient prescribed?

1. Superscription
2. Inscription
3. Subscription
4. Signa

18-57. If, in the course of filling a prescription, the HM feels that there may be a discrepancy or incompatibility, the HM should take which of the following actions?

1. Let the patient know that you discovered an error and will be checking with the prescriber before filling the prescription
2. Consult the prescriber to verify the prescription before filling
3. Both 1 and 2
4. Fill the prescription as written

18-58. What types of prescription medications have the potential for abuse?

1. Noncontrolled
2. Controlled
3. Schedule VI
4. All of the above
18-59. Which of the following is a Schedule III medication?

1. Marijuana
2. An antitussive
3. Amphetamines
4. Nonbarbiturate sedative

18-60. What schedule of medications can never be ordered with refills?

1. II
2. III
3. IV
4. V

18-61. How many board members are on the Controlled Substance Inventory Board?

1. One
2. Three
3. Four
4. Six

18-62. Controlled substances must be inventoried at least?

1. Annually
2. Bi-annually
3. Quarterly
4. Daily
ASSIGNMENT 19

Book Assignment: “Clinical Laboratory,” pages 19-1 to 19-30

19-1. Which of the following is considered the preferred source for blood specimens obtained for clinical examination?

1. Venipuncture
2. Finger puncture
3. Arterial puncture
4. Antecubital puncture

19-2. When performing a finger puncture, the first drop should be wiped away to avoid which of the following conditions?

1. Bacterial contamination
2. Clotting at the puncture site
3. Dilution of the specimen with alcohol
4. Dilution of the specimen with tissue fluids

19-3. How far above the intended phlebotomy site should the tourniquet be placed?

1. Directly above site
2. 1-2 inches above the site
3. 2-3 inches above the site
4. 3-4 inches above the site

19-4. The correct needle position for venipuncture is (a) what degree angle and (b) with the bevel in what position?

1. (a) 15-30 (b) up
2. (a) 20-40 (b) down
3. (a) 15-30 (b) down
4. (a) 20-40 (b) up

19-5. A tourniquet is normally applied before to aid in the process of venipuncture. At what point in the venipuncture procedure should the tourniquet be removed?

1. Just before needle insertion
2. Just after needle insertion
3. Once blood flows freely into tubes
4. No longer than two minutes

19-6. When should specimens be labeled?

1. Before collecting samples
2. Before submitting samples to laboratory
3. Before leaving patient
4. Any time after collecting samples

19-7. Which color tube is the best choice for routine chemistry tests?

1. Red top
2. Lavender top
3. Gray top
4. Yellow top

19-8. Which color tube is the best choice for a CBC?

1. Red top
2. Lavender top
3. Gray top
4. Yellow top

19-9. The part of the microscope on which the prepared specimen is placed for examination is called the ________.

1. Arm
2. Base
3. Frame
4. Mechanical stage
19-10. What objective should be used for a detailed study of stained bacterial smears?

1. Low power
2. Oil immersion
3. High power
4. Either 2 or 3 above

19-11. A Complete Blood Count includes which of the following?

1. Total RBC count
2. Hematocrit
3. Differential WBC count
4. All of the above

19-12. The function of hemoglobin in the body is to?

1. Fight infection
2. Transport oxygen to the tissues
3. Aid in blood clotting
4. Regulate blood chemistry

19-13. Which of the following factors affect the hemoglobin values?

1. Age
2. Sex
3. Altitude
4. All of the above

19-14. A low RBC count may indicate that the patient has which of the following listed conditions?

1. Leukopenia
2. Anemia
3. Dehydration
4. Uremia

19-15. The normal value for male hemoglobin is?

1. 10-16
2. 12-18
3. 14-18
4. 15-20

19-16. What is the term used for the volume of erythrocytes expressed as a percentage of the volume of whole blood in a sample?

1. Hematocrit
2. Hemoglobin
3. Red Blood Count
4. Complete Blood Count

19-17. Hematocrit for a normal, healthy female is within what range?

1. 30-40 percent
2. 37-47 percent
3. 42-50 percent
4. 44-52 percent

19-18. Select the term used to describe an abnormally high WBC count.

1. Leukocytosis
2. Erythrocytosis
3. Leukopenia
4. Pancytopenia

19-19. Which of the following conditions may cause leukopenia?

1. Radiation
2. Psittacosis
3. Anaphylactic shock
4. Each of the above
19-20. Which study within a CBC often provides the most helpful information in determining the severity and type of infection?

1. Red Cell count  
2. White Cell count  
3. Hemoglobin  
4. WBC differential

19-21. What is the function of leukocytes?

1. To carry oxygen through the blood  
2. To control various disease conditions  
3. To aid in clotting blood  
4. Each of the above

19-22. What type of leukocyte compromises the largest percentage of cells in the circulating blood?

1. Lymphocyte  
2. Neutrophil  
3. Erythrocyte  
4. Thrombocyte

19-23. Which leukocyte functions by ingesting invading bacteria?

1. Neutrophil  
2. Eosinophil  
3. Lymphocyte  
4. Monocyte

19-24. Which leukocyte helps respond to parasitic infections?

1. Neutrophil  
2. Eosinophil  
3. Lymphocyte  
4. Monocyte

19-25. When performing a WBC differential, which cell has the large, scattered dark blue granules that are darker than the nucleus?

1. Lymphocytes  
2. Monocytes  
3. Basophils  
4. Neutrophils

19-26. Which leukocyte fights viral infection?

1. Neutrophil  
2. Eosinophil  
3. Lymphocyte  
4. Monocyte

19-27. The largest of the normal WBCs is the?

1. Monocyte  
2. Lymphocyte  
3. Eosinophil  
4. Basophil

19-28. What is the term used for bacteria that cause disease?

1. Pathogen  
2. Virus  
3. Non-pathogen  
4. Flora

19-29. The difference between anaerobes and aerobes is that anaerobes need oxygen to reproduce.

1. True  
2. False

19-30. What is the term used to define bacteria that are round in shape?

