STARFLEET MARINE CORPS

# COMBAT MEDICINE BRANCH MANUAL

Revision 2017

# SUMMARY OF CHANGES

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# SUMMARY OF CHANGES CONTINUED

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# MEDICAL
# BRANCH MANUAL

## 2017 Edition

By Order of the Commanding Officer, Training and Doctrine Command (COTRACOM).

Shane Russell
Major General
COTRACOM

*Shane Russell*

Official:

Steve Bice
Brigadier
SFMC Surgeon General

*Steve Bice*

**NOTE.** *This manual is not intended as a legitimate medical reference. No medical information presented in this book should be interpreted as actual medical advice. This is a work of fiction! You should not attempt to offer any type of first aid or medical treatment based on anything you read in this manual! Get it? This is not for real!*

**History .** The following are the Editions when this manual was published.

xxxx Revision
xxxx Revision
2009 Revision
2017 Revision

**Summary.** Welcome to the 4th revision of the Medical Branch Guidebook of the STARFLEET Marine Corps (SFMC). This publication is intended primarily for members of the SFMC, which is a component of STARFLEET, The International Star Trek Fan Association, Inc. (SFI). However, anyone with an interest in our part of the Star Trek universe is invited to look and learn.

This manual was created for members of the SFMC, their friends, and others with an interest in the Medical Branch concept of Star Trek as it is applied by the SFMC. It is intended to serve as a handy reference work for members of the Medical Branch. It covers the equipment, techniques, missions, and organization of the SFMC Medical Branch. In short, it is a one-book source for the new Medical member wherein they can get the information they need to know to role-play as a member of the Medical Branch.

The majority of this work is obviously fictional in nature, but the references to uniforms and insignia of the SFMC are accurate. It is intended to provide a source of "background material" for members of the SFMC Medical Branch, and/or anyone interested in the concept of the Medical Branch in the 24th century. It is not intended to be the last word on the subject, however, as branch material is constantly being revised, upgraded and updated by the members of the branch themselves.

**Reporting Authority.** The governing authority for training information is the Commanding Officer, Training and Doctrine Command (COTRACOM). Send questions, comments, or suggestions to: Tracom@sfi-sfmc.org

**Distribution.** This publication is available in electronic media only and is intended for the use by Starfleet Marines attending the SFMCA Medical Branch School.

**Pronoun Disclaimer.** The use of he/his/him, etc., and in particular the term "man" as in "crewman", are used for convenience as the standard English language conventions of unknown- gender pronouns. Not very politically correct, perhaps, but grammatical... and a lot less awkward than crewpersons". The point is we don't mean anything by it. Women in the service are just fine with us.

**Acknowledgements.** This revision of the Medical Branch guidebook by Steven E Bice Jr. is the 4th revision of the manual produced by Chris Esquibel, Greg Franklin, Jill Rayburn, Sean Niemeyer, Sofyan Sahrom, & TRACOM. This manual would not have been possible without the dedicated efforts of the following people from the past: Nancy Lynch, Raye Crews, Rex Prior, and others.

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**Dedication.** "To the people that put themselves in harm's way so that others may live."

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# Part 1 - Introduction

## How to use this manual

Dear Medical Branch Student,

This Medical Branch Guidebook is organized in similar fashion to the other SFMC Branch Guidebooks as a general reference for information and medical protocols of the Medical Branch. It begins with the history of military medicine, organization of the Medical Branch and the different techniques and protocols in the medical branch. Also included in the appendices are some notes on:

- Comparative anatomy of the three species of the Federation,
- A glossary of medical terms, slang and acronyms, and
- Sample career progressions for Nursing Officers and Medical Specialist of the SFMC Medical Branch.

Depending on the initial level of medical knowledge, the appendices especially the glossary is likely to be very useful for those with minimum or no background medical knowledge, and will likely be referred to a lot while reading the manual. In this case, it is suggested that a printout of the glossary be made for easy reference and learning while reading the manual. The reason for this is because the manual originally is written to be read by any personnel with elementary medical knowledge to allow a balance so that students with but that those with some medical knowledge would not be totally bored while students with minimum or no medical knowledge would not be totally lost.

Also in the words of Brigadier General John Robert, "this guidebook is just a general introduction to some of the things you will be learning" (Roberts, Medical Branch Manual, 2006). It is essentially a familiarization guide and NOT meant to be a form of medical reference. While the procedures and protocols in this manual are based on real-life medicine, it is not meant to be performed by personnel without proper and further real-life training.

Finally, I would like to welcome you to the Medical Branch regardless of whichever Corps of the Branch you choose to be trained and serve in. As ultimately, we are here to provide "care above and beyond the call of duty" for the Marines of the SFMC.

Welcome to the Medical Branch, and enjoy this introduction to the world of medicine on which you are about to embark! In a few months, you will be able to help us provide "care above and beyond the call of duty."

Semper Fidelis,
BDR Steven E Bice Jr, SFMD
Surgeon General of the SFMC
Director, Medical Branch
Starfleet Marine Corps

## Part 2 - Story: "The Golden Hour"

It's been a hard day. Following Murphy's Laws of combat, you and your Powered Infantry platoon had taken more than your share of objectives today, so you were given more than your fair share to take. But take them you did, and now in your new field headquarters, it is time to call it a day. A perimeter has been secured and the town cleared of enemy infantry. Prisoners have been passed on to the Military Police units from your support unit, and your platoon is breaking out of its suits for diagnostics, repairs and maintenance. This town isn't the end of your advance, and you're going to have a busy day tomorrow.

You're helping one of your squad leaders check out a damaged suit. You glance at your chronometer: 2200 hours exactly. Another hour and maybe you can get some sleep. You say as much to your squad leader when suddenly his head bursts open and showers you with bloody fragments. You hear someone in the distance yell "Sniper!" and you turn toward the noise. Before you get completely turned around you feel a crushing pain in your chest and you fall to the ground. You try to catch your breath, but your lungs won't fill with air. You try to yell for help, but all that you hear escape your lips is a sickening gurgling sound. You suddenly feel cold. Then there is darkness.

Fortunately for you, your headquarters is not completely caught off guard. The direction of fire is quickly located, and Light Infantry counter snipers attempt to remove the enemy from his hiding place. In the meantime, the call for medics has gone out on the combat net. It has only been three minutes since you've been shot.

It has been a critical three minutes, though. It is the start of a race, which will now be run between death and your field combat medical team. The first 60 minutes of the race will be the most critical-your med team calls it, "The Golden Hour". Whether you live or die will largely be determined by who's ahead at the end of this first 60 minutes, and right now, death has a good head start.

By the time the enemy fire is suppressed and the medics reach you, almost five minutes have passed since you were shot. It is obvious that it is too late for your squad leader, so the medics immediately examine you. At first it is difficult for them to distinguish your injuries from the blood and debris sprayed on you by your squad leader's injury. Quickly enough, though, one medic discovers the dime-sized hole in your chest. His tricorder tells him you're still alive, but only barely. Almost seven minutes have passed. Death is heading into the first turn, and your medics are still at the starting line.

If your medics have a hope of winning, they are going to have to quickly make up for lost time. Their tricorder is checking and recording a number of diagnostic measures, but for now, their primary concern is to "scoop and run". They must get you to a better-equipped medical facility now. The tricorder tells them there is no spinal injury, so they quickly strap you to an antigrav gurney and load you into the S-30 Valkyrie they use as an ambulance. Unfortunately for you, orbital jamming from enemy starships is still preventing reliable transporter use.

Once inside the ambulance, they try to stabilize your death spiral. Although they are well-trained, well-conditioned professionals, this is still a hectic time for them; they know that everything they do, or don't do, in the next few minutes may be the difference between life and death. The first priority for them is the same as it's been for centuries in emergency medicine, the basic ABCs of life support: Airway, Breathing, and Circulation. Your brain must have oxygen to manage your life support systems, so the medics' first job is to establish a flow of oxygen from an outside source to the brain.

The first order of business is to clear an airway that allows oxygen to flow into the patient's lungs. The tricorder has already told the medic there are no obstructions in your airway, but your breaths are shallow and unproductive. This brings up point two: make the patient's lungs work properly so oxygen can get into the bloodstream. The tricorder supplies the medic with the source of your breathing problem: left breath sounds absent. Both medics know the significance. The bullet must have pierced a lung, collapsing it like popping a balloon. Your chest cavity is filling with blood and air, crushing your lung. A moment later, the tricorder reaches the same diagnosis: hemopneumothorax.

To get enough air into the remaining lung to provide your body with oxygen, the medics are going to have to help you breathe. They are painfully aware that time is short, so they decide to intubate, that is, to place a specialized combitube into your oral cavity, sealing off the esophagus and providing a direct passage for air into your lungs (it may seem archaic, but it's fast and it works!).

While one medic deftly inserts the combitube, the other administers a hypospray of tri-ox compound to supply a quick boost of oxygen to your bloodstream. He follows this with a small patch on your neck. The inside of the patch is filled with "microneedles"-microscopic hypodermics each filled with a time-release dosage of Dobutrex. The Doubutrex will constrict your blood vessels and help prevent hypovolemic (low blood volume) shock. Then a low-level forcefield at the foot of the gurney is switched on, which gently presses on your lower extremities to keep what blood remains inside your body in your torso and head where it is needed.

While the meds and force field are administered, the first medic attaches a small field ventilator onto the end of the combitube, which will inhale for you and gently push the air into your good lung. Were powered medical devices not available, the task would be done by a simple plastic bag that would be squeezed by the medic, known an ambu-bag. He then applies an occlusive dressing to your chest wound to prevent more air from being sucked in through the opening. The medics glance at the ambulance's chronometer: 2213 hours.

One medic continues to read the tricorder's results to the other. Next is your blood pressure (BP): "60 over 40" he whispers. That's low for a human (hypotension is the term for low blood pressure), and it's due to the amount of blood you're losing from the bullet wound. BP measures how well blood circulates through your arteries. The first number is the systolic pressure, or pressure at the peak of the circulation cycle when the heart contracts. The second number is the diastolic pressure while the heart relaxes. Sufficient pressure is needed to send blood through your body and provide oxygen. If there is a leak in the system and a lot of blood is lost, the systolic pressure starts to drop. When it drops too low, not enough oxygen is getting to the brain. A systolic pressure of 60 is too low for you to live much longer.

The medics can't plug the leak right away. That's going to require a surgeon and a field hospital. So, they take another approach: they increase the pressure by adding more fluid to the system-they start an IV. Intravenous fluids supplement the blood supply to make up for the blood volume lost through the leak. If they weren't terribly familiar with your physiology, the medics would use a simple saline solution. However, your dog tags show them that you are one of the 75% or so of humans that will accept artificial blood (technically known as pseudohemato replacement fluid, or PRF to the medics). This is a small piece of good news for you, as the PRF will help get oxygen to your brain as well as simply adding fluids.

While all this has been going on, the S-30's pilot has been getting you airborne. Getting back to the field hospital will be no mean feat either: much of the intervening territory is not secure, and the enemy rarely heeds the large red cross on the side of the Valkyrie. The skill of a combat pilot is often required. The medics report some hopeful results through the med net: your blood pressure is slowly rising and your pulse is strengthening. The first lap is over, and the medical team is back in the race.

The med net is the radio system operated by the field medical teams. It connects them to the combat net (the radio system used by combat units) as well as to whatever systems of field hospitals and mobile surgical hospitals have been established in an area. In this case, there is a field hospital not far, and the medics have already been in touch with them. Their tricorder data has been downloaded to the trauma team at the hospital, and they have confirmed the medics' diagnosis and treatment. They are standing by with a surgical team at the hospital to repair the damage to your chest.

At 2220 the field hospital is crowded. A lot of Marines have been injured in the battle today. The stasis tubes are full, so any more patients that come through the doors between now and the hospital ship pickup will either be stabilized, healed, or will die without the chance of being 'frozen' for later treatment. The good news is, you've hit a slight lull, and there is a trauma team available to attend to you as soon as the Valkyrie lands. The trauma team is waiting on the landing pad. The doctor in charge of the team rushes up to the medics as the rest of his team begins to extract you from the rear of the ambulance.

The Medics give the 'bullet' to the doctor. This is the slug of vital information about your case, "Twenty-eight-year-old human male. GSW to the upper left chest, BP 80 over 40, no lung sounds on the left. IV PRF running wide open." This means the faucet-type valve controlling the rate at which the IV fluids enter your body is open as far as it can go. "500 milliliters Tri-Ox IV push and point 22 milligrams Dobutrex sub-Q over one minute." The information confirms what the doctor has seen from the tricorder download. Like sprinters passing the baton, the medics pass you on to the trauma team for the remaining laps of the race. Their job is done.

Now it is up to an entirely new crew to bring you into the final stretch. With less than 40 minutes in your golden hour left, though, there is hope. Once you reach a fully equipped medical facility, your chances of survival increase exponentially. For here, the medical team has a complete and immediate real-time display of your condition and all the damage to your body.

By far the largest strides in medicine in the last century have been in diagnostics. In a fully equipped hospital, there is no worry of missing a bleeding vessel or other undetected collateral damage from a wound such as this. Once you are on the biobed, the doctors will be able to see everything that is wrong with you and will be able to repair it almost as easily.

Once on the biobed, the doctor closes the Surgical Support Frame (SSF) around your chest. This is a clam shell contraption that houses diagnostic equipment, micro surgery tools, real-time visual displays of your organs, and a sterile field to allow work on you without risk of infection. The SSF shows your hemopneumothorax: your lung has collapsed, and blood and air seeping into the chest cavity are preventing it from re-expanding. The lung needs to be reinflated, both to help you breathe and to help control the bleeding.

Without even consulting the SSF, though, the doctor can tell there are complications. Your trachea is not in the center of your neck where it should be, but is slowly shifting to the side opposite your wound. You are developing a tension hemopneumothorax: your lungs and heart are undergoing a mediastinal shift, that is, the air in your chest cavity is pushing the organs in your chest out of place, and they will eventually squeeze off the great vessels of your heart and kill you if the pressure is not relived soon.