1. Strep  
2. Cocci  
3. Rods  
4. Bacillus
19-31. In the Gram’s stain, what is the primary stain?

1. Crystal violet  
2. Gram’s Iodine  
3. Acetone  
4. Safranin

19-32. Gram positive bacteria stain what color?

1. Green  
2. Pink  
3. Red  
4. Deep blue or purple

19-33. Which bacteria causes strep throat?

1. Staphylococcus aureus  
2. Streptococcus pyogenes  
3. Neisseria gonorrhoeae  
4. Clostridium tetani

19-34. Which bacteria causes gonorrhea?

1. Staphylococcus aureus  
2. Streptococcus pyogenes  
3. Neisseria gonorrhoeae  
4. Clostridium tetani

19-35. Which bacteria causes tetanus?

1. Staphylococcus aureus  
2. Streptococcus pyogenes  
3. Neisseria gonorrhoeae  
4. Clostridium tetani

19-36. What is the term used for a substance that, when introduced into an individual’s body, is recognized as foreign to the body, and causes a detectable reaction?

1. Pathogen  
2. Antigen  
3. Reagin  
4. Antibody

19-37. The RPR is a specific test to diagnose syphilis.

1. True  
2. False

19-38. The RPR test to screen for syphilis is best used with what type of specimen?

1. Serum  
2. Plasma  
3. Whole blood  
4. Either serum or plasma

19-39. If the monospot is negative, the patient does not have infectious mononucleosis.

1. True  
2. False

19-40. Which of the following chemical preparations is frequently used to detect fungi?

1. Hydrogen sulfoxide  
2. Hydrogen peroxide  
3. Potassium hydroxide  
4. Potassium sulfate

19-41. The best urine specimen for screening purposes is that taken during which of the following times?

1. First morning  
2. Random  
3. Fasting  
4. 24 hour

19-42. What is the desired urine sample volume for routine testing?

1. 10 ml  
2. 20 ml  
3. 15 ml  
4. 12 ml
19-43. Which of the following colors would be considered abnormal in a urine sample?

1. Colorless
2. Amber
3. Straw
4. Red

19-44. Which urine color is most related with the presence of blood?

1. Dark orange
2. Red
3. Yellow
4. Olive green

19-45. Which urine color is most related with the presence of bile?

1. Dark orange
2. Red
3. Yellow or brown
4. Olive green

19-46. Which urine color is most related with a patient being treated with Pyridium®?

1. Dark orange
2. Red
3. Yellow
4. Olive green

19-47. A report on urine clarity is valid regardless of standing time.

1. True
2. False

19-48. The specific gravity of a liquid is the weight of the substance as compared to an equal volume of _______.

1. Ethanol
2. Methanol
3. Distilled water
4. Saline

19-49. Normal specific gravity for routine urinalysis is within what range?

1. 1.010 - 1.030
2. 1.001 - 1.015
3. 1.020 - 1.030
4. 1.015 - 1.030

19-50. The addition of one drop of 2 percent acetic acid to urine sediment will disintegrate which cell?

1. White blood cells
2. Mucous threads
3. Casts
4. Red blood cells

19-51. What cell is not normally found in urine?

1. White Blood Cell
2. Red Blood Cell
3. Epithelial Cell
4. All of the above

19-52. Which critical result is indicative of uncontrolled diabetes?

1. Hemoglobin below 7
2. Hematocrit below 20
3. White blood cells in urine
4. Glucose and ketones both present in urine

19-53. What operational program may be used on some operational platforms to treat critical patients in a mass casualty situation when delay of blood products would cause a critical delay?

1. MEDEVAC
2. WBB
3. CASEVAC
4. Frozen Blood program
20-1. Why is the spica or figure eight bandage used around the elbow?

1. Allows for movement while holding a compress
2. Hard to apply
3. Best for controlling bleeding
4. Can be only applied by using a 6 inch roller bandage

20-2. What size bandage is used for applying a roller bandage to the ankle or foot?

1. 2 inch
2. 3 inch
3. 4 inch
4. 6 inch

20-3. What is a Barton Bandage used for?

1. Head fractures
2. Auricular fractures
3. Fractures of the lower jaw
4. Holding compress on the head

20-4. The Automated External Defibrillator analyzes cardiac rhythm and selects the appropriate strength of electrical therapy which stops an arrhythmia, allowing the heart to re-establish a normal rhythm.

1. True
2. False

20-5. Which statement is false concerning Normal Saline?

1. Is used in patients that are in danger of developing dehydration or hypovolemia and cannot take fluid orally.
2. The amount of normal saline infused largely depends on the needs of the patient.
3. There are no dangers in giving “too much” normal saline.
4. Normal saline is typically the first fluid used when hypovolemia is severe enough to threaten the adequacy of blood circulation.

20-6. Hetastarch is a substitute for blood plasma and has oxygen carrying capabilities.

1. True
2. False

20-7. In the United States, oxygen bottles are colored green. What is the international color code of oxygen bottles?

3. White
4. Green
5. Blue
6. Green with a white band

20-8. Which of the following is a true statement concerning oropharyngeal airways?

1. Can only be used on a conscious patient
2. An airway of proper size is measured from the tip of the earlobe to the corner of the mouth
3. Insert the airway into the mouth and rotate 90° as it slides into to pharynx
4. Only comes in one size
20-9. The oropharyngeal airway is the airway of choice for patients with a gag reflex.
1. True
2. False

20-10. The effective life of an oxygen breathing apparatus (OBA) is?
1. 45-60 minutes
2. 15-30 minutes
3. 20-45 minutes
4. The canister never needs changing.

20-11. How many stages of extrication are there?
1. 4
2. 3
3. 5
4. There is only one stage; the actual rescue

20-12. Which is a true statement when treating a patient that is radioactively contaminated?
1. Ensure you have a dosimeter prior to entering the area.
2. Be ready to fill out training forms prior to entering the scene of the incident.
3. Good judgment is confirmed when stopping medical personnel from performing their duties.
4. Treatment of life threatening injuries takes precedence over decontamination procedures.