But there are other problems too. The bullet was not an explosive round, but rather a soft-cored hollow-point, which was intended to expand on impact and do as much internal damage as possible. It worked. In addition to your tension hemopneumothorax, you are also developing a cardiac tamponade. The membrane surrounding your heart, the pericardium, is filling with blood. If it continues to do so, it will eventually suffocate your heart, building up pressure in the sac until the heart can no longer function.

Fortunately, your med team has all the modern computerized power tools available to 24th century emergency physicians. The tension hemopneumothorax is relieved with a chest tube inserted by the SSF, and then the hole through the chest and lung is repaired with a tissue regenerator, which closes the holes in successive layers of tissue between the lung and skin. The tube is slowly withdrawn, with the regenerator following closely behind to seal up afterward.

The fluid in the pericardium is evacuated with a pinpoint transporter beam known as a tissue transporter. The holes in the blood vessels causing the bleeding are closed easily with precision blood vessel regenerators. Within minutes, the bleeding is stopped. You are responding well to the PRF, and additional units of real type-specific replacement blood are on the way. You will have a very sore chest in the morning, but you will live.

It could have gone very differently, though. If the field hospital was under attack, or the energy from its generators was needed for combat, your team may have had limited access to powered equipment. In that case, they would have had to nick the pericardium with an old-fashioned scalpel, insert a plastic chest tube for your hemopneumothorax, and sew everything shut with plain-old stitches. It would have taken longer. They might have missed the cardiac tamponade. They might have failed to stop the bleeding in time. Or they may have saved your life anyway- modern doctors do not need the modern conveniences to save your life, but they sure help.

# Part 3 - History and Traditions

## History of Battlefield Medicine

Most every member world of the Federation has a long history of emergency medicine. Terran cave paintings and similar archeological evidence from dozens of worlds show that even primitive peoples recognized there was significance to injury that made it a special state worthy of commemoration. This makes the history of emergency medicine a long and complex one. For simplicity and brevity, we'll look at one specific portion of this history: that of Earth.

### Wisemen, Shamans, and Medicine Men

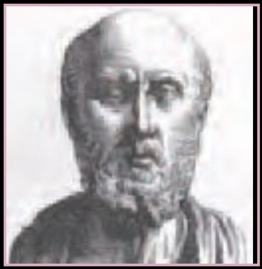
Soon after early man recognized the danger of injury, some wise elder of the clan became the warrior to lead the fight against death and evil (the source for injury and disease to many ancient peoples). Archeological evidence indicates that even prehistoric peoples knew the medicinal benefits of at least some plant substances. Even centuries before Hippocrates started swearing oaths, the subspecialty of Emergency Medicine was born with these ancient healers.

### The Sumerians: Bandages Begin

After the onset of recorded history, though, the picture of ancient medical practice is still sketchy. The Sumerian civilization, which flourished along the Tigris and Euphrates, left behind texts that mention the treatment of wounds. The ancient directions were to wash the wound, cover with a plaster of plants and/or animal extracts, and bandage. But the causality between wounds and subsequent symptoms (fevers and chills from infection, weakness from loss of blood, etc.) seems to have escaped the Sumerians. This stayed true throughout most of ancient history.

### The Egyptians: Medicine Becomes a Practice

Ancient Egyptian writings, thousands of years even before the reign of Tutankhamen, make the first mention of the physician. They also document certain advances in the treatment of wounds. The Egyptian physician would treat injuries with ointments. Some of these were made from pine or fir resin, which has an inherent antiseptic value (though the Egyptians were as yet unaware of the existence of bacteria). Often the ointments would be mixed with honey and even animal oils. Honey, which is not receptive to bacterial growth, acts as a sort of firebreak for incipient infections. There is even evidence that these doctors tried to close wounds by immediate suturing, as we know ancient embalmers did. The materials they used ranged from adhesives (cloths covered with sticky resins) to clamping devices (made from thorns or insect mandibles) to stitches made from thread or even a woman's hair.



*Above: Hippocrates*

### The Humors of Ancient Greece

During the Peloponnesian war the Athenians were suffering badly from defeat at the hands of the Spartans. It was during this time that Hippocrates issued the directive that all physicians "who desire to practice surgery, must go to war." Even 400 years before this, the Greeks had developed the idea to treat casualties in an area separate from the battlefield (although the idea of the hospital would have to wait a few centuries for the Romans). As early as the battle for Troy, fallen combatants were taken from battle and brought to ships or barracks to be treated- although the treatment they received was far from lifesaving. Physician's assistants (the precursor to the nurse and said by Homer to be women "of extraordinary beauty") would sprinkle wounds with wine, grated goat cheese, and barley meal. Usually, the patient promptly expired. But by the time the Peloponnesian War was in full swing, Hippocrates and the new breed of Greek Emergency Physicians were practicing a more advanced medicine. Lacerations were treated with cold compresses and salves of mercury, arsenic and lead. Deep cuts were closed with clips, possibly fashioned from insect mandibles. Bleeding extremities were met with tourniquets, but the proper use of them was not discovered until the 1500s, so gangrene was the usual result. Still in all, this care did little harm and may actually have done some good. However, the Greek doctors still didn't know that tying off a bleeding vessel inside a wound is the key to permanently stopping bleeding. The doctors of the time can't be blamed, though. At this stage of history, their knowledge of anatomy is almost nil. They don't even know, for example, that blood is pumped through the body by the heart.

Even the idea of a pump won't be discovered until Alexander the Great's time. This ignorance led to the interesting, if not very helpful, idea of 'humors'. The Ancient Greeks believed the body was made up of four humors: blood, phlegm, yellow bile, and black bile. Pain, which the Greeks did not understand to be a symptom, was thought to result from an imbalance of the humors. To rid a casualty of his bad humors, a doctor would prescribe a regimen of bleeding, purging and starving. Many times this treatment killed a patient who may have recovered if simply left alone. What was beneficial during this time, though, was that the Greek doctors were at least vaguely aware of sepsis (infection), even though they were still unaware of the existence of bacteria. They used drugs and bandages in an attempt to heal fractures, infection, and hemorrhages - steps, even when alongside missteps, in the right direction for treating trauma.

### Ayurvedic medicine

Ayurvera (the science of living) is the scholarly system of medicine. One of its most famous texts from the compendium of Susruta, the Susrutasamhita was known for describing various forms of surgery including the repair of torn ear lobes perinea lithotony and several other excisions and other surgical procedures.

### Persian and Islamic medicine

Persian medicine has a long and prolific history. Its greatest contribution to battlefield medicine was perhaps the development of the first scientific methods in the field of medicine especially in terms of clinical trials, dissection and postmortem autopsy introduced by Ibn Sina (Avicenna) who is considered the father of modern medicine, in his medical encyclopedia, Al-Qanun fi al-Tibb (Canon of Medicine) sometimes considered the most famous book in the history of medicine, remained a standard text in Europe up until its Age of Enlightenment. Other contributions of Persian medicine include the Tashrih al-badan (Anatomy of the body), by Mansur ibn Ilyas which contained comprehensive diagrams of the body's structural, nervous and circulatory systems. In the 13th century, Ibn al-Lubudi rejected the theory of four humurs of the Ancient Greeks and instead believed that the body and its preservation depended exclusively upon blood, an important concept in the field of emergency medicine and medicine as a whole.

### Changes Come Slowly

Over the next thousand years, emergency medicine would remain in the shadow of religious fervor. In the Middle Ages, the use of the sling bandage for arm injuries and weight-and-pulley traction in the treatment of leg fractures were among the few advances made. In fact, the sling is still used for shoulder fractures when immediate bone knitting is not possible, and weight and pulley traction was used for centuries for hip fractures. During the Crusades, there is evidence that wounded soldiers were removed from the battlefield at the end of the day for treatment elsewhere.

## A Renaissance in Wound Treatment

In renaissance times, superstition still dominated medical practice, though Ambrose Pare, the barber's apprentice who became a surgeon, not only advanced the use of the tourniquet but also accidentally improved the protocol for treating wounds. The normal practice to this point was to pour oil into a wound to stop the putrid smell and promote the formation of pus. On one occasion, Pare ran out of oil when he came to the last soldier of the day, and had to dress the wound with just a clean cloth. He went to bed that night feeling guilty. The next day, much to his surprise, the soldier he had treated with cloth did not have a fever and was in minimal pain, in sharp contrast to those he had treated with oil. Thereafter, Pare abandoned the idea of filling wounds with oils in favor of allowing nature to take its own course. Also, advancing medicine in these early days was Harvey's description of the human blood system in the 1600s. Supported by the discovery of carbon dioxide and oxygen in the following century, this shed light on the roles played by circulation, blood pressure and respiration in trauma recovery.

## The Revolutionary War: Army Hospitals & Texts

On July 27, 1775, the Continental Congress created a medical service for a 20,000 man army and named Dr. Benjamin Church of Boston as director general and chief physician. That year, Dr. John Jones of New York published the first American surgery text that was widely used in the war. Dr. Benjamin Rush, signer of the Declaration of Independence, ran a Continental Army hospital and wrote the first American preventive-medicine text for Army physicians. It was used until the Civil war. A historic first occurred in 1777, when George Washington ordered the inoculation of all Continental Army recruits to prevent smallpox. Never before had an entire army been immunized. And it worked. In 1778, Army doctors at Valley Forge published the first American pharmacopoeia, a 32-page list of medications. Dr. James Tilton built a well-ventilated, uncrowded Army hospital with isolation wards in 1779, influencing hospital design for decades.

## Napoleon and the Invention of Medivac

Even before the role of bacteria in spreading infection was known, however, the Napoleonic Wars spurred new attempts to treat the wounded in a timely if not efficient manner. Up to this time, wounded had always been left on the battlefield until the end of the day. But Bonaparte's surgeon-in-chief introduced the use of rudimentary carts to evacuate and transport wounded soldiers from the battlefield to nearby aid stations, even while the battle raged on. In fact, he was the first to use air evacuation of the wounded when he employed a hot air balloon in 1792.

## Anesthesia and the Discovery of Bacteria

In the 1800s Virchow introduced anesthesia. Finally, there was a relief from pain. The fight against infections was improved by the discovery of bacteria and the work of Louis Pasteur and Joseph Lister, though for a long time many doctors still rejected the idea that infection could be caused by something unseen. Nevertheless, this new knowledge gradually forced a rewriting of the procedures for emergency care of the wounded.

## The American Civil War: A Dark Time

The loss of life during the American Civil War was staggering, very much because battlefield medical treatment was a disaster, having fallen far behind the new advances in military technology and its new ways to tear up and destroy human bodies. The medical corps was disorganized, there were no ambulances, and generals on both sides found medical supply wagons disconcerting to the carrying out of battle plans. Worst of all, everything that was being learned about infection and the treatment of wounds were all but ignored. Surgeons rarely washed their hands, and they reused instruments and sponges without cleaning them between patients. In the end, the Confederate and Union armies lost over 200,000 men from battle wounds. Many of these deaths were a result of infections that could have been treated within the then-current state of the art.

### The Ambulance Arrives

By the end of the Civil War, the new health dangers posed by a tightly packed urban populace demanded more efficient transport of the critically wounded. The first ambulance appeared in Cincinnati in 1865. But the first true ambulance system was developed a year later in New York with Bellevue Hospital. Within three years, Bellevue received nearly 1,500 requests for transport, and by 1883 the ambulance service to Bellevue and the surrounding hospitals serviced over 10,000 patients. These primitive ambulances were horse - drawn affairs that carried a driver and a surgeon. Little medicine was carried on these ambulances, and more often than not, the doctor was on board simply to pronounce a patient's death on arrival. This was punctuated by the fact that during this time, and for decades after, these ambulances were operated by local mortuary services.

### The Spanish-American War: The Rise of Bacteriology

In the Spanish-American War, US troops first crossed oceans to fight in places teeming with disease. Wounded totaled 1,581; typhoid cases, 13,770. Malaria, yellow fever and dysentery struck thousands. US Army physicians, research boards and commissions studied cholera, plague, dengue fever, malaria, beriberi and amoebic dysentery. MAJ Walter Reed led a typhoid board, which established the principle that line commanders, are responsible for unit sanitation. Later he headed the 1900-1901 yellow-fever commission in Cuba, which proved the disease was mosquito-borne. COL William Gorgas, using Reed's research to fight malaria, made building of the Panama Canal possible. Gorgas later became Army Surgeon General and received the first Distinguished Service Medal ever issued (1918).

### World War I: Shock and Sea Water

While people in the United States were being taken to the hospital in hearses, war abroad was forcing new advances in the emergency treatment of trauma. In World War I, doctors realized that soldiers who were bleeding profusely went into shock, in part because of a loss of blood volume. A doctor from Cleveland introduced the idea of replacing lost blood intravenously with sea water (saline solution is still used today for fluid replacement), and for the first-time shock was treated with fluid therapy. Military medicine was involved in this war from the very beginning. In fact, the first US officer and the first US enlisted man to be killed in the war were a US Army doctor and medic. Preventative medicine played a major role: this was the first major war in which mortality from communicable disease was less than from battle wounds. The motor ambulance added a new level of mobility to the evacuation of casualties, too. And high death rates of Army pilots sparked the study of aviation medicine. It was also in World War I that women were first allowed into the US military as nurses. Although not legally commissioned officers, they wore officer rank and were the first women to hold rank in the US Army.

### World War II: Field Hospitals Make Their Debut

The second great conflict of the 20th century saw the creation of field hospitals, which permitted patients to be cared for close to the battle zone. Technological advances allowed surgeons to monitor blood pressure and respiration during emergency procedures. The need for whole blood, rather than plasma, in surgery was proven, and whole blood revolutionized traumatic surgery. Blood drives in the United States provided massive quantities of whole blood, which were refrigerated and shipped overseas. Soldiers fought all over the globe, exposed to every climate, disease and weapon known to man. Out of this came tremendous medical and surgical advances. "Shell shock" and "battle fatigue" received unprecedented study, as did other psychiatric problems -- with emphasis on outpatient care. Research labs studied the effects of climate and developed clothing and behavior rules to protect soldiers from cold and heat injuries. Mass penicillin production was achieved, and the lifesaving miracles of antibiotics were first proven on North African battlefields in 1943. New methods emerged for fast treatment of wounds and shock.

### The Korean War: M*A*S*H Debuts

Helicopters came into common use to transport the worst of the battlefield wounded during the Korean War. By war's end in 1953, over 17,000 casualties had been airlifted by helicopter. This spawned improvement in helicopters and further refinement of aeromedical battlefield evacuation in Vietnam. The Medivac flights carried soldiers to new Mobile Army Surgical Hospitals of 60 beds. Inside these MASH units, greater use and variety of antibiotics decreased infection from battle wounds, and the ability to treat shock was dramatically improved with IV electrolyte solutions.

Fluid therapy now meant that a severe traumatic injury didn't have to be a death sentence. The problem of kidney failure was finally tackled with dialysis. The MASH units, run by surgeons, practiced the art of triage (the sorting and classification of patients according to severity) and brought a new expertise of early treatment of wounds that otherwise would have caused severe disfigurement or death. Surgically, the single difference that distinguished emergency medical care in Korea from that in World War II was the decrease in limb amputations. In WWII, the only option in the case of damage to a major artery was to tie off the artery and hope gangrene didn't set in. Amputation was the usual result. New techniques in the repair and tying of arteries now meant that arms and legs could be salvaged.

### Vietnam: The Pre-Fab Hospital Hits the Field

In Vietnam, efficiency and speed were enhanced by the MUST (medical unit, self-contained, transportable), a sort of "instant" hospital that could be moved by truck or aircraft. The inflatable rubber shelter had its own electrical power, air conditioning, heating, water supply and waste-disposal system. Replacing tents, it improved patient care and comfort. The first arrived in Vietnam in 1966. Noncombatant medical people worked "under fire" in Vietnam as a matter of course. Several Vietnam medics joined their predecessors from earlier wars in winning the Medal of Honor.

### Desert Storm: Preparing for the Worst

In 1991, the United States and the United Nations Coalition struck at Iraq and the Iraqi troops occupying neighboring Kuwait. Allied air superiority meant that enemy positions could be destroyed and/or softened by air strikes for many days before ground troops were sent in. This lead to a decisive ground victory, with allied casualties numbered less than 1000. No one knew this would be the result beforehand, though, and the Persian Gulf War became the largest mobilization of medical personnel since Vietnam. Medical units were activated from the US Reserves who established field hospitals and prepared for massive casualties. These men and women also had to undergo special training in order to deal with chemical weapon exposure since Iraq possessed such weapons and threatened to use them.

### Operation Iraqi Freedom and the War on Terrorism

In 2001, the United States and her allies were once again in conflict with Iraq. After the terror attacks of September 11th, 2001, it was decided that this would never happen again. The first part of the struggle began in Afghanistan were the ruling Taliban were overthrown. The second phase was to oust the Iraqi dictator, Saddam Hussein. The conflict was marred by insurgency and the use of IED, or improvised explosive device. Operation Iraqi Freedom caused many more casualties than Desert Storm. Several new medical advances were made including the use of pseudo blood replacement fluids and a new technology consisting of an

engineered biopolymer, microporous particle, with a controlled pore size, which was designed to act as a sieve to dehydrate the blood and thus serve to accelerate the natural clotting process. These two new products were instrumental in preventing death from massive blood loss.

### World War III: Advances Come Too Late

The Eugenics Wars made the general populace understandably leery of the medical community since geneticists were at least indirectly responsible for the carnage that resulted. Another world war between the United States (and its allies) and the Chinese Hegemony didn't help advance medicine much either. Large-scale use of nuclear weapons meant millions of deaths without much hope for treating wounded. Survivors of initial attacks were often doomed to slow and painful deaths from radiation poisoning. Military doctors did make some great advances in treating radiation poisoning, but the practical classroom in which they made these discoveries included patients who were dying faster than the doctors could learn. By the time they found the keys to treating the insidious conditions of radiation poisoning, it was too late for most. In the end, over 27 million people died as a result of the war. Military field hospitals treated millions of civilians during WWIII. Unfortunately, many simply became hospices for those slowly dying of radiation poisoning.

### The Colonial Marines: A New Corpsman

When the MegaCorporations began colonizing other planets, they needed trained fighters to protect and police their colonists. Thus, the Colonial Marines were born. Formed on a model of several of Earth's ground forces (most notably, the United States' Army and Marine Corps), the Colonial Marines formed the first truly space borne ground forces. During this period, the Colonial Marines began training their own Corpsmen (battlefield medics), rather than recruiting from the Navy Hospital Corps, as had been done by the USMC since 1898. The modern Colonial Marine Corpsman was now responsible for emergency treatment of injuries related to decompression, the extreme cold of space, and exposure to alien environments, as well as traditional injuries. The Colonial Marine Corpsman of this era without question earned his nickname "Doc".

### The UNPF Marines

In the face of relentless attacks and a steady advance by Romulan forces, the United Nations of Earth nationalized all armed forces in 2158 to create the United Nations Peace Force, and Marine Corpsmen were once again on the front lines on alien worlds. When the tide of war was finally turned at the Battle of Cheron, UNPF Corpsmen were there, making sure fallen Marines made it back to the field hospitals. During this period, great strides were made in the improvement of diagnostic equipment. The tricorder was used as a portable diagnostic computer. The dermal regenerator also made its debut, although in a much more primitive form than we use today.

### Starfleet and the SFMC

In response to the Romulan Invasion, five separate civilizations joined together to form the United Federation of Planets as a peaceful and cooperative organization of defense and exploration. However, no one had forgotten the lessons they had learned at the hands of the Romulans. A strong naval force, STARFLEET, was created; and to take the battle to the ground, the SFMC was an integral part of that new defense force. The Medical branch of the SFMC began expanding into STARFLEET sickbays. While the heart and soul of SFMC medicine was still the Medic and the emergency care given on the front lines, Marine medical personnel were seen in larger numbers in shipboard sickbays as well. STARFLEET CMO's came to place high value on the trauma experience and extensive medical knowledge possessed by the SFMC medical personnel.

### The Klingon War

The Klingon War was, perhaps, the bloodiest in SFMC history. Vicious Klingon attacks with disruptors, bat'leths, and d'k taghs resulted in thousands of Marine casualties. The brutality of these weapons often carried Marines beyond the ability of even the highly-trained Corpsman to save. Throughout this bloody conflict, SFMC Medics remained ever faithful to their duty and to their brothers and sisters in the Corps. It was during this period that SFMC Medicine began the extensive frontline use of stasis tubes for the severely injured. It was also the period wherein pinpoint tissue transporters and vascular regenerators were perfected. Medicines like Tri-Ox Compound and Stokaline were introduced just before the war and were in heavy use by the latter 23rd century.

## Medical Traditions

The widely varying origins of Medicine on various planets initially produced a myriad of traditions for the Starfleet and SFMC Medical branches. So many, in fact, that most all were eventually shunned or banned by the medical community and/or its commanders for simplicity's sake if nothing else. Only a few survive.

### The Lab Coat

When a doctor graduates from medical school he is traditionally given his own lab coat with his name embroidered on it. The gift is usually made by a special instructor or a resident the student has served under. Lab coats are not worn as often as they once were, but be assured that every doctor has one- even if it is stashed away somewhere special.

### The Nurse's Pin

Another graduation ritual in the medical community is that of "pinning". Each nursing school mints a unique pin that is presented to its graduates in a special ceremony. Pins are worn today even less frequently than lab coats, but again, every nurse has his or hers somewhere special without fail.

### The Combat Medic Badge

This special badge is actually based on a nearly ancient design from Old Earth. It signifies the special and rigorous training a Medic goes through in the SFMC Medical Branch. It is also a symbol to nonmedical Marines that this person is someone special who may one day save their life in the field. The badge is earned on graduation from Basic Combat Medic School. It is not actually required to be worn on any Marine uniform, but many local commanders have authorized its wear with the Class A and B uniforms.

### The Autohepatic Function Test

"Autohepatic" refers to one's own liver. The AFT is the tongue-in-cheek name for a mythical test that determines if one's liver properly metabolizes alcohol. It generally refers to any social occasion attended by the medical staff wherein alcohol will be served. It is often followed by bouts of an equally frivolous condition known to branch members as "Post-Traumatic Drinking Disorder."

### The Medical Motto: "Care Beyond the Call of Duty"

A slogan once used by the US Army Medical Command, one of the largest military medicine organizations in any planet's history. The slogan stuck with the military medicine branches of nearly every incarnation of ground forces since the Colonial Marines, and was officially adopted as the SFMC Med Branch's motto in 2179.

### The Medical Slogan: "Best Care Anywhere"

The origins of this slogan are unclear. Some historians attribute it to actual use by US Army medical units in the latter 20th century, while others cite its use in an entertainment program from the same era. In any case, it was adopted by medics on a grass roots level centuries ago, probably in a tongue-in-cheek mockery of the

Branch Motto, which many of the medics historically dislike. Despite the Medical Branch's best efforts to the contrary, it remains with the Branch today.

### The Medical Device: "The Cross"

There are several enduring symbols of the medical profession from several worlds. Most familiar to Starfleet and SFMC members are the cross and the caduceus, both of which come from ancient Earth. The cross was the longtime symbol of the battlefield medic or corpsman, while the caduceus typically represented the physician. Starfleet adopted the caduceus as its Medical Department symbol in the 2100s. When the SFMC Medical Branch adopted its current device, it chose the cross both to distinguish itself from the Starfleet department, and to hold to the spirit of the corpsman.

### The Surgeon General

The traditional title of the Director, SFMC Medical Branch is the SFMC Surgeon General. He/she is referred to as such regardless of rank, although the last eight Surgeon Generals have been Brigadier or Major Generals.

### The Hippocratic Oath

Pledged by Terran doctors since ancient times, this oath is still recited today by medical practitioners graduating from Terran medical schools and/or the service academies.

*I swear by Apollo the physician, by Aesculapius, Hygeia, and Panacea, and take to witness all the gods, all the goddesses, to keep according to my ability and judgment the following oath:*

*To consider dear to me as my parents him who taught me this art;*

*To live in common with him and if necessary to share my goods with him, to look upon his children as my own brothers, to teach them this art if they so desire without fees or written promise;*

*To impart to my sons and the sons of the master who taught me and the disciples who have enrolled themselves and have agreed to the rules of the profession, but to these alone, the precepts and instruction.*

*I will prescribe regimen for the good of my patients according to my ability and my judgment and never do harm to anyone. To please no one will I prescribe deadly drug, nor give advice which may cause death. But I will preserve the purity of my life and my art. I will not cut for stone, even for patients in whom the disease is manifest. I will leave this operation for practitioners (specialists in the art).*

*In every house where I come I will enter only for the good of my patients, keeping myself from all intentional ill -doing and all seduction, and especially from the pleasures of love either women or with men, be they free or slaves. All that may come to my knowledge in the exercise of my profession or outside my profession or in daily commerce with men, which ought not to be spread abroad, I will keep secret and will never reveal.*

*If I keep this oath faithfully, may I enjoy my life and practice my art, respected by all men and in all times; but if I swerve from it or violate it, may the reverse be my lot.*

This oath in a military context can often be perplexing. The provision to do no harm can cause a crisis for some doctors on the front lines, especially for those serving as Special Operations Surgeons with SpecOps teams whose members (ALL members) must use weapons in anger against an enemy. Therefore, UFP courts and Starfleet and SFMC courts-martial have consistently ruled that the prohibition to do no harm shall apply only to 'patients' of the practitioner in combat situations. The oath's admonition of doctor-patient privilege has been unilaterally upheld by courts since ancient Earth.

## Part 4 - Organization of the Medical Branch

### A Division of Labor: STARFLEET Medical versus SFMC Medical

SFMC Medicine is almost entirely limited to the practice of military medicine (i.e. - treating battlefield casualties) in the theater of operations (TO). Outside the TO and all other fields of medicine, the Corps relies on the support of STARFLEET Medical, just as Marines have relied on Navy Medicine for generations.

There are, however, vocal factions both in STARFLEET and the SFMC who want to change this arrangement. Some SFMC planners want a complete medical branch to make the Corps autonomous, and some STARFLEET leaders want exclusive purview over all aspects of military medicine. But while these voices are loud, they are a minority. The current, mostly amicable, working arrangement between the two medical corps has existed over 200 years, and nothing is likely to change soon.

One practical effect of the current arrangement is that Marine Medical personnel usually (thank goodness) have little to do in their chosen field of battlefield trauma unless there are Marines actually engaging the enemy somewhere. Therefore, many SFMC Medical personnel are regularly assigned to STARFLEET starbases or ship sickbays (usually ones embarking Marines). When needed, these personnel are swiftly transferred to their pre-positioned equipment and deployed to the field as an SFMC Medical unit.

### Corps of the Medical Branch

It takes a team of health care professionals for the SFMC Medical Branch to provide "Best care anyway" in the field for the Marines. Thus, the Medical Branch is actually made up of 5 different Corps. While the respective field commands are responsible for the deployment and administration of the Medical Unit, the individual corps on the other hand is responsible for the training and doctrine of the various professionals within their corps. While one may argue that the current Corps is not as comprehensive enough when compared to the other health care organizations, one must not forget that the SFMC Medical Branch only focuses on Military Medicine.

1) *Medical Corps*
2) *Nursing Corps*
3) *Medical Specialist Corps*
4) *Combat Medic Corps*
5) *Medical Services Corps*

#### Medical Corps "Safeguarding the Fighting Strength"

The Medical Corps are made up entirely of commissioned officers consisting of all the Physician, Surgeons, Medical (Doctors) and Dental Officers. A newly Commissioned Officer in the Medical Corps will begin his career as a Medical / Dental Officer. He will be likely posted to a Medical Strike Groups or one of the Doctors attached to a Rifle Battalion. Medical Officers are commissioned as First Lieutenants and will be promoted to Captain in about a year. This is to recognize their extensive education and experience. The Medical Corps are led by the Chief Medical Officer.