20-13. Which of the following is not a concern about the distance a casualty can be carried?
1. Weight of the casualty
2. Strength and endurance of the stretcher bearers
3. Nature of the casualty’s injuries
4. The amount of radiation with which the victim is contaminated.

20-14. Which of the following is not a phase of Care of Patient en Route?
1. Medical Evacuation Care
2. Tactical Field Care
3. Care under Fire
4. Tactical Evacuation Care

20-15. Line #3 in the MEDEVAC Request is?
1. Radio frequency
2. Number of patients by precedence
3. Security at pick up site
4. Special equipment required

20-16. When establishing a helicopter landing site, the ground slope can be no more than ____ degrees.
1. 7
2. 15
3. 10
4. Helicopters cannot land on a slope.
For questions 20-16 through 20-19, use the following diagram:

A. Indicates the Reactivity  
B. Indicates Health Hazard  
C. Indicates Flammability  
D. Indicates any Special Hazards  

The National Fire Protection Association has developed a labeling system for indicating the health, flammability, and reactivity hazards of chemicals. The labels are made into squares to comprise a diamond-shaped label.

Match the color to the corresponding definition in the diagram above.

20-17. Red

1. A  
2. B  
3. C  
4. D

20-18. White

1. A  
2. B  
3. C  
4. D


1. A  
2. B  
3. C  
4. D

20-20. Yellow

1. A  
2. B  
3. C  
4. D

20-21. In HAZMAT management situations, site control is divided into 3 zones. In which zone does personnel decontamination happen?

1. Hot Zone  
2. Warm Zone  
3. Support Zone  
4. None of the above

20-22. When decontaminating personnel contaminated from a HAZMAT situation, the most frequently appropriate method of decontamination is?

1. Dilution  
2. Absorption  
3. Chemical Washes  
4. Disposal and Isolation
21-1. All of the following are measures first aid is intended to address EXCEPT?

1. Save Life  
2. Prevent further injury  
3. Replace proper medical diagnosis and treatment  
4. Preserve resistance and vitality

21-2. All of the following are rules to follow when providing first aid EXCEPT?

1. Maintain breathing  
2. Prevent or treat for shock  
3. Stop bleeding  
4. Panic at the first site of blood

21-3. Which one is NOT recommended when preparing for emergency situations?

1. Practicing skills in scenarios  
2. Keeping current on current emergency medical procedures and equipment  
3. Knowing your surroundings and resources available to you  
4. Familiarizing yourself with your equipment while responding to an emergency scene

21-4. Casualties in a non-tactical environment whose injuries are critical but who will require only minimal time or equipment are?

1. Priority I  
2. Priority II  
3. Priority III  
4. Priority V

21-5. What is the method for sorting casualties in a multiple casualty incident (MCI)?

1. F.I.N.I.S.H  
2. S.T.O.P  
3. Stop at the first patient I come to and provide for all their needs  
4. S.T.A.R.T

21-6. A patient in a tactical setting with an upper airway obstruction and life threatening bleeding would fall into which category?

1. Delayed  
2. Expectant  
3. Minimal  
4. Immediate

21-7. What is the maximum amount of time allowed for continuous suctioning of an infant’s airway?

1. 5 seconds  
2. 10 seconds  
3. 15 seconds  
4. 2 seconds

21-8. When inserting the Combitube® and after the device is sitting between the teeth and properly aligned between the printed black rings, what is the next step?

1. Inflate the white cuff  
2. Inflate the blue cuff  
3. Confirm tube placement  
4. Assess for spontaneous respirations
21-9. Casualties with a total upper airway obstruction, inhalation burns, or massive maxillofacial trauma who cannot be ventilated by other means are candidates for a King LT® airway.

1. True
2. False

21-10. When performing a needle chest decompression, what is the preferred size of the needle required to adequately decompress the chest?

1. 14 gage
2. 16 gage
3. 18 gage
4. 20 gage

21-11. Distributive shock is a loss of intravascular volume, which may occur from blood, plasma, or fluid loss.

1. True
2. False

21-12. All of the following are stages of shock EXCEPT?

1. Early
2. Irreversible
3. Compensated
4. Decompensated

21-13. Normally, a loss of approximately _____of the person’s blood volume will create a life-threatening condition.

1. 0.5 liters
2. 2 ounces
3. 1 gallon
4. 1 liter

21-14. A patient with a skin assessment of pale and cool and whose blood pressure dropped briefly would be considered to be in what type of shock?

1. Neurogenic
2. Psychogenic
3. Hypovolemic
4. Cardiogenic

21-15. Approximately how long does it take for death to occur from massive hemorrhage?

1. 4-6 minutes
2. 3-5 minutes
3. 10 minutes
4. 2 minutes

21-16. What is the most common cause of shock the HM will encounter?

1. Uncontrolled hemorrhage
2. Syncope
3. Dehydration
4. Sepsis

21-17. All of the following are components of the scene size up EXCEPT?

1. Safety
2. Mechanism of Injury
3. Number of Patients
4. Types of injury

21-18. The index of suspicion is derived directly from which of the following?

1. Mechanism of Injury
2. Number of patients
3. Scene assessment
4. Triage category
21-19. The general impression is crucial to identifying which of the following?

1. Transport decision
2. Patient’s overall systemic condition
3. Obvious significant external problems
4. All of the above

21-20. An interruption of arterial blood flow to the brain is best described as a/an ______. 

1. Convulsion
2. Cerebrovascular Accident
3. Syncopal episode
4. Epileptic episode

21-21. All of the following are steps in treating Syncope EXCEPT?

1. Lying patient down in shock position
2. Placing a cool cloth on the patient’s forehead
3. Loosening their clothing
4. Giving the patient something to eat

21-22. What does the acronym AVPU stand for?

1. Airway, Vital signs, and Pulses are Uniform
2. Alert, Verbal, Painful, Unresponsive
3. Analyze, Verify, Process, Uniformity
4. None of the above

21-23. What is the acronym used when assessing a patient during a rapid physical exam?

1. PASTHAM
2. ABCDE
3. SAMPLE
4. DCAP-BTLS

21-24. A patient experiencing respiratory distress can rapidly progress to full arrest. Always be prepared to utilize ______. 

1. AED
2. Advanced Airway procedures
3. CPR
4. None of the above

21-25. A patient experiencing respiratory difficulty should be forced to lie down in order to ease their breathing and reduce the workload on the body.

1. True
2. False

21-26. The HM can administer a nebulizer treatment without a medical officer’s order.

1. True
2. False

21-27. Which of the following is not a contraindication for using Activated Charcoal for patients suffering from poison ingestion?

1. Altered mental status
2. Unable to swallow
3. Patient is suspected of having swallowed acids or alkalis
4. Unable to speak
21-28. If a patient is hypotensive, then the systolic blood pressure is below what?

1. 110
2. 100
3. 90
4. 80

21-29. In cases of airway obstruction from severe glottic edema, what procedure may be necessary?

1. Needle chest decompression
2. Mouth to mouth ventilations
3. Cricothyroidotomy
4. Endotracheal intubation

21-30. During a patient assessment the HM notices that the patient seems to have a fruity breath odor, the HM suspects the patient is suffering from ______.

1. Hypoglycemia
2. Hyperglycemia
3. Alcohol poisoning
4. Drug Overdose

21-31. The HM suspects a patient is suffering from a brain injury. Upon assessment the HM discovers the patient has asymmetrical pupils, headache, nausea, and vomiting. The HM suspects the patient is suffering from ______.

1. A mild concussion
2. A migraine
3. A stroke
4. Increased intracranial pressure

21-32. Which of the following signs and symptoms is considered a late sign of a hemothorax?

1. Deviated trachea
2. Cyanosis
3. Shock
4. Coughing up frothy red blood

21-33. When treating a patient with an abdominal evisceration, it is acceptable to place the organs back inside the abdominal cavity in order to keep the organs warm and moist as well as prevent infection.

1. True
2. False

21-34. After the baby has delivered and the cord has been cut, which of the following steps is correct when delivering the placenta?

1. Pull on the umbilical cord until the placenta delivers
2. Push the cord back inside the mother
3. Start an IV
4. Wait approx 10-20 minutes for the placenta to deliver spontaneously

21-35. What is the first step in the management plan for care under fire?

1. Direct casualty to move to cover / apply self-aid if able
2. Protect casualty from sustaining further injury
3. Use a tourniquet for hemorrhage that is anatomically amendable to tourniquet application
4. Return fire / take cover
21-36. During Tactical Field Care, what is the best way to control compressible hemorrhage when a tourniquet is not amendable?

1. Use combat gauze as the hemostatic agent of choice with at least 3 minutes of direct pressure
2. Make the tourniquet work
3. Use a large battle dressing
4. All of the above

21-37. What is the usual dose of morphine for adult patients in severe pain?

1. 2-5 mg
2. 5-10 mg
3. 10-15 mg
4. 10-20 mg

21-38. Morphine can be given to patients who have suffered a head injury.

1. True
2. False

21-39. Which of the following steps in bleeding control are no longer utilized?

1. Apply Tourniquet
2. Elevate the extremity
3. Use of pressure points
4. Both 1 and 2

21-40. After bleeding has been controlled by a tourniquet, how is the patient marked?

1. A large “T” on the affected limb
2. A “T” marked somewhere on the body
3. A “T” with the time marked on the forehead
4. A patient care tag strapped to the patients clothing

21-41. What is the first step in treating for hypovolemic shock?

1. Maintain the Airway
2. Start an IV
3. Elevate the patients feet and keep warm
4. Take BSI precautions

21-42. Which type of suture material is best used for surface closures and cause very little tissue reaction?

1. Silk
2. Cotton
3. Catgut
4. Dermalon

21-43. The most common method of anesthesia used by the HM is the infiltration of the anesthetizing agent into the nerve trunks that innervate the fingers or toes.

1. True
2. False

21-44. For a large, gaping, soft-tissue wound, a primary closure is acceptable.

1. True
2. False

21-45. When cutting sutures, what is the maximum acceptable length for the tails to be?

1. 1/16 inch
2. ¼ inch
3. As short as practical for removal on the face and lip
4. As long as necessary for convenience
21-46. Any person who has an acute pain in the back or neck as well as a significant mechanism of injury, should be treated as though there is a fractured spine, even if there are no other symptoms.

1. True
2. False

21-47. When is it acceptable to move a patient with a suspected pelvic fracture?

1. Never
2. When absolutely necessary regardless of stabilization steps taken
3. When absolutely necessary after MAST garments have been applied to stabilize the pelvic region
4. All of the above

21-48. What method should be utilized when opening the airway of a patient who is suspected of having a spinal cord injury?

1. Head tilt, chin lift
2. Jaw Thrust
3. Tongue in cheek
4. None of the above

21-49. Never attempt to remove a foreign body stuck to or penetrating an eyeball.

1. True
2. False

21-50. When bandaging an eye with an impaled foreign object, what should be done?

1. Bandage the injured eye only
2. Bandage both eyes
3. Bandage neither eye
4. Remove the foreign object then bandage the eye

21-51. When applying **First Aid** for removing foreign objects, which statement below is **NOT** correct?

1. Remove bullets to aid in stopping bleeding
2. Do not attempt to remove powdered Glass
3. Do not attempt to remove widely scattered foreign objects or materials from the skin
4. Do not remove deeply embedded objects

21-52. When applying aid for animal bites, what should you **NEVER** do?

1. Wash the wound and surrounding area
2. Cover the wound with a clean sterile dressing
3. Cauterize areas that are bleeding to aid in transport
4. Transfer to nearest treatment facility for evaluation

21-53. What degree of thermal burns to the skin is characterized by epidermal blisters, mottled appearance, and a red base? Damage extends into but not through the dermis. Recovery usually takes 2 to 3 weeks.

1. Second degree burn
2. First degree burn
3. Third Degree burn
4. Fourth degree burn
21-54. The rule of nines assigns what percentage value for burns of the anterior chest and anterior neck?