#### Nursing Corps "Faithful in adversity"

Nurses of the Nursing Corps known as Nursing Officers have the autonomy to practice nursing that is unmatched by civilian or even Starfleet Nurses. While focused on military medicine, the Nursing Corps are trained and equipped to provide full spectrum patient care. SFMC Nurse Practitioners are known and respected for their extensive knowledge, experience and clinical skills. Nursing Officers similar to Medical Officers are initially commissioned as Second Lieutenants but will be promoted to First Lieutenant within a year once they have met the requirements. The Nursing Corps are led by the Chief Nursing Officer, Nursing Corps

### Medical Specialist Corps "United In Our Care"

The Medical Specialist Corps are another essential component of the SFMC medical team. The Corps consist of Respiratory, Physical, Occupational Therapist, Behavioral Science Specialist and Counselors. Similar to Nursing Officer, they are initially commissioned as Second Lieutenants but will be promoted to First Lieutenants within a year. The Medical Specialist Corps are led by the Chief Medical Specialist, Medical Specialist Corps

### Combat Medic Corps "So That They May Live"

With the exception of the Commanding Officer, Medic Corps, the medic corps are the only non-commissioned corps of the Medical Branch. The Medic Corps is responsible for the training and professional development of all the Medics. The Medic Corps also include Advanced Medics who are Physician Assistants. These physician assistants are Warrant Officers who are ex-combat medics. The Medic Corps are led by the Commanding General, Combat Medic Corps, and the Chief Medic, Combat Medic Corps as the Senior Enlisted Personnel.

### Medical Services Corps "In Support Of Care"

The smallest of all 5 Corps, their motto accurately describes their mission, to provide support so that others may focus on their primary task. While most of the support is provided by the Support Branch, there are some roles which require specialist support which is thus provided by the Medical Services Corps such as the Medical Services Officer, Biological and Chemical and Defense Officer. All others who do not fall in either of the other corps come under the Medical Service Corps.

### MOS Listings for Medical

MOS for the Medical Branch are generally divided into the 5 Corps, and the respective units. It is important to keep in mind, then, that there is much specialization and proficiency levels even within these MOS's which is shown by the various skill and category identifiers. For more information about Medical MOS, please refer to the SFMC MOS Manual.

## Medical Commands

The Medical Branch is organized and divided into 4 Commands for administrative and deployment purposes. Each Command is commanded by either the Deputy or Assistant Surgeon-General.

### Combat Support Command (CSC)

The CSC provides detached medical personnel to field units. For example, every Infantry or Combat Engineer Platoon has one C-Medic assigned to it as the platoon medic; every Aerospace squadron has an A-Medic or Flight Surgeon, etc.

Personnel attached to the units are usually considered organic to the units and under their direct operational command. The CSC Headquarters is the only unit-sized organization within the command. They are responsible for all matters of coordination, training, assignments and support, etc. They are also responsible for the coordination and training of combat lifesavers in the unit. Most all other assignments in the CSC are given to only one or two detached Medical Personnel at a time. CSC Personnel generally undergo cross training in the Service Branch where they will serve. For instance, C-Medics will attend Powered Infantry School before field assignment with a PI Platoon. For this reason, Medics are usually highly respected by the units they support.

### Medical Unit Command (MUC)

The MUC is responsible for all the personnel and equipment, which deploy as Medical Units. CSC personnel in their disparate assignments actually make up about half of the Medical Branch, but are not assigned en masse as medical units. The MUC is the next largest command and are responsible for the various SFMC Medical Units. These are the Medical Forward Support Battalions and Divisions. Medical Strike Groups are also under this command. When not in training or operational duties, MUC personnel are often assigned to serve in STARFLEET facilities while not deploying as SFMC Medical Units, but all are pre-assigned to units with prepositioned equipment in various places throughout the Federation. This is to ensure that their medical skills are always relevant and maintained to the highest level.  On a moment's notice, these personnel will be reassigned from their STARFLEET posts to join up with their equipment and deploy wherever needed. On average, these units can be on station and operational within 72-96 hours.

### Training, Doctrine and Research Command (TDC)

The Training, Doctrine and Research Command are responsible for the training and education of Medical Branch personnel from all four Corps. They develop doctrine, establish standards, and research to meet the demands of the SFMCA. The School of Medicine is the cradle of all Medical Personnel and provides training through a full spectrum of courses, from basic to advance and also post-graduate studies in military medicine. This Command also works closely with Support's Branch Research and Development department relating to research on all medical and physiological aspects of soldier performance.

### Fleet Liaison Command (FLC)

The final Medical Field Command and by far the smallest, FLC is the Corps' connection to STARFLEET Medical, which fills most all of the routine care requirements of the SFMC. The FLC also works with STARFLEET Medical to dispatch hospital ships and other mobile resources where they are needed in support of SFMC personnel. Wherever Allies hold orbital superiority over an SFMC battlefield, FLC will make sure STARFLEET hospital ships will be on station to treat wounded.

## Types of Medical Units

As with most other SFMC Branches, the units of the MUC rarely reflect in real life the ideal table of organization and equipment (TO&E). Unlike other branches, there is no basic maneuver element like a fire team or squad, and the closest thing to a Marine Strike Group (MSG) in size would be a Mobile Surgical Hospital. Most medical units are smaller than a typical MSG.

### Combat Support Command:

These medical units are those under the combat support command, they are considered organic to the units that they are attached to and are under their direct command. Every deployed unit of the SFMC will have some level of support from these units. The biggest medical unit at this level is the Forward Support Medical Company (FSMC) which sets up the FAS.

### Element Medical Support - Combat Medics

Element Medical Support refers to the smallest Medical unit or personnel attached to SFMC elements, essentially the Combat Medics, the backbone of the Medical Branch. Here C-Medics serve as platoon medics.

This is usually the smallest element that Medical personnel are normally attached to. Squads or any element smaller than platoons usually have a Marine that is trained as a Combat Lifesaver. Experienced C-Medics who have served as platoon medics and with skill level 2 and above, serve as company medics. Together they serve to maintain the unit in which they are attached to in fighting fit conditions. When deployed during operations. The Company Casualty Point, which serves as the primary triage point will be set up by the Company Medic. Any injuries that cannot be handled by the platoon medic will be sent to the company medic at the company casualty point who will triage the casualty, prep and prioritize them for movement to the Aid Station. Branches such as the Aerospace and Maritime Operations will have A-Medics and U-Medics attached instead of C-Medics

### Aid Stations

Aid Stations are temporary, highly mobile units that serve on the front lines and are set up by the medical company attached to the Unit. There are two general types: Battalion Aid Stations (BAS) and Field Aid Stations (FAS). The BAS serves as the primary staging area for evacuation of casualties up to the Battalion level and provides a higher level of medical care. The pace of battle, security of front lines, availability of transporters/ambulances, and number of casualties will all determine how much care is given at the BAS. A FAS supplies the same level of care as the BAS, but on a larger level. FASs are usually set up in the immediate area of the front where the main force deploys.

A BAS is usually manned by one I-Medic with five C-Medics, and is usually housed in a single EMU (Emergency Medical Unit-see "Equipment"). Most BASs are assigned two S-30 Valkyrie that transports crew and EMU, and is used as an ambulance. A BAS has at least 2 doctors and 3 nurses, 1 medical administrator, 3 to 5 I-Medics, 12 to 16 C-Medics, 2 to 4 RTs, and a Behavioral Science Specialist (BSS). It also has 3 EMUs, a PACC (Portable Advanced Command and Control post) and a SPSL (Standardized Portable Structure, Large). Four S-30s carry the equipment and crew, and then serve as ambulances once the unit is set up. Aid Stations are considered as an organic asset of the unit that they are attached to and are considered under the direct command of the units.

### Medical Unit Command:

These units are directly under the Medical Unit Command. The smallest unit would be the Main Support Medical Company (MSMC), which is a reinforced Medical Company and would be the smallest unit capable of forming a Field Hospital. Most medical units would be the Medical Strike Group which would be capable of forming large Mobile Surgical Hospital and even Field Hospitals.

### Forward Surgical Team / Mobile Surgical Hospital (MSH)

Set back farther from the front lines, but still close enough to make transport easy and quick. A limited number of surgical procedures, and the majority of nonsurgical procedures, can be accomplished here. This is the first stop for most battlefield wounded, especially when a hospital ship is not available.

Three EMUs together with a MORE (Mobile Operating Room Equipment) forms a Forward Surgical Team. Forward Surgical Teams are organized to provide surgical procedures as forward as possible that are otherwise out of reach of the Mobile Surgical Hospital and are thus more compact and rapidly deployable. They are capable of handling a caseload of 25 critical patients for up to 72 hours and surgery for 18 total operating hours.

Mobile Surgical Hospital (pronounced "mash") on the other hand will be formed by five to seven EMUs with at least 3 MOREs. Other more specialized equipment may be assigned as well. This specialized equipment, a PACC and three SPSLs are transported in a single T-4 Titan cargo craft, while the EMUs and MORE are transported in separate S-30s. A typical Mobile Surgical Hospital is staffed by 7 to 9 doctors, one of which is a Medical Commander. The nursing staff consists of a Charge Nurse, Scrub Nurse, Nurse Anesthetist, and three more nurses. About 20 to 25 Medics are assigned (the number of I-Medics and C-Medics varies and not inclusive of Medical Specialist Medics). A Mobile Surgical Hospital is the smallest unit that is assigned a Pharmacist and support staff (and with them a Medical Administrator). The Mobile Surgical Hospital will also have a Medical Specialist Department usually consisting of RT, PT and Medical Specialist Medics. Bigger Mobile Surgical hospitals will be equipped with a few stasis tubes that can hold severely wounded in suspended animation until they can receive advanced care. Mobile Surgical Hospitals are fully capable of handling almost 600 casualties in a 24-hour period.

Field Hospitals and MSHs provide comprehensive emergency medical care on the battlefield. Their equipment is not as sleek and cosmetic as that in a starship sickbay, but it is rugged and can take the punishment of repeated setup, teardown and transport.

### Field Hospital (FH)

A Field Hospital provides the highest level of battlefield care in the absence of hospital ships. Advanced surgical procedures can be accomplished here, as well as any level of nonsurgical emergency care. Field Hospitals are equipped with more stasis tubes to allow for a higher amount of caseload that they can handle. The equipment is efficiently organized for advanced casualty treatment. Surgical "slugs" are formed by an EMU pre-op area connected to two MOREs, which are in turn connected to an EMU post- op. As many of these slugs (so named for their appearance) can be fielded as necessary, but usually five are used. Two or more EMUs are used for triage and care, with four more for recuperative wards. Each slug is transported by an S-34 Valor, with the additional EMUs being transported by S-30s. This leaves the Field Hospital with four Valor, and six Valkyrie ambulances. Three T-4s transport the balance of the MSHs equipment and structures. The staffing of the Field Hospital is large, consisting of at least three trauma team, which is composed of a surgeon, scrub nurse, nurse anesthetist, and two C-Medics. Each EMU is assigned 3 nurses and 3 medics. A compliment of support staff from both the Medical Specialist Corps and the Medical Services Corps are usually attached to the MSH Medical Administrator, Pharmacist, Counselor (with two BSSs), RT, and PT round out the medical staff.

### Combat Support Hospital (CSH)

Essentially similar to a Field Hospital but slightly bigger, the CSH also includes a full complement of staff from the Medical Specialist and Medical Services Corps. The CSH is the highest level of care provided by the Medical Branch and is designed not only for extended operations, but to meet a full spectrum of military operations. MGH are usually formed by Medical Battalions though they are seldom formed and deployed.

### Hospital Ship

The Hospital Ship is a STARFLEET unit and so is covered here only briefly. It supplies the highest level of care possible, and is always the first choice for casualty care when it can be safely stationed near the battlefield and when transporters can be used. Under these circumstances, FH and CSH are rarely deployed, and the staff is usually assigned to the Hospital Ship. (their equipment is held aboard in case it becomes necessary to deploy them). However, enemy jamming or atmospheric conditions can often render transporters unsafe. In this case, the level of care a patient would receive on a hospital ship must be carefully weighed against the amount of time it will take to get the patient there by ambulance. Then, MSHs are usually deployed and often become the first choice for critical casualties. Of course, when enemy orbital defenses make it unsafe for Hospital Ships to loiter near the battlefield, Mobile Hospitals (MSH or MGH) are the last, best hope for most casualties. Sometimes the Hospital Ship will make quick dashes into the system to pick up casualties from FH and CSH and then dash back out to a safe distance. But this can't always be relied upon.

## Specialized and other Medical Units

### Medivac Units

Battlefield Casualty Evacuation Units-Medivac for short-are combined-service units assembled as Aerospace Squadrons. A Medivac Unit uses a Field Hospital, Mobile Hospital, or Hospital Ship for their base of operations, and is responsible for casualty transportation other than by matter transport. A typical Medivac Unit averages two S-34 Valors and four S-30 Valkyries. If the squadron supports a MSH or large Field Hospital; one or two T-4 Titans may also be assigned. The squadron can be reinforced with close air support or fighter cover if needed. Some Medivacs are assigned directly to a MSH or Field Hospital, while others operate independently and are assigned based on need and logistical support. Each S-34 is crewed by a pilot, systems officer, two I-Medics, and four E-Medics. Each craft is equipped with six emergency stasis units. Only a doctor, nurse, or I-Medic are qualified to place patients in stasis, so it is important to have at least one I -Medic on the aircrew.

Similarly, each S-30 has 2 stasis tubes, and so must carry an I-Medic aboard. The Valkyrie is a smaller craft, though, so its total aircrew consists of a pilot, I-Medic, and E-Medic. Maintenance and support personnel for the Aerospace Craft round out the Medivac Staff.

### Rescue Teams

Under the direct command of the Medical Unit Command is the 25th Rescue Group made up of 3 Rescue Wing each. Each Wing in turn is made up of 3 Squadrons who are organized along very similar lines to Medivac Units and have dedicated aerospace craft and personnel assisting them. However, they do not use any specific medical units as a base of operation. They are assigned specific tasks and may utilize and medical units as higher headquarters or command dictate. The purpose of the Rescue Team would be the recovery and medical treatment of personnel in both humanitarian and hostile combat environment where Medivac units are unable to assist. They are able to handle all forms of combat and civilian rescue operations, be it aerospace, urban or even in the battlefield behind enemy lines. The often work alongside SFMC Special Operations Teams and STARFLEET Away Teams, and as such has the highest operational tempo of any unit in the SFMC.