1. 13
2. 14
3. 26
4. 28

21-55. Under normal conditions, heat exposure injuries are preventable injuries.

1. True
2. False

21-56. What is the most common condition caused by working or exercising in hot environments?

1. Heat Cramps
2. Heat Stroke
3. Heat Exhaustion
4. Death

21-57. Which cold injury is a mild cold injury that happens from prolonged exposure in temperatures above freezing to as high as 60 degrees F?

1. Immersion Foot
2. Frostbite
3. Chilblain
4. No injury results

21-58. A diluted solution of which of the listed substances will neutralize alkali burns to the skin?

1. Alcohol
2. Phenol
3. Vinegar
4. Baking soda

21-59. The usual treatment for chemical burns is to flush with copious amounts of water. The two exceptions to this rule are in the case of which of the following chemicals?

1. Phosphoric acid and lye
2. White phosphorus and carbolic acid
3. Dry lime and carbolic acid
4. Sulfuric acid and carbolic acid

21-60. What is the most effective method of re-warming a victim of hypothermia?

1. “Buddy warming”
2. Covering the victim with blankets or a sleeping bag
3. Hot water bottles at the neck, armpits, groin, and the chest
4. Immersion in a tub of warm water

21-61. How many additional atmospheres of pressure are applied at a depth of 33 feet in sea water?

1. 3
2. 14.7
3. 1
4. .445

21-62. What is NOT one of the three principle categories for injuries when discussing diving related disorders?

1. Decompression Sickness
2. Toxicities
3. Barotrauma
4. Trauma
21-63. A middle ear squeeze is classified under which type of diving injury?

1. Arterial Gas Embolism
2. Barotrauma
3. Dalton’s Law
4. DCS

21-64. The treatment for a middle ear squeeze consists of all the following EXCEPT?

1. Decongestants
2. NSAIDS for pain and inflammation
3. Administer ear drops for ruptured ear drum
4. No diving chit

21-65. Which law deals with Decompression Sickness (DCS)?

1. Dalton’s Law
2. Henry’s Law
3. Boyle’s Law
4. Nature’s Law

21-66. Which statement below is NOT applicable for treatment of Decompression Sickness?

1. 100% oxygen by mask
2. Obtain a dive history
3. Contact the closest Recompression Facility, Dive Medical Officer, or Dive Medical Technician.
4. Do not pressurize the cabin of aircraft when transporting to treatment facility
22-1. Poisoning is defined as contact with or exposure to a toxic substance.
   1. True
   2. False

22-2. Toxicology is defined as the science of poisons.
   1. True
   2. False

22-3. A patient presents with dilated pupils, fever, dry skin, urinary retention, decreased bowel sounds, and increased heart rate. What toxidrome does this set of symptoms suggest?
   1. Narcotic
   2. Anticholinergic
   3. Withdrawal
   4. Non-syndrome syndrome

22-4. A patient presents with salivation, lacrimation, urination, and muscle weakness. What toxic syndrome does this set of symptoms suggest?
   1. Anticholinergic
   2. Cholinergic
   3. Narcotics
   4. Sympathominetic

22-5. What is the most common route of exposure to toxic chemicals in the home?
   1. Absorbed
   2. Injected
   3. Ingested
   4. Inhaled

22-6. Which of the following is the method of choice for the HM to use to induce vomiting?
   1. 15-30 cc of syrup of Ipecac
   2. 2 teaspoonfuls of dry mustard in water
   3. 2 teaspoonfuls of an active charcoal slurry
   4. To tickle the back of the victim’s throat

22-7. When a patient ingests an acid or base treatment is to give a neutralizing agent orally.
   1. True
   2. False

22-8. If the HM is unable to reach the poison control center or a physician for specific instructions, how should the HM treat a victim who has ingested turpentine?
   1. Induce vomiting and observe
   2. Give 1 to 2 ounces of vegetable oil orally
   3. Neutralize the poison with vinegar and water
   4. Give 1 to 2 tablespoonfuls of milk of magnesia

22-9. Of the following, which is considered the most common agent in inhalation poisoning?
   1. Carbon dioxide
   2. Carbon monoxide
   3. Freon
   4. None of the above
22-10. Treatment for an inhalation poisoning victim includes all of the following EXCEPT?

1. Removal from the contaminated atmosphere
2. Administration of oxygen
3. Administration of stimulants
4. Treatment for shock

22-11. A patient presents exhibiting signs of anaphylactic reaction to a bee or wasp sting. Of the following, which is NOT considered appropriate treatment?

1. Removal of patient’s jewelry
2. Subcutaneous injection of epinephrine
3. Warm packs over the sting site
4. Removal of the stinger by scraping with a dull knife

22-12. The victim of a scorpion sting may safely be given any of the following pharmaceuticals EXCEPT?

1. Demerol or morphine
2. Calcium gluconate
3. Valium
4. All the above are acceptable

22-13. Symptoms of a black widow spider bite may include severe pain, dyspnea, and _______.

1. Obvious swelling
2. Abdominal rigidity
3. A necrotizing lesion
4. Fever and chills

22-14. Crotalids are identified by _______.

1. Slit-like pupils of the eyes
2. Flat, triangular heads
3. Semi curved bite marks
4. Both 1 and 2

22-15. What is the key identifying feature of the North American coral snake that distinguishes it from other snakes with similar markings?

1. The yellow band is always next to the red band
2. The red band is always next to the black band
3. It has a distinctive bite pattern
4. It has deep pits below the eyes

22-16. On patrol, a member of the unit receives a rattlesnake bite just below the elbow. What first aid treatment should be performed?

1. Place a tourniquet 1 inch proximal to the bite site
2. Place a constricting band 2 inches proximal to the bite site
3. Place a constricting band 2 inches distal to the bite site below the elbow
4. Both 2 and 3 above

22-17. Valuable information on the antivenom is found in the package inserts.

1. True
2. False

22-18. The Puffer, Surgeon, Trigger, and Parrot fish are known to be _______.

1. Poisonous at all times
2. Poisonous to the touch
3. Not poisonous
4. Poisonous during red tide
22-19. A person suffering from a Venomous Fish sting should?