### SFMC Pararescuemen "That OTHERS may live"

The Marines that make up the Rescue Teams are an elite within the Medical Branch Corps, known as Pararescuemen CR-Medic), and are led by Rescue Officers CREO). Any commissioned officers from the Medical Branch who have completed The Basic School are eligible to apply to be Rescue Officers. Medical Officers from the Medical Branch are not allowed to apply as they have not completed The Basic School. Rescue Officers are only allowed to serve 5 tours with most normally serving 2 to 4 tours before they have to their original MOS. Rescue Officers will go through almost the exact same training as R-Medics.

Experienced medics who have proven themselves are invited to apply and join this elite group. The journey to be a Pararescuemen is an extremely long and strenuous journey. It takes two years to complete the course and requires intense physical and mental effort to complete it. Of the dozens who begin the process, only the most determined will graduate as 250s, there have been cases, where as few as five people graduate from a class of nearly 60. More than 90 percent drop out from each class, making it one of the training courses with the highest training drop-out rate in the SFMC

**Biological, Chemical and Hazardous Materials Teams (BCH Teams)**

BCH Teams purpose is to protect the Marines from all forms of Biological and Chemical Warfare, they assist in the setting up of biological and defense systems. They are also responsible for handling hazardous materials and decontamination procedures which is one of their most important role. However their role also goes beyond just defense, and includes a whole spectrum of activates, such as sensitive site exploitation and assessment, multi-spectral obscuration and vulnerability assessments. Just like Rescue Team they are commonly attached to Starfleet Away teams or sometimes to Special Operations Teams.

**About Combat Lifesaver**

The Combat Lifesaver is a non-medical branch personnel that is selected from the element or unit by their respective commanders for additional training beyond basic first-aid with particular emphasis on triage. The primary duty of the Marine does changes but he now has an additional duty to provide enhanced first aid up to his level of care before the C-Medic arrive. Combat Lifesavers are mainly trained by the Medical Platoon and Company that is attached to the unit.

Skills of the Combat Lifesaver

- Basic casualty evaluation
- Airway management
- Chest injury and tension pneumothorax management
- Controlling Bleeding
- Intravenous Drip therapy
- Requesting medical evacuation

## Echelons of Medical Care

The different medical units described above actually reflect the different echelons of medical care provided in the Starfleet Marine Corps. Each echelon reflects an increase in medical capabilities while retaining those found in the previous echelon. The fourth echelon which is the highest medical care possible, are provided by STARFLEET Hospital ships, while the first 3 are provided by the Medical Branch. This arrangement of echelons of medical care is designed to enhance patient evacuation, treatment and return to duty as far forward and close to the lines as possible as determined by the tactical situation.

**Echelon I -** Medical care is provided by the medical personnel that are organic to the field units. And is almost always fully available to them. Its main emphasis is to provide measures that allow the patient to Return to Duty or in not, to stabilize him and allow for his evacuation to the next echelon of care. All other echelons after this are almost entirely provided by the Medical Unit Command of the Medical Branch. This Echelon is provided by:

- Self Aid, Buddy Aid and Combat Lifesavers
- Platoon Medics and Company Medics
- Battalions Medical Company (Forward Support)

This Echelon of medical care provides the following capabilities:

- Immediate lifesaving measures.
- Prevention and treatment of disease and non-battle injuries.
- Combat operational stress control and preventive measures.
- Patient acquisition and initial stabilization
- Medical evacuation from supported units to supporting medical treatment elements.
- Treatment provided by the FAS and BAS.

**Echelon 2 -** The next echelon of medical care is the first level that main surgical procedures are available. Just like the first echelon, they are organized to be made available as far forward and as close to the lines as possible. This Echelon is provided by:

- Forward Surgical Teams
- Mobile Surgical Hospital

This Echelon of medical care provides the following capabilities:

- Emergency Medical treatment
- Surgical intervention
- Combat operational stress control and preventive measures.
- Patient-holding capabilities

**Echelon 3+ -** At this echelon the medical care are more than able to provide resuscitation, treatment wound surgery, and postoperative treatment. Patients are usually stabilized at this echelon, and if necessary allow for continued evacuation or Returned to Duty. This Echelon is provided by:

- Specialized Medical Companies (Main/Area Support)
- Field Hospitals

This Echelon of medical care provides the following capabilities:

- Full operational emergency surgical capabilities
- Preventive Measures
- Emergency and Operational Dental Care
- Patient-holding capabilities

**Echelon 3 (Enhanced) -** This not considered another echelon of medical care but rather an enhancement of the third echelon. It is not normally available and is usually organized and tasked to meet a specific objective or purpose by the SFMC or the Federation. This is the highest level that is available in the theater of operations. This Echelon is provided by:

- Medical Battalions
- Combat Support Hospitals

This Echelon of medical care provides the same capabilities as Echelon 3 but with the additional capabilities:

- Definitive treatment of patient
- Rehabilitative capabilities
- Operational Dental Care

**Echelon 4 -** This is the highest echelon of medical care is provided mainly by STARFLEET Medical through the Hospital Ships. It is considered out of the theater of operations. At this stage, the medical care is able to provide full and definitive treatment and allow the soldier a maximum return of function through a combined utilization of medical, surgical and rehabilitation.

## Part 5 - Equipment

The array of medical equipment in the current state of the art can be bewildering to recruits. Not every type of bandage and swab is covered here, but the most common items of equipment and medications are listed below. For more information about Medical Arms & Equipment, please refer to the SFMC Arms & Equipment Manual.

### Pharmacopeia

The complete SFMC Medical Pharmacopeia is over 15,000 pages long, and reading it is often prescribed to overstressed Academy students to help them sleep. Here is a short list of the most common drugs used in trauma medicine, but be sure to consult the official pharmacopeia for exact indications, actions, incompatibilities, warnings and adverse reactions.

#### The Fab Five

The five most common emergency meds are known collectively as the Fabulous Five. They are the drugs found in the EMS field ampule:

#### Dobutamine Hydrochloride

Also known as Dobutrex, this is a direct-acting inotropic agent, which increases blood pressure and heart rate, and constricts blood vessels. It is used to treat hypovolemic shock and certain cardiac disorders.

#### Sterilite

Sterilite is a broad-spectrum anti-infective that has antibiotic, antifungal, and antiviral properties. It is popular because it is tolerated well by most species, works against a large number of infectives, and has few adverse reactions (save rare allergic reactions in Humans, Bajorans, and Klingons).

#### Terakine

Terakine is an analgesic that is not as powerful as powerful as the once-common melanex, but has far fewer side effects. It is the drug of choice for Vulcan's when pain management drugs are called for, since Melanex has the embarrassing side effect in Vulcan's of turning the skin bright yellow.

#### Tricordrazine

This is a powerful cardiac and autonomic nervous system stimulant, which increases cardiac output and 02 consumption, and stimulates production of naturally occurring epinephrine and norepinephrine. It has fewer adverse reactions than cordrazine (which it has largely replaced), but many patients still have allergies/ hypersensitivities, and must use polyadrenaline instead.

#### Tri-Ox Compound

Tri-Ox breaks down into O2 in the blood, rapidly delivering oxygen to all parts of the body. Unlike conventional O2 gas, Tri-Ox is noncombustible and liquid at room temperature so it is easy to transport, store, and administer.

### The Dirty Dozen

Out of the thousands of drugs available to SFMC Medical, 17 account for nearly 30% of all drug orders in the branch. In addition to the Fab Five above, the remaining meds comprise what is known as the Dirty Dozen.

**Anesthizine**

This is a fast-acting, long-lasting general anesthetic with a relatively low incidence of side effects. It is employed on starships as part of the anti-intruder system. Anesthizine is the agent of choice for humanoid chemical anesthesia should neural calipers be contraindicated.

**Corophizine**

Corophizine is a broad-spectrum antibiotic that has also exhibited an undetermined antiviral action in some cases (though it is not generally relied upon for viral infections). It does not have the antifungal and antiviral properties of sterilite, but it is effective against the few bacterial strains resistant to sterilite, and can be used on most patients allergic to sterilite.

**Hemosynthelite**

This drug can stimulate rapid generation of new blood cells in those species, which manufacture their colored blood cells in their bone marrow. This can greatly benefit patients suffering from high blood loss. Although work continues, equivalent drugs for species that generate blood cells from other sites or organs are not yet available.

**Hyronalin**

Hyronalin constricts blood ves-NH CH3 sels, thereby stopping capillary bleeding. This vasoconstrictor HO CH CH2 ability helps relieve congestion in allergic reactions. Its isoproterN2 enol effect leads to alertness and respiratory stimulation. It also is used as a cardiovascular stimulant, and is very effective in the treatment of most radiation poisoning.

**Inaprovaline**

Inaprovaline has widely replaced lidocaine in suppressing cardiac arrhythmias. It doesn't have the topical anesthetic effects of lidocaine, but is better in the treatment of arrhythmias, as evidenced by a large decrease in the use of beryllium (the fall- back drug when lidocaine is ineffective) since inaprovaline's introduction. It also has fewer adverse reactions than lidocaine.

**Lasix**

Lasix is the SFMC's most commonly used diuretic. It is powerful, can be given orally and IV, and is easy to replicate. It draws all the excess fluid out of the body and especially out of the lungs.

**Masiform D**

Originally developed as a stimulant, Masiform D was later found to have antitoxin properties against saplin and saplin-like poisons. It combines with the poison on the molecular level and prevents absorption into the bloodstream. Larger doses can aid in the removal of the poison as well.

**Meperidine Hydrochloride**

Meperidine Hydrochloride is a narcotic analgesic that is highly effective in the management of severe pain for most carbon-based life forms. Unfortunately, it can be highly addictive, with addiction susceptibility varying widely by species. Care should be used in administering this drug.

**Metropan**

Used in fracture management to increase the rate of healing and for pain, Metropan stimulates rapid bone cell growth. Since it can interfere with the action of many stimulants, it should not be given when cardiac or neural problems exist or may be impending. Fractures can wait in these cases.

### Norep
A synthetic hormone based on norepinephrine, Norep is used to restore blood pressure in certain acute hypotensive states, and in the treatment of cardiac arrest. Norep should not be used for treating hypotension due to blood volume deficits, except as an emergency measure, until blood volume replacement therapy can be completed.

### Polyadrenaline
A synthetic autonomic nervous system stimulant that can be used in place of hyronalin or tricordrazine. Polyadrenaline is not as strong or fast acting, but has fewer adverse reactions and is better tolerated in life forms with cobalt-based blood like Andorians or Bolians.

### Vertazine
Vertazine counteracts combat fatigue and stops vertigo induced by being in close proximity to an explosion. It is also administered via sub-Q patch to prevent vertigo or disorientation in zero-g combat personnel.

## Four in the Field
These are the four popular medications in the pharmacopeia that are distributed to Marines in the field for self-administration as part of their personal med kit, or as part of their standard field pack.

### Acetaminophen 5
Often referred to as "Infantry Candy", this fifth-generation acetaminophen is a fairly innocuous analgesic that is often distributed to troops in the field for self- administration in oral caplets. It is contraindicated for life forms with cobalt-based blood such as Andorians or Bolians.

### Atropine
Atropine increases heart rate, provides vasoconstrictive effects, and slows sweat and salivary gland secretions. It is useful as a broad-based antidote for nerve- agents. Marines in the field carry an atropine self-injector that also holds a dose of Masiform-D for non-nerve-agent chemical weapons.

### Cortropine
This is a nonaddictive central nervous system stimulant, which, in low doses, can fortify a person for prolonged physical and mental exertion. It is taken orally by Marines in the field if prolonged periods of activity with little time for sleep are anticipated. Cortropine, by the way, is also used to treat hyperkinetic behavior in children, and narcolepsy.

### Retentinol
Known to Marines in the field as "stop-up pills", retentinol combines an antidiuretic with an antidiarrheal, promoting water reabsorption and fecal retention simultaneously. It is used by personnel in sealed environmental or powered armor suits to decrease waste output while enclosed in the garment. Normal functioning in waste excretion returns with discontinued use of the drug. Use of retentinol for more than 24 hours is discouraged.

## Fluid Therapy
For trauma use, IV solutions are usually supplied as a microfine powder inside a flexible IV bag of 1000ml capacity. They are reconstituted with sterile water, which can be easily supplied by a medical-grade water

sterilizer. Using this equipment, canteen water can become lactated ringers in less than a minute. The most commonly used solutions (listed on the following page) are isotonic, meaning they maintain the balance between intracellular and extracellular fluid levels.

### DSW

DSW stands for Dextrose S% in Water. Although DSW was phased out long ago for emergency treatment of humans (many have problems with the dextrose), Andorians, Vulcans, and Bolians all seem to do fabulously on the solution. Since these species' electrolyte balance can be negatively impacted by common IV electrolyte solutions, DSW is the first choice for fluid replacement in these species in the absence of species-specific electrolyte solutions.

### Lactated Ringers (LR)

Also known as Ringer's Lactate, this is the fluid of choice for treating acute blood loss in species with iron-based blood. The electrolyte composition of LR is very similar to that of human plasma, except that LR does not contain magnesium. It is contraindicated for copper-based or cobalt-based blood.

### Micatropha

Micatropha is a water and electrolyte solution formulated for cobalt-based blood. It also contains the synthetic hormone aktatropha, which aids circulation in cobalt- based blood, making it the solution most likely to produce drug-incompatibilities (see "Starting an IV" in Part S).

### Normal Saline (NS)

NS (0.9% saline in water) provides fluid volume with some sodium and chloride. It is the most commonly used fluid for blood volume expansion across most humanoid species. Most humanoid blood is saline, and the lack of extra electrolytes found in species-specific solutions like LR makes NS a great alternative when treating many different species. It is also used for fluid resuscitation in treating burns, and for wound irrigation.

### PRF

Pseudohematic Replacement Fluid or "artificial blood" is the fluid of choice to combat excessive blood loss in patients who tolerate it. Its fluorocarbon hemoglobin analog works with iron, copper, or cobalt-based blood. It has a thin consistency so it can be more rapidly infused than plasma or whole blood. It need not be type-specific, and it transports oxygen nearly as well as whole blood. On the down side, about 25% of any given population of humanoids will exhibit SEVERE allergic reactions or hypersensitivity to PRF-so it should not be given if the patient's allergy status is unknown.

### Sterile Water

As the name implies, a pretty plain solution for IV fluid therapy. It doesn't do much for the patient except add fluid volume, but for some physiologies, that's the best you can hope for. It is the first choice for unknown physiologies, and can also be used for wound irrigation. It is most commonly used for reconstituting micro powdered IV solutions.

### Vulcanoid Ringers

A solution similar to Ringer's Lactate, but with electrolyte levels specifically adjusted to copper-based blood. In dire emergencies, patients with Iron-based blood can usually tolerate Vulcanoid Ringers if diluted 70% with sterile water. Additional electrolyte therapy may be required in these cases.

## Part 6 - First Aid

**Do not attempt to perform first aid on anyone unless you are properly trained to do so. Applying first aid without the proper knowledge can cause serious harm to someone or even worse, kill them. First aid should only be administered by those people that are trained to do so. This manual is not intended to be a substitute for formal first aid training, which means that reading this manual does not qualify you to perform first aid. In order to be qualified you need to take and pass formal first aid training. If you are interested in obtaining first aid training, please contact your local Red Cross/Red Crescent office or your local hospital.**

One of the most important duties of medical personnel in the SFMC is to render first aid to those who require it. Often life or death hinges on the first crucial minutes after an injury and by performing proper first aid the chances that a victim will live are greatly increased.

### Definition

First aid is defined as the immediate and temporary aid given to sick or injured people until more advanced medical treatment can be provided. More often than not first aid is a series of simple medical techniques that can be performed by someone trained to do so.

### History

Most member worlds of the Federation had developed advanced forms of first aid and battlefield first aid by the time they were admitted into the Federation. But even then for most, the origins of first aid had been lost to antiquity and most records had been either destroyed or lost.

On Earth the first group thought to have specialized in battlefield care for the wounded was the Knights Hospitaller or as known to many people the Order of Saint John in 1099. Almost 800 years later in 1863 the order would be instrumental in the founding of the Red Cross at the First International Geneva Convention. The Red Cross was to provide "aid to sick and wounded soldiers in the field". The Red Cross emblem that was chosen is reversal of the Swiss Flag to represent the host country of the Geneva Conventions.

Since that time developments in first aid and many other medical techniques have been fueled by large wars.

### Basic First Aid

#### Life-saving Measures

When you or someone that you are with is wounded, or injured first aid must be given at once. The first step is to apply, as needed, the four life-saving measures. The measures are:

1. Danger - Ensure that the scene is safe for you and the Marine patient
2. ABC - Clear the airway; Check and restore breathing and heartbeat.
3. Stop bleeding
4. Prevent shock
5. Dress and bandage any wounds

**Danger - Ensure that the scene is safe for you and the Marine patient.**
**Scene Size-Up. Ensure that it is safe enough for you and the patient. Remove hazard or if necessary really necessary, remove the patient.**
**ABC - Clear the Airway; Check and Restore Breathing and Heartbeat**
**DO NOT give rescue breathing or heart massage to an individual who is both breathing and has a pulse (heartbeat). Doing so can do more harm than good and there is a good chance that you'll injure them.**

**Airway - Clear the airway:** The lack of oxygen intake through normal respiration and the lack of a heartbeat lead to death in as little as 4 minutes. When treating a casualty, first find out if he/she is breathing. If you cannot detect any breathing do the following:

1. Place the individual on their back and kneel beside their head.
2. Clear the airway by removing any obstructions in their mouth.
3. Place your hand (the hand nearest their feet) under their neck and put your other hand on their forehead.
4. Extend their neck by lifting with the hand under the neck and pushing down on the forehead. This action also lifts the tongue away from the back of the throat, thus opening the airway.

**Breathing - Check for Breathing:** After opening the airway, **LOOK, LISTEN, and FEEL,** to find out if the individual is breathing. To determine if the individual is breathing the following should be done:

1. Put your ear near the individual's mouth and nose and hold this position for about 5 seconds.
2. LOOK to see if the individual's chest is rising and falling.
3. LISTEN and FEEL for breathing

**Restore Breathing: IF THERE ARE NO SIGNS OF BREATHING, START MOUTH-TO-MOUTH RESUSITATION AT ONCE!**

The following procedures should be used:

1. Put a hand under the individual's neck to keep the head tilted far back.
2. Press down on his forehead with the other hand (head-tilt, chin-lift only if there is no suspected head, neck or spine injury).
3. Move this hand and pinch their nostrils between your thumb and index finger.
4. Open their mouth wide.
5. Take a deep breath and place your mouth over theirs, making an airtight seal with your lips.
6. Blow into their mouth.
7. Give two (2) quick but full breaths to make sure their lungs are full. Look for the chest to rise
8. Remove your mouth, turn your head, and LOOK, LISTEN, and FEEL for exhaled air.
9. Repeat this procedure once every 5 seconds until the individual exhales.

If you feel strong resistance when you first blow air in the individual's mouth, quickly reposition the head and try again. If the airway is still no clear, roll them onto their side. Hit them sharply between the shoulder blades with the heel of your hand to dislodge any foreign objects. If the individual's abdomen bulges (air is going into the stomach), apply gentle pressure on their abdomen with one hand and force the air out. If this makes the individual vomit, quickly turn them onto their side, clean out their mouth, and continue giving mouth-to-mouth resuscitation.

**NOTE: If there is a suspected head, neck or spinal injury, do not perform the head-tilt, chin-lift. Instead perform the Jaw-Thrust to open the airway instead. Also if you have a mouth to barrier device, use it.**
**Circulation - Check for Heartbeat:** When you find an individual that is unconscious, check to see if they have a heartbeat and is breathing. To check for a heartbeat, use the following procedures:

1. Tilt the individual's head back (but still maintain head-tilt, chin-lift).
2. Place your fingers on their throat.
3. Feel for the Adam's apple.
4. Slide the fingers down from the Adam's apple to the side of the throat.
5. This will place the fingertips over an artery, where the pulse can be felt.

**Restore Heartbeat:** You must start external heart massage quickly, as permanent damage to the brain may occur if it is deprived of oxygenated blood. External heart massage provides artificial circulation by squeezing the heart between the breastbone and the backbone, forcing blood through the lungs, brain, and body. To perform mouth-to-mouth resuscitation and external heart massage at the same time:

1. Kneel at the individual's side.
2. Blow four quick but full breaths into the individual (as described earlier) to fill the lungs with air (their head must be tilted back and their airway open).
3. Locate the tip of the breastbone and measure two finger-widths up from that tip.
4. Place the heel of the other hand alongside the fingers. Then, put both hands together and interlace the fingers. Push downward on the chest 30 times at a rate of 100 counts (compressions) per minute.
5. Lean forward with the elbows locked. That will compress the individual's chest about 1 ½ to 2 inches. Then release the pressure on the chest.
6. After each 30 compressions, shift positions slightly and give them 2 quick, but full, breaths.
7. Continue this 30 to 2 ratio: Until the individual can breathe by themselves and their pulse returns (by checking for pulse every 2 minutes), until relieved by someone or if the individual dies.

**Stop the Bleeding**
**Before attempting to stop any bleeding be sure to put on rubber gloves. This will reduce the likelihood of any transmission of any blood borne diseases. Also, try to avoid any contact between blood or any other bodily fluids and any exposed skin. Be sure to wash off and sterilize any exposed skin that comes in contact with those fluids.**

If the individual is breathing and their heart is beating, the next thing to do is to stop any bleeding from any wounds. Before you stop the bleeding, you must find all wounds. After finding all wounds, stop bleeding by using the following procedure:

1. Without touching or trying to clean the wound cut and lift the clothing away from it. **DO NOT UNDER ANY CIRCUMSTANCES** touch the wound or try to remove objects from it.
2. Put a field first aid dressing on the wound, trying not to contaminate the dressing or the wound. Wrap the dressing around the wound and tie the ends securely with a square knot. If possible, tie the knot directly over the wound.
3. If bleeding continues after the dressing is secure on the wound, press the bandage for 5 to 10 minutes.

If more pressure is needed to stop the bleeding, put a thick pad or stone on top of the dressing and tie the

ends of the dressing over the pad or stone. This is called a pressure dressing. If the wound is in an arm or leg and the bleeding has not stopped, raise the injured limb above the level of the heat. Doing this helps to slow the bleeding. **DO NOT** raise a limb with a broken bone unless it is properly splinted.
If blood is spurting from the wound, there is bleeding from an artery. To stop it, press the on the point of the body where the main artery supplying the wounded area with the blood is located. This pressure should shut off or slow down the flow of blood from the heart to the wound until a pressure dressing can be put on it. In some cases, you may need to keep the pressure on the pressure point even after you put the dressing on. There are 11 such pressure points, Major and Minor.

If the wound continues to bleed after you apply pressure to a pressure point and apply a pressure dressing, use a tourniquet. The use of a tourniquet should however be a measure of **LAST RESORT ONLY**. Put the tourniquet between the wound and where the injured limb joins the trunk. Put it 2 to 4 inches above the wound, not over it. Never loosen or remove a tourniquet once it has been put on. Immediately let any medical personnel know that a tourniquet has been applied.

### Prevent Shock

Unless shock is prevented or treated, death may result, even though the injury would not have fatal. Shock may result from an injury, but is more likely to result from a severe injury. Warning signs of shock are restlessness, thirst, pale skin, and rapid heartbeat. An individual in shock may be excited or appear calm and tired. They may be; sweating when their skin feels cool, taking small, fast breaths or gasps, staring blindly into space or may become blotchy or bluish around the mouth.

After giving the individual the first two lifesaving measures, look for signs of shock. If the individual is in shock or is about to go into shock, treat them at once for shock. To treat for shock, proceed as follows:

1. Place the casualty in a comfortable position. The position depends on their condition. If they are conscious, place them on their back with their feet raised 15 to 20 cm (6 to 8 in). If they are unconscious, place them on their side or abdomen with their head turned to the side. If they have a head wound, raise the head higher than their body. If the wound is of the face and/or neck, set them up and lean them forward with their head down or in the position for someone that is unconscious. If they have a sucking chest wound, set them up of lay them down on the injured side. If they have an abdominal wound, lay them on their back with their head turned to the side.

2. Keep the individual warm. It may be necessary to place ponchos or blankets under and over them.

### For More Information

For more information on first aid please contact your local Red Cross/Red Crescent office or even your local hospital. Also, you can check out these sites for more information:

- The American Red Cross: www.redcross.org
- The Mayo Clinic First Aid Guide:

www.mayoclinic.com/health/FirstAidIndex/FirstAidIndex

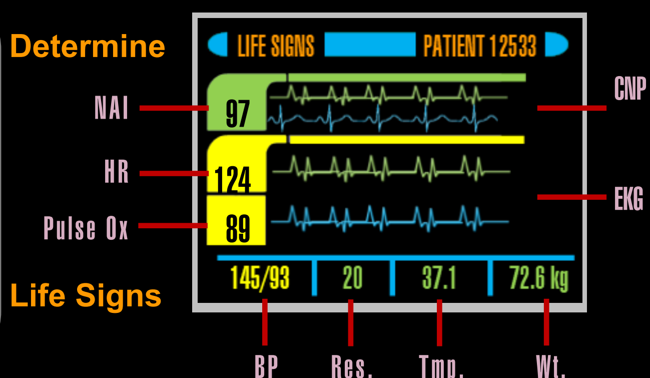
# Part 7 - Techniques and Procedures

You had instruction in first aid and cardiopulmonary resuscitation (CPR) in Basic Training, and you will get frequent refreshers in the Medical Branch. But covering these subjects again here, at this stage in your blossoming career, would be quite redundant. Instead, this section will attempt to orient you to some common techniques and procedures. Do not attempt any of these procedures unless and until you have completed detailed instruction.

In SFMC Medicine, a prescribed procedure for treating a patient is known as a clinical path. Part 5 will follow a very generalized hypothetical clinical path in treating battlefield wounded:

1. Determine patient's life signs.
2. Perform a primary assessment.
3. Perform a secondary assessment (optional step that may be performed much later based on circumstances).
4. Triage the patient (if necessary) based on assessment(s).
5. Treat ABCs (Airway, Breathing, Circulation) if indicated in 2 and allowed by
6. (Step 3 moved to end.)
7. Stop bleeding and prevent/treat shock if indicated in 2 and allowed by 4. (Step 3 moved to end.)
8. Start an IV if indicated in 2 and allowed by 4.
9. Stabilize and transport if allowed by 4.


Actual-size hand-held Med Tricorder display and input buttons in start-up configuration. The LIF, DIA, & LAB functions replace GEO, MET, and BIO.




An example of the Medical Tricorder display for life signs. The display shown is actual size. The small screen can be hard to read, so a simple touch on any reading will give a magnified display of just that figure. normal tricorder.

To determine life signs with a medical tricorder (hand-held or Medglove), press "E" for external input, then select "Med Scanner" from the menu Press "F1" and "LIF" to start scanning. Point the scanner at the patient and pass it over the head, chest, and abdomen.

The tricorder will display neural activity index (NAI) and composite neural profile (CNP), heart rate and electrocardiogram (EKG), pulse oximetry (pulse ox), blood pressure (BP), respirations, temperature (temp), and weight simultaneously. Values within normal ranges for the species will be displayed in green; values higher than normal in yellow; lower in red.

## Monitoring Life Signs

To continually monitor life signs with the tricorder's internal scanner, switch the input device to internal by pressing "I", then press "F2" and "LIF". The tricorder will monitor life signs and start an historical file in the "Alpha" library-indicated by a steady "Alpha" light. If any particular life sign should vary from its initial reading by a significant amount, the "Alpha" light will flash and an alarm will sound. Pressing "LIF" will call up the life sign display and the changed reading(s) will flash on the display. In this mode, you will have to keep the tricorder within a meter of the patient and keep the scanning head pointed towards them. With the Medglove tricorder, the best way to monitor a patient is to stick a remote scanner on their chest. (Press "E" for input and select "Remote Scanner" from the menu.)