1. Soak the wound in hot water for 30 to 90 minutes
2. Apply Ice packs to the wound
3. Urinate on the wound
4. Apply a tourniquet

22-20. Identify the fish with which there is antivenom available.

1. Stonefish
2. Scorpionfish
3. Zebrafish
4. All of the above

22-21. Antivenin is available to neutralize the effects of the following types of Coelenterates?

1. Portuguez man o war, sea blubber
2. Sea anemone, rosy anemone
3. Box jellyfish, sea nettle
4. Sea wasp, box jellyfish

22-22. How many hours after the last dose does narcotic withdraw normally peak?

1. 2 hours
2. 24 hours
3. 48 hours
4. 72 hours

22-23. The most widely abused drug(s) is/are?

1. Ethanol
2. Opiates
3. Barbiturates
4. Amphetamines

22-24. Which of the following is not a symptom of alcohol abuse?

1. Nausea
2. Vomiting
3. Confusion
4. Increased level of consciousness

22-25. Withdrawal from barbiturates is less life threatening than narcotic withdrawal.

1. True
2. False

22-26. Central nervous system stimulants are used for all of the following EXCEPT?

1. Decrease mental alertness
2. Combat drowsiness
3. Fatigue
4. Attention Deficit Hyperactivity Disorder (ADHD)

22-27. Signs and symptoms of stimulant intoxication include all of the following EXCEPT?

1. Hypertension
2. Increased appetite
3. Dilated pupils
4. Increased body temperature

22-28. A person may display which of the following sign(s) after using a hallucinogenic drug?

1. Pin-pointed pupils
2. Decreased heartbeat
3. Flushed face
4. Both 2 and 3 above
22-29. Marijuana falls into which of the following categories of drugs?

1. Barbiturate
2. Physically addicting
3. Cannabis
4. Harmless

22-30. Persons who regularly abuse inhalants risk which of the following injuries?

1. Severe brain damage
2. Damaged internal organs
3. Death
4. All of the above

22-31. In caring for drug-intoxicated persons, the HM should perform what actions as the first priority?

1. Check for an adequate airway
2. Keep the victim awake
3. Induce vomiting if the victim is awake
4. Transport to a medical facility
ASSIGNMENT 23

Book Assignment: “Medical Aspects of Chemical, Biological, and Radiological Warfare,”
pages 23-1 to 23-34

23-1. When was the first large scale use of chemical agents?
1. WW I
2. WW II
3. Iraq War
4. Vietnam

23-2. Terrorists will not use chemical agents because they are difficult to make.
1. True
2. False

23-3. M9 Chemical Agent Detection Paper turns what color if a nerve agent is present?
1. Gold
2. Green
3. Red
4. Yellow

23-4. M8 Chemical Detection Paper turns what color when it comes into contact with VX?
1. Yellow
2. Red
3. Purple
4. Green

23-5. M8 Chemical Detection Paper turns what color when it comes into contact with G class nerve agents?
1. Yellow
2. Red
3. Purple
4. Green

23-6. What MOPP Level affords the most protection?
1. 1
2. 2
3. 3
4. 4

1. True
2. False

23-8. Nerve agents enter the body through what area.
1. Eyes
2. Skin
3. Respiratory Tract
4. All the above

23-9. A MARK 1 Kit consists of?
1. Atropine
2. 2-PAM CL
3. CANA
4. Both 1 and 2
23-10. For severe nerve agent symptoms give how many MARK 1 kits in a row?

1. 1
2. 2
3. 3
4. 4

23-11. How many MARK 1 kits can a non-medical person give?

1. 1
2. 2
3. 3
4. None

23-12. How long do you wait after giving the first MARK 1 kit before giving another in a patient with moderate symptoms?

1. 1 to 2 minutes
2. 3 to 5 minutes
3. 10 to 15 minutes
4. Only one can be given

23-13. To decontaminate a patient with nerve agent you use?

1. Soap and Water
2. 0.5% hypochlorite solution
3. M291
4. All of the above

23-14. Chemical agents H, HD, and HN are all what type of agents?

1. Nerve
2. Blister
3. Riot
4. Pulmonary

23-15. Symptoms of mustard agent contact are?

1. Miosis
2. Paralysis
3. Blisters
4. Dizziness

23-16. What antidote is used for lewisite?

1. Atropine
2. BAL
3. 2-PAM CL
4. CANA

23-17. Decontamination of blister agents within two minutes will reduce the toxic effects by?

1. 10%
2. 25%
3. 50%
4. 75%

23-18. Which of the following is a blood agent?

1. AC
2. HD
3. CS
4. CG

23-19. What is the initial treatment for cyanides?

1. Atropine 10mg IM
2. BAL
3. Sodium Nitrate, IV
4. CANA 10mg IM

23-20. Which agent smells like new mown hay?

1. CG
2. Cl
3. DP
4. AC

23-21. CS is a highly toxic substance.

1. True
2. False
23-22. Lacrimators are also known as?
1. Tear Gas
2. Nerve Gas
3. Blood Agents
4. Chocking Agents

23-23. Decontamination for harassment agents generally consists of?
1. Use of M291
2. 0.5% Bleach Solution
3. Washing with baby shampoo
4. Exposure to wind

23-24. The first priority for first aid for a chemical agent patient is?
1. Control massive hemorrhage
2. Decontaminate exposed skin
3. Treat for shock
4. Adjust patients mask

23-25. Initial management of a chemical agent casualty is?
1. Removal of MOPP gear
2. Decontamination with 0.5% hypochlorite solution
3. Both 1 & 2
4. None of these

23-26. What are the three types of Biological Agents?
1. Fungus, Bacteria and Viruses
2. Fungus, Bacteria and Toxins
3. Bacteria, Viruses, and Toxins
4. Viruses, Toxins, and Fungus

For questions 20-29 through 20-35, use the following diagram:

Match the following examples to the class of Biological Agent.

23-27. Anthrax
1. A
2. B
3. C
4. D

23-28. Plague
1. A
2. B
3. C
4. D

23-29. Smallpox
1. A
2. B
3. C
4. D

23-30. Ricin
1. A
2. B
3. C
4. D

23-31. Marburg
1. A
2. B
3. C
4. D
23-32. Botulism
   1. A
   2. B
   3. C
   4. D

23-33. Ebola
   1. A
   2. B
   3. C
   4. D

23-34. Biological outbreaks that occur in multiple geographical locations are classified as?
   1. Natural Occurrence
   2. Intentional Release
   3. Both 1 and 2
   4. Small scale

23-35. Which of the following is NOT an indicator of biological agent release?
   1. Unusual disease for geographic area
   2. Absence of competent natural vector
   3. Restricted geographical distribution, epidemiological grouping or clustering
   4. Low morbidity and mortality compared with a normal occurrence of the disease

23-36. Viruses can be treated with the use of antibiotics.
   1. True
   2. False

23-37. Viral Hemorrhagic Fevers are susceptible to?
   1. Air
   2. Phenolic Disinfectants
   3. 1% Bleach Solution
   4. Both 2 & 3

23-38. A dirty bomb could be used by a terrorist organization.
   1. True
   2. False

23-39. What type of radiation is sometimes called penetrating radiation?
   1. Alpha
   2. Beta
   3. Gamma
   4. None of these

23-40. A lethal full body dose of radiation is?
   1. 4 to 5 rem
   2. 4 to 5 Sv
   3. 400 to 500 mrem
   4. 40 to 50 mSv

23-41. What is the most effective shielding?
   1. MOPP Suit
   2. Wood
   3. Aluminum
   4. Lead

23-42. The time of onset of which symptoms will give you an estimate of radiation dose/exposure?
   1. Diarrhea
   2. Nausea and Vomiting
   3. Seizures
   4. Ataxia
23-43. Once a patient is removed from a radiation source, Chronic Radiation Syndrome symptoms will resolve.

1. True
2. False

23-44. Injuries resulting from a nuclear explosion are treated differently.

1. True
2. False

23-45. A patient can be certified decontaminated from a radiological incident with?

1. M256A1
2. M291
3. AN/PQS 2A
4. AN/VDR 2
24-1. The HM may provide temporary emergency dental treatment under which of the following conditions?

1. To combat infection
2. To provide relief from pain
3. To prevent further damage to oral structures
4. All of the above

24-2. If a patient reports to the dental clinic after hours with a toothache, which of the following steps should the duty HM first take?

1. Give the patient 2 aspirins and schedule a sick call appointment for the next day
2. Notify the duty dental officer
3. Notify the duty medical officer
4. Place a temporary filling, check the occlusion, and make an appointment for the patient

24-3. Which of the following choices best describes a symptom?

1. HM observes bleeding gums
2. HM observes a fractured tooth
3. The patient informs the HM of a toothache
4. All of the above

24-4. Which of the following choices best describes a sign?

1. HM observes a large hole in a patient’s tooth
2. Patient tells the HM that he/she chewed a piece of ice
3. Patient tells the HM that he/she has the filling in a pocket
4. Patient tells the HM that he/she has been in pain for 2 weeks

24-5. When pain from an affected tooth manifests to a healthy, non-involved tooth, what is the condition called?

1. Referral symptom
2. Referred pain
3. Pain manifesto
4. TMJ

24-6. Which of the following conditions exists if a patient is experiencing pain caused by the pressure of fluid building up inside the pulp chamber?

1. Periapical abscess
2. Periodontitis
3. Acute pulpitis
4. Pericoronitis

24-7. Which condition exists when swelling is confined to a small area at the site of a sinus tract?

1. Sinus abscess
2. Grape abscess
3. Cellulitis
4. Gumboil

24-8. When performing an emergency treatment for a periapical abscess, what instrument will be used to drain the abscess?

1. Bard Parker and #15 blade
2. Explorer
3. Syringe
4. None of the above
24-9. A patient with a periapical abscess may complain of which of the following symptoms?

1. Teeth are loose
2. The tooth “feels longer” than the others
3. A “deep, gnawing pain” in the affected area
4. Excessive bleeding

24-10. What type of inflammation is present in marginal gingivitis?

1. Cratered
2. Severe
3. Oozing
4. Mild

24-11. Necrotizing ulcerative gingivitis (NUG) is commonly referred to by what term?

1. Trenchcoat
2. Trenchmouth
3. Foul mouth syndrome
4. Glowing gums syndrome

24-12. What colored membrane will be covering the gingiva if a patient has NUG?

1. Bluish-grey
2. Reddish-white
3. Bluish-white
4. Gray-white

24-13. Periodontitis usually results from what untreated condition?

1. Marginal gingivitis
2. Congenital birth defect
3. Juvenile periodontitis
4. Periodontal syndrome

24-14. Which of the following conditions exist if a patient complains that their gums are “itching”?

1. Periodontal abscess
2. Periodontitis
3. Acute pulpitis
4. Pericoronitis

24-15. What is the correct emergency treatment for a periodontal abscess?

1. Irrigate affected area with a 3-way syringe
2. Use a soft-bristled toothbrush and angle the bristles on the affected area using the “Bass Technique”
3. Gently probe the affected area with a scaler to establish drainage
4. Use an explorer and puncture the most raised portion of the abscess to express the pus

24-16. Which of the following solutions should be used to irrigate the tissue flap if a patient has pericoronitis?

1. Glycerite of iodine
2. Warm saline solution
3. Hydrogen peroxide
4. Flap conditioner

24-17. What are the two common types of stomatitis found in the oral mucosa?

1. Genital herpes and aphthous stomatitis
2. HIV and aphthous stomatitis
3. Herpetic and cold sores
4. Herpetic and aphthous stomatitis
24-18. Bleeding from an extraction site is referred to by which of the following terms?

1. Postextraction alveolar osteitis
2. Postextraction hemorrhage
3. Postbleeding hemorrhage
4. Dry socket hemorrhage

24-19. Postextraction alveolar osteitis is a condition commonly referred to by what term?