## Interpreting Life Signs

It is important to have a good grasp of the origin and significance of life signs. Below is an explanation of each life sign, with average figures for some species shown. Don't worry too much about memorizing the normal values for every species you may treat, as tricorders and other diagnostic tools can always provide the normal range for comparison.

### Neural Activity Index (NAI)

The NAI is a reference point regarding the health of the central nervous system (CNS). It is expressed in a percentage of normal functioning from 1 to 100. This means that the same NAI values can be used for all species, which is a useful comparative measure of CNS functioning. NAI is affected by sleep, stimulation, coma, drugs, and other factors that affect the level of stress or consciousness in a patient. The normal value for a conscious and unmedicated adult is above 90. 70 to 90 indicates some factor affecting normal activity, as in unconsciousness or neural toxins or inhibitors in the body. Values below 70 indicate a serious medical condition. An NAI below 20 is generally evidence of a catastrophic injury to the patient's CNS.

### Composite Neural Profile (CNP)

Detailed brain wave activity is measured with an electroencephalogram (EEG). The EEG displays a series of lines that show brain activity. The CNP is the short-form of the test that displays a single line to indicate general activity. The tricorder will display the patient's CNP as a moving line display, with a static line display underneath of the species-normal CNP for comparison. Reading and interpreting CNP graphs will be covered in your advanced training.

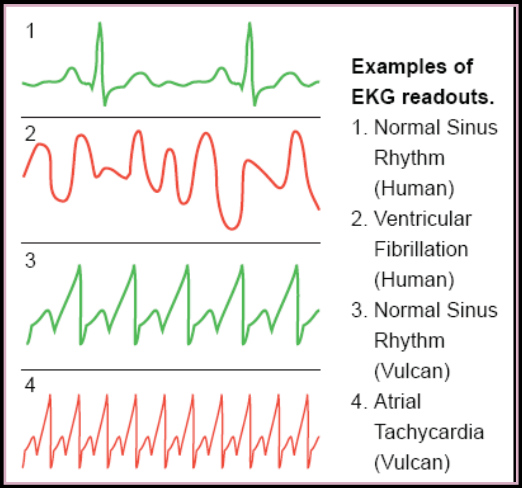
### Heart Rate (Pulse)

A pulse is the rate at which the heart is beating expressed in beats per minute. A heart rate well above average is known as tachycardia. Extreme tachycardia (over 150 for a resting human) can be a signal of serious cardiac problems (the heart is working much harder than it should). A pulse well below average is known as bradycardia. It is normal for some people to

| | |
|---|---|
| Andorian | 170 |
| Bolian | 125 |
| Human / Betazoid | 70 |
| Klingon | 60 |
| Romulan | 250 |
| Saurian | 30 |
| Vulcan | 240 |

have a low heart rate-especially well- conditioned soldiers or athletes (some human marathon runners have a normal pulse in the 30s!). Still, excessively low pulse can indicate dangerous problems with the heart.

Mean Heart Rates for Various Species in beats per minute:




### Electrocardiogram (EKG)

The EKG is a graphic display of the heart's electrical activity.
To understand the significance of the EKG, you must understand how the heart works. The heart is able to beat in a coordinated manner because of a series of complex electrical impulses that, in 80% of humanoid species, originate in the atrium(s) in the upper part of the heart-in a nerve assembly known as the sinoatrial node. Therefore, a normal EKG shows a sinus rhythm (the term is used even in species without a sinoatrial node to indicate a normal EKG).

When the beat of the heart is no longer originating from where it is supposed to, the rhythm is abnormal and is called an arrhythmia. Two common and severe arrhythmias are ventricular tachycardia (V-Tach) and ventricular fibrillation (V-Fib). They are called ventricular because the origin of the electrical activity controlling the heart comes from the area of the ventricles instead of the sinoatrial node. Patients in V-Tach may show stable pulse and BP briefly, but the arrhythmia does not allow the heart to pump blood effectively, and BP soon falls. V-Tach usually leads to V-Fib. In V-Fib, the heart is in total chaotic activity, without any coordinated pumping action. Cardiac arrest usually follows. The development of V-Tach and/or V-Fib is often signaled by the presence of PVCs (premature ventricular contractions) in the EKG display.

### Pulse Ox

Pulse ox shows how much oxygen is being carried in the blood, and is a fair indicator of how efficiently the patient is breathing. Pulse ox is expressed in a percentage from 1 to 100. Normal is about 95; anything below 85 to 90 suggests serious problems with the lungs. A pulse ox below 80 is an ominous sign that the patient is in serious pulmonary distress.

### Blood Pressure (BP)

BP is expressed in two numbers, for example, "90/40" or "90 over 40". The upper number, the systolic pressure, represents the pressure in the blood vessels when the heart contracts. The lower number, the diastolic, represents the pressure when the heart is relaxed between beats.

Stress can cause the BP to rise, and combat can be very stressful, so it is not unusual to see elevated BPs in the field. However, when BP is unusually high (for humans, more than 140/90), the patient is said to be hypertensive. Hypertension can be caused by trauma, or may be indicative of a medical condition. Extreme hypertension (in humans, a diastolic over 130) can be symptomatic of serious medical problems, and can cause a stroke in otherwise healthy people.

Hypotension is the term for low BP. It is more difficult to diagnose because, for some people, low BP is normal.

Excessive hypotension, though, is a sign of a serious problem-without sufficient pressure the heart can't move blood efficiently, and the brain and heart may not get enough oxygen. Blood loss is a major cause of hypotension in combat casualties.

Mean BP Values for Various Species in systolic/diastolic:

| | |
|---|---|
| Andorian | 90/50 |
| Bolian | 95/50 |
| Betazoid | 160/110 |
| Human | 120/80 |
| Klingon | 130/80 |
| Romulan | 85/50 |
| Saurian | 30/10 |
| Vulcan | 80/40 |

## Respiration

If a patient is breathing much faster or slower than is normal for their species, it may mean problems. Pain or anxiety may increase respirations, as may a low pulse ox. Ironically, since breathing requires energy, the faster a patient breathes the more oxygen they will use up in their unconscious attempt to bring their oxygen level up. Not only the rate of breaths but the effort of them is also monitored. If a patient must exert extraordinary effort to breathe, their breathing is termed labored. If breaths are short and the expansion of lungs small, breathing is said to be shallow. In species with normally high respiratory activity (Vulcans, Andorians, etc.), slow and/or shallow respirations are particularly alarming.

Mean Respiration Rates for Various Species in breaths per minute:

| | |
|---|---|
| Andorian | 38 |
| Bolian | 14 |
| Betazoid | 21 |
| Human | 18 |
| Klingon | 15 |
| Romulan | 58 |
| Saurian | 5 |
| Vulcan | 61 |

## Temperature

An increased temp is usually a sign of infection. In an attempt to kill invading cells, the body increases the temperature in the system. Increased metabolic processes in fighting the infection also drive the temp up. A

| | |
|---|---|
| Andorian | 38.9° |
| Bolian | 38.7° |
| Betazoid | 37.8° |
| Human | 37.2° |
| Klingon | 35.6° |
| Romulan | 32.2° |
| Saurian | 3 to 5° above ambient |
| Vulcan | 32.8° |

fever will also cause the heart rate to rise, and the increase in metabolic state will also mean an increased use of oxygen.

| | |
|---|---|
| Andorian | 70 (male) 45 (female) |
| Bolian | 78 (male) 52 (female) |
| Betazoid | 69 (male) 58 (female) |
| Human | 70 (male) 60 (female) |
| Klingon | 80 (male) 50 (female) |
| Romulan | 75 (male) 55 (female) |
| Saurian | 50 (male) 54 (female) |
| Vulcan | 70 (male) 50 (female) |

Mean Body Temps for Various Species in degrees Celsius

### Weight

Even though a patient's weight rarely changes during evaluation and treatment, it is a vital statistic because many medication doses are calculated based on the patient's weight. The tricorder calculates weight by sampling mean body density and finding body volume. It then expresses the figure in terms of kilograms at one gravity for standardization.

Mean Weight for Various Species (in kg at 1 gravity):

## Perform a Primary Assessment

A primary assessment (or primary survey) is the initial evaluation of a patient to identify and stabilize any immediate life-threatening injuries or conditions. The major objective is to check and ensure the ABCs of life support (airway, breathing, circulation). Prior to modern diagnostic tools, this assessment was accomplished through a series of aggressive and invasive procedures that took as long as five to ten minutes. In some cases, you may have to perform a primary assessment this way, but most often it can be done much more quickly and easily with a tricorder.

To perform a primary assessment with the tricorder, select the Med Scanner as input device. Then press "F1" and "DIA". Starting at the head, pass the Med Scanner slowly over the body, being sure to include the extremities. As the scanner identifies life-threatening injuries, it will categorize them by severity and threat level to the patient, identify them on the display, and recommend a course of treatment to stabilize the condition. If there is more information than will fit on a single display screen, the tricorder will display right and/ or left arrows to indicate further displays before or after the current one. Press the arrows to go to the screen you want.

It is important to familiarize yourself with several alternative ways of treating the conditions the tricorder may find. While the tricorder suggests the optimal course of treatment, it will not know your current operational conditions. It doesn't know how many patients you must treat, how many supplies you have, if you will be functioning under fire, etc. If you blindly follow the recommendations of the tricorder, you may find yourself out of supplies or time with dozens of casualties waiting for your help.

## Trauma

The number of conditions an assessment may uncover, and the corresponding treatments for each, are the topic of extensive advanced training for medics, nurses, and doctors. Even a fraction of this information couldn't be covered in this guidebook. However, most of what you see in your primary assessments will fall into the broad category of trauma. In medical terms, trauma is any injury, accidental or intentional, caused by a harsh object or instrument. In major battlefield trauma, the harsh objects are most often shrapnel, projectiles and phaser beams. Blunt trauma is any trauma that does not involve an invasive penetration of the skin. These are often abdominal injuries caused by an impact.

## Trauma Kinetics

There are two things that must considered in the trauma patient. They are mechanism of injury and index of suspicion. Mechanism of injury is the strength, direction, and nature of forces that cause injury to a patient. If your patient has been involved in a shuttle accident, the mechanism of injury is the process by which forces are exchanged between the shuttle and what has been struck, the patient and the shuttle interior, and the various tissues and organs as they collide with each other inside the patient. Index of suspicion is the anticipation of injuries based on analysis of the mechanism of injury. If your patient has been struck by phaser fire, you can suspect burns, blunt force trauma, internal injuries, and cellular degradation. As you can see these are important in the evaluation of trauma patients.

## Blunt and Penetrating Trauma

Blunt trauma occurs when the body is struck by, or strikes an object. The energy is transmitted to the organs and tissues of the patient. Injury is caused by this energy not the striking object. For example, your patient was involved in hand to hand combat with a Jem'Hadar soldier. During the melee, he was punched in the face. The damage was caused by the fist striking the face and compressing the tissue. Cells are stretched, blood vessels torn, and bone may have been crushed. Furthermore, the brain may have collided with the back of the skull and then the front possibly causing a serious head injury.

Blunt trauma may also cause serious internal injuries. The force of compression may cause the hollow organs like the stomach or the bowel to rupture, spilling the contents and bleeding. In the chest cavity, alveoli or smaller airways may burst, allowing air to enter into the pleural space. Solid organs, such as the liver or spleen may be lacerated, causing copious blood loss.

Penetrating wounds are those that break the skin. This occurs when an object (energy source) continues its path into the body. Energy may also be transmitted to the surrounding body tissue. Internal damage is then carried beyond the open wound site. This typically happens with projectile weapon injuries.

As medical personnel in the SFMC, you will see blast injuries on a regular basis. There are several things to consider for this type of injury. First of all, the explosion will create an intense amount of heat, which then causes combustible gases to expand very rapidly. A wave of pressure extends outward from the center of the blast compressing and decompressing everything in its path. Objects in this pressure wave become projectiles, flying in all directions with tremendous velocity. Patients caught in the pressure wave often become projectiles themselves. There are three main phases of a blast:

- Primary (This phase involves the initial air blast and pressure wave) Typical injuries include: auditory, sinus, lung, and stomach /intestinal Thermal burns may also occur during this phase
- Secondary (The patient is struck by debris propelled from the blast by the pressure wave)
- Tertiary (The patient is thrown into the ground or another object)

### Ballistics

Ballistics is the study of projectile weapons and their characteristics. An important part of this study is trajectory. This is the curved path that a projectile travels once it has been launched from a weapon. The projectile is subjected to the force of gravity as it travels though the air and begins a downward slope. The greater the velocity of the projectile, the flatter its curve of travel will be. The projectile will travel straighter for a greater distance.

A more significant aspect the traveling projectile is energy dissipation. Several factors including drag, expansion, profile, and cavitation affect dissipation. As the projectile travels through the air it is slowed by wind resistance, also known as drag. The faster the projectile, the greater the drag will act upon it. If all other variables are equal, the projectile fired at a closer distance will cause more severe damage then that of a projectile fired from a greater distance. The profile is the size and shape of a projectile as it contacts the target. The larger the profile the more surface area will be contacted, thus promoting a more rapid exchange of energy. In an effort to increase the rate of energy release, some projectiles are designed to expand upon target entry. The rotation or tumble of the projectile will also present a wider profile increasing the energy transfer. Either way, the damage to the target will increase exponentially. Speed of the projectile determines the amount of energy that can be expanded. With high speed, high-energy projectiles the damage will be increased. Pathway expansion is important in understanding a patient's wounds. A cavitation wave is created when the projectile contacts the body. Tissue is pushed in front of the projectile and lateral to its path. The resulting wave of pressure moves in front of and along side the weapon, leaving a cavity in its wake. Organs can be contused, ruptured, or fractured by this pressure. In conclusion, the faster the projectile travels, the greater its profile, the greater the energy exchange, the greater the cavitation wave, the greater the damage to target will be.

### Responsiveness

Most traumas you will encounter will be obvious either by observation, or by tricorder assessment. But while the tricorder can tell you what's medically wrong with the patient, it can't tell you the extent to which that condition is affecting the patient. Everyone responds differently to pain for instance. So it will be incumbent on you to check the patient's responsiveness and mental status.