1. Dry socket
2. Dry tooth
3. Dry clot
4. Dry hole

24-20. To treat post extraction alveolar osteitis, what type of dental material is placed in a tooth socket?

1. 2 x 2 gauze pad with eugenol
2. Penrose drain with eugenol
3. Iodoform gauze with eugenol
4. Cottonballs with eugenol

24-21. Tooth fractures are classified into how many different types?

1. 1
2. 2
3. 3
4. 4

24-22. Fractured teeth can involve which of the following areas of a tooth?

1. Enamel and dentin only
2. Enamel, dentin, and pulp only
3. Enamel, dentin, pulp, and root
4. Enamel, dentin, and cementum only

24-23. Which of the following dental materials will be used to treat a Type I fracture?

1. Cavity varnish
2. Temporary splint
3. Temporary crown form
4. Zinc oxide and eugenol

24-24. A Type II fracture involves an exposure of the pulp.

1. True
2. False

24-25. HMs who provide emergency treatment of a fractured mandible will use which of the following materials?

1. Arch bars and wires only
2. Dental splints only
3. Both 1 and 2 above
4. Elastic bandage
### ASSIGNMENT 25


25-1. All of the following Decedent Affairs Programs are utilized to carry out standard responsibilities **EXCEPT**?

1. Current Death
2. Graves Registration
3. Concurrent Death
4. Casualty Assistance Calls Program

25-2. Which program is initiated during major military operations?

1. Current Death
2. Graves Registration
3. Concurrent Return
4. Return of Remains

25-3. Which of the following will **NOT** require submission of a Personnel Casualty Report?

1. Prisoner of War
2. All active duty members
3. Active duty Navy
4. Retired Navy inpatient at MTF

25-4. The PADD should be notified of a death during what hours of operation?

1. 0600-2300
2. 0500-2400
3. 0700-2300
4. 0800-2200

25-5. A CACO is normally assigned to assist the needs of family members for what period of time?

1. 30 days
2. 45 days
3. 60 days
4. 90 days

25-6. The Commanding Officer must write a letter of condolence to the appropriate NOK within what time frame?

1. 24 hours
2. 36 hours
3. 48 hours
4. 1 week

25-7. When an individual is involved in a motorcycle or automobile accident or under the care of a physician and death occurs, they must receive an autopsy.

1. True
2. False

25-8. When an autopsy is desired but not required permission must be granted from the PADD.

1. True
2. False

25-9. What type of message should be used to notify BUMED and Navy Mortuary Affairs of a disaster resulting in the death of naval members?

1. Priority
2. Flash
3. Single Address
4. General

25-10. When a search and recovery operation continues longer than 36 hours how often is a report submitted to BUMED?

1. 72 hours
2. 48 hours
3. 24 hours
4. 12 hours
25-11. Which of the following determinations is **NOT** made by Navy Mortuary Affairs?

1. Unidentifiable
2. Identification of remains
3. Unidentified, unknown
4. Group remains, known individuals

25-12. The Navy awards annual mortuary contracts to local funeral homes anticipating what minimum number of deaths per year?

1. 1
2. 2
3. 3
4. 4

25-13. What type of contract is utilized when there are no mortuary contracts in effect?

1. Private contract
2. Single funeral contract
3. Local contract
4. One time contract


1. A
2. B
3. C
4. D


1. A
2. B
3. C
4. D


1. A
2. B
3. C
4. D

25-17. Grave plot.

1. A
2. B
3. C
4. D


1. A
2. B
3. C
4. D


1. A
2. B
3. C
4. D

25-20. Prior to the transportation of remains they may be refrigerated below what degrees Fahrenheit?

1. 55°
2. 50°
3. 45°
4. 40°
25-21. Who may be able to provide mortuary services if death occurs in an area not served by Navy facilities?

1. Department of Homeland Security  
2. Department of the Interior  
3. Department of State  
4. Department of Treasury

25-22. What form must accompany the remains of a member to a CONUS point of entry from OCONUS?

1. DD 2064  
2. DD 1146  
3. DD 771  
4. DD 1141

25-23. How many copies of the Statement of Recognition (DD 565) must accompany the remains?

1. 1  
2. 2  
3. 3  
4. 4

25-24. What are the dimensions of the standard and oversized naval caskets?

1. 24x80 and 22x77  
2. 25x80 and 23x77  
3. 25x81 and 22x78  
4. 25x81 and 23x78

25-25. When the mortician is unable to seize the odor of remains, they will not be accepted for burial at sea.

1. True  
2. False

25-26. Which of following is NOT an authorized method of primary transportation for remains?

1. Government air  
2. Funeral coach  
3. Train  
4. Chartered taxi

25-27. Cremated remains may be shipped to a CONUS point of entry via commercial air.

1. True  
2. False

25-28. When transporting remains of death resulting from a communicable disease, there is a label placed on the transfer case that states ______.

1. Contagious  
2. Warning  
3. Communicable disease  
4. Infectious

25-29. To be selected as an escort of remains you must meet all of the following criteria EXCEPT?

1. Same branch of service  
2. From the same city  
3. Same pay grade  
4. Same status

25-30. The escort selected by the PADD is also known as ______.

1. PADD escort  
2. Duty escort  
3. Special escort  
4. None of the above
25-31. Who is ultimately responsible for assigning an inventory board for the personal effects of a deceased member?

1. NAVPERESCOM
2. Commanding Officer
3. Supply Officer
4. BUMED

25-32. To whom, must an application requesting a commercial headstone be submitted?

1. MEDDEN Affairs
2. Mortuary Affairs
3. NAVPERSCOM
4. Veteran Affairs

25-33. When requesting funds for services of deceased military personnel other than Navy and Marine Corps, what form is used?

1. DD 1375
2. DD 2062
3. MED 5360-3
4. DD 2063

25-34. Which of the following is not a classification for national cemeteries?

1. Open
2. Closed
3. New
4. Planned

25-35. Any Navy or Marine Corps member serving on active duty at the time of death may be buried in any open national cemetery including Arlington, Virginia (with requirements met).

1. True
2. False