To check for responsiveness, you need to gauge three important criteria:

- The patient's ability to open and close their eyes on command.
- The patient's ability to respond verbally to questions.
- The patient's ability to move their body in response to stimuli (verbal and painful).

Each of these responses is given a score, which we call the Responsiveness Scale. You will learn how to score each item in your advanced training.

### Altered Mental Status

Another area with which modern diagnostics can have problems is in the area of determining Altered Mental Status. The NAI may or may not reflect a change when a patient is confused, disoriented, or suffering from some other condition wherein their mental status or level of consciousness is not what it should be.
The most common and expedient method for checking for AMS is four very common and easy questions:

- Do you know what day it is?
- Do you know your name?
- Do you know where you are?
- Do you know what is happening to you?

If the responses to all four questions are correct, the patient is said to be alert and oriented times four, or simply, "A and 0 times four." If some or all of the questions are answered incorrectly, the patient is exhibiting AMS to some extent. Now, further detective work will be necessary.

## Perform a Secondary Assessment

After identifying and stabilizing life-threatening conditions discovered in the primary assessment, a secondary assessment may be performed in the field. A secondary assessment can usually wait, though, until the patient is seen at a hospital facility. The goal of the secondary assessment is to find everything wrong with the patient, life-threatening or not.

To perform a secondary assessment with the tricorder, select the Med Scanner, then press "F2" and "DIA" and scan the patient. A secondary assessment requires ultrahigh resolution scanning and a lot of computing cycles, so it usually takes longer to perform than the primary assessment.

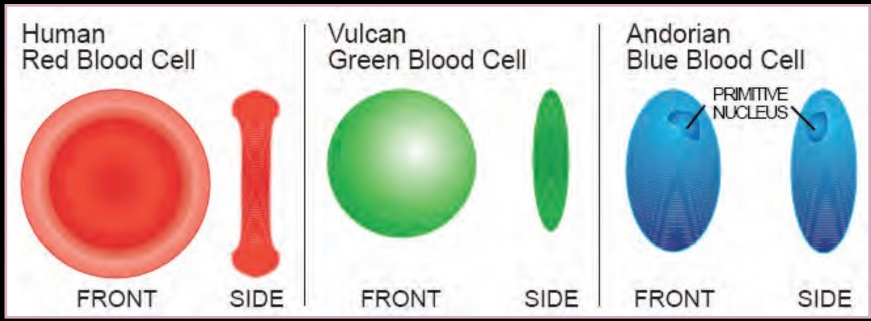
A standard hand-held medical tricorder is better at secondary assessments than the Medglove. The Medglove's computers are designed for rapidly determining life signs and primary assessments. This forces the secondary assessment algorithms into an awkward computing architecture that delays computing cycles, slowing the assessment. Also, the secondary survey will be less accurate with the Medglove due to the wider aperture of the palm Med Scanner (which makes life sign and primary survey scanning quicker).

### Conducting Lab Tests

The tricorder can be used to detail several measurements that are collectively known as labs. This comes from the colloquial term for these tests since they were conducted in laboratories before the advent of modern diagnostic tools. The tricorder automatically performs several labs as part of its normal functioning (much of the information in the primary and secondary assessments is based on lab results). Normally, though, the tricorder does not display these results unless specifically asked to do so. This prevents overloading the medic with information when the interpretation of the lab results is obvious. If a particular lab result is anomalous or in some other way difficult to interpret, then the actual lab will be included in the assessment display screens.

To view the lab results, or to order a test not normally accomplished in routine assessment, you must access the lab section of the tricorder. To view tests already conducted as part of an assessment, simply select "F1" and "LAB". The display screen will list the tests conducted. Touch the appropriate test name to see the results. To conduct a new test, select an input device, press "F2", then press "LAB" and select the test you desire.

To monitor a particular lab on a constant basis, select the test in the manner above, then while displaying the results of the test, press "F2" and "LAB" again. The "Delta" library light should light brightly while the test is conducted again. The light will stay on but dim afterward to indicate the "Delta" library is in use. Every time the test is repeated (the interval varies by test type), the light will brighten again. The light will flash and an alarm will sound if significant changes in results occur.




Some of the most common lab tests performed by the tricorder are shown below. More tests are available, and peripheral input devices and isolinear optical chip sets can add even more tests to the battery.

Complete Blood Count (CBC)

The CBC is one of the most common blood tests in medicine. It is actually a collection of blood component counts that provides important diagnostic information. Most humanoid blood can be divided into two categories of components: plasma, and formed elements. Plasma is the liquid portion of the blood in which the formed elements are carried. It is about 90% water, about 8% proteins, and 2% salts and acids.

90 to 99% of humanoid blood formed elements are erythrocytes, or colored blood cells. The color varies due to the mineral on which the hemoglobin is based. For instance, human hemoglobin is based on iron, iron oxide is red, and so the blood has a general reddish appearance. Similarly, copper-based blood (as in Vulcans) is green, and cobalt-based blood (as in Andorians) is blue. The shape of these cells varies by species as well (see illustration).

About .5 to 8% of the formed elements are thrombocytes, or platelets, which aid in the formation of blood clots. Humans are among the slowest-clotting humanoids with only .6 to 1% thrombocytes in their blood. Klingons are among the fastest clotting with 6 to 8%. Approximately .1 to 1.5% of humanoid-formed elements are leukocytes, or white blood cells, which fight infection by digesting invading organisms.

The CBC is a count of some of these components, as well as other measures, and includes the following tests:

### Hematocrit

The first measure in the CBC is the hematocrit or simply crit. This is a count of erythrocytes as a percentage of total blood volume. In humans, a normal crit is about 40. Several factors including species, gender, and age can all affect the crit, but the tricorder easily compensates for those to indicate the normal range for the patient.

When a patient loses a lot of blood, the hematocrit will initially stay the same-since it is a percentage of whole blood, and whole blood is being lost. However, the body makes replacement plasma quicker than replacement blood cells, which eventually leads to a drop in crit. As IV fluids are introduced, the crit falls even lower even faster because the blood is diluted (if PRF is used, the tricorder will compensate for the artificial blood cells in calculating the crit). Chronically low hematocrit, a drop of more than 10% below normal, is called anemia. The body usually adjusts to the condition when it comes on gradually, but when it is caused by hemorrhaging the body is unable to adapt quickly enough and serious problems ensue.

### Hemoglobin

Another marker for blood loss is the hemoglobin level. Hemoglobin is the material inside the erythrocytes that actually carries the oxygen. The measure of it indicates how well the blood is doing its job of transporting oxygen to the body. Normal for a human would be a value of about 15-around 10 or below becomes a source of concern.

### WBC Count

The CBC also calculates the count of infection-fighting white cells. An elevated WBC count is usually a marker for infection.

| Species | Type | RH Factors |
|---|---|---|
| Andorian | Et, Ef, Eq, J, N | none |
| Bolian | Eb, Eb2 | none |
| Betazoid | Cb, Db, Ob | +, -, neutral |
| Human | A, B, AB, O | +, - |
| Klingon | K | ++, +, -, - - |
| Romulan | Sr, Tr | +, - |
| Saurian | L, M, Ns, Os, P | none |
| Vulcan | S, T | +, - |

### Platelets

Low platelet levels indicate a patient will have difficulty in clotting, and controlling their bleeding will be problematic. There are artificial clotting agents that can be used, but real platelets are a better substitute when available for transfusion.

### Type and Cross-Match

Although it hasn't always been part of the CBC, today a CBC automatically includes a type and cross-match. This procedure once took a lab 30 minutes, but can be done by a tricorder in seconds. Species usually have at least a couple erythrocyte types based on antigens in the blood. They may also have a Rhesus (RH) factor as well. Transfusing the wrong blood type or RH factor can lead to fatal reactions, so it is vital that if real blood is transfused, it matches the type of the patient exactly.

Blood Types and RH factors for various species:

### Coag Panel

A coagulation panel, or coag panel for short, further measure the body's ability to control its own bleeding. For iron-based blood, the panel consists of a platelet count, a prothrombin time (PT) test, and a partial thromboplastin time (PTT) test. For other species, the PT and PTT tests may be replaced with other species-specific tests.

### Chem-7

0ne of the most common tests to check for chemical imbalances in a patient is the Chem-7 (a test of seven important blood chemistries). It is ordered for a specific blood base as in "Chem-7, Cobalt" or "Chem-7, Copper" since different blood bases have different chemistries. A tricorder will automatically perform the Chem -7 that is correct for the species being examined. The chemistry levels checked in the "Chem-7, Iron" are:

1. Sodium
2. Potassium
3. Chloride
4. Bicarbonate
5. Glucose
6. BUN
7. Creatinine

Tests 1-4 are collectively known as electrolytes or "lytes". They are a quick indicator of chemical imbalance, and are important in managing IV fluid therapy. Abnormalities in lytes can be lethal-severely low sodium, for example, can cause seizures; high or low potassium can cause arrhythmias.

Glucose is the sugar that provides most carbon-based humanoids with the energy required for living, and it is dissolved in plasma. Very high glucose levels (hyperglycemia) may indicate diabetes. Very low levels (hypoglycemia) can produce confusion or even coma.

Blood Urea Nitrogen, or BUN, and creatinine are compounds dissolved in plasma. Collectively, they give an accurate reflection of how well the kidneys are functioning. High values indicate a possible malfunction of the kidneys or severe dehydration. Extremely high values may be symptomatic of renal failure, which will require dialysis to stabilize.

### Arterial Blood Gases (ABG)

ABG measures the pH level of the blood and also P02, PC02 and HC03. The test is used to determine if the patient is in an acidotic or alkaline state. It also tells if this state originates from a respiratory or metabolic problem.

P02 (or sometimes seen as Pa02) is the partial pressure of oxygen. This is the measure of the pressure exerted by oxygen in its free form that is dissolved in the plasma. It is an indirect measure of the oxygen content of the arterial blood. P02 is decreased in patients who are unable to oxygenate arterial blood due to 02 diffusion difficulties; patients who have premature mixing of venous blood with arterial blood; or patients who have under ventilated and over perfused pulmonary alveoli).

PC02 (sometimes seen as PaC02) is a measure of the partial pressure of carbon dioxide in the arterial blood. This is called the respiratory component because this value is primarily controlled by the lungs. As the level of C02 increases, pH will decrease. PC02 is elevated in primary respiratory acidosis and decreased in primary respiratory alkalosis.

HC03 (bicarbonate) measures the metabolic (renal) component of the acid base equilibrium. As the level of HC03 increases, the pH also increases. HC03 is elevated in metabolic alkalosis and decreased in metabolic acidosis.

### Urinalysis (UA), Guiac and other rare labs

These formerly common tests (the UA analyzes urine, guiac stool) were routinely done before the invention of medical scanners. However, these tests check for the presence in the urine or stool of something that indicates another problem-and that other problem can now easily be found directly by the tricorder without the indirect evidence presented by these tests. For example, blood in the stool or urine in a trauma case signals an abdominal injury involving bleeding. However, you would have direct evidence of this from your tricorder's assessments, and so would not need the UA or Guiac.

Other tests that were similarly common before tricorders were peritoneal lavage (used to check abdominal bleeding), x-rays (to check for fractures, foreign bodies, etc.), CT or MRI scans (for internal visualization), and similar diagnostic tests. All these have been made obsolete by the tricorder, but some (like lavage) may be exhumed in the field when scanners and diagnostic equipment fail or are jammed.

## Triage the Patient

Triage is the procedure of surveying patients and establishing priorities for their treatment. It is a dynamic process that is done and redone as new casualties enter the medical facility, and as time goes by. A patient that initially presents with a seemingly minor injury may 'crash' rapidly and be reassigned a new triage level.

Triage occurs at nearly every level of battlefield medicine. Variations in the procedure exist at each level depending on the availability of transporters, stasis tubes, treatment facilities, etc. But generally speaking, triage is conducted in the following way.

### Tagging

Each triaged patient is given a colored tag, usually placed around the neck or extremity. This tag consists of a card on which the patient's life signs and tricorder diagnosis can be written. A special triage printer peripheral can be used with the medical tricorder that will produce self-adhesive labels for the tags that contain the same information. On the back of the tag is a pocket for an isolinear optical chip with diagnostic tricorder data if available. Each tag is color coded on the following criteria.

### Black

Black tags are for very severely injured personnel who are not expected to live even if they receive emergency or even advanced medical treatment.

### Blue

Blue tags are placed on those casualties that are very severely injured and who would not survive battlefield emergency medical treatment, but who have a reasonable chance of surviving advanced medical treatment if they are placed in stasis now for later treatment.

**NOTE:** The availability of stasis tubes must always be considered when blue-tagging, and some blue-tags may be down checked to black if more blue tag candidates come in who have a better chance of surviving stasis and treatment than those who are in the stasis tubes now.

### Red

Red tags are used for those personnel who are severely injured but who have a reasonable chance of survival with emergency treatment, but who could die or have severe permanent disabilities without it.

### Yellow

Yellow tags are placed on personnel who are moderately injured but who will survive, and a short delay in treatment of their wounds will not lead to serious problems.

### Green

A green tag is given to the 'walking wounded', those who have minor lacerations, back or neck sprains, or uncomplicated bumps or bruises.

## Transportation Priorities

If you are triaging at Field Aid or at an impromptu battlefield triage area, the priorities you establish will be more for transportation than for treatment. The sequence in which tagged casualties are transported will vary with the method of transport and the availability of stasis facilities.

### By Transporter

If transporters are available, and transport directly to stasis is possible, blue tags have top priority for transport. Red tags go next-to the highest-level medical facility capable of receiving their transport (usually a Hospital Ship or MSH). Yellow tags go next, but they may be sent to a Field Hospital or even a Battalion Aid Station if their injuries are not too severe. Green tags will generally be treated at Field or Battalion Aid, and either returned to their unit or transported later.

If stasis facilities are not available, blue tags are treated the same as black tags. Black tags are not a priority for transport.

### By Ambulance

If transporters are not available and patients will be transported by ambulance, the red-yellow-green sequence is usually followed. Black tags are not a priority for ambulance transport.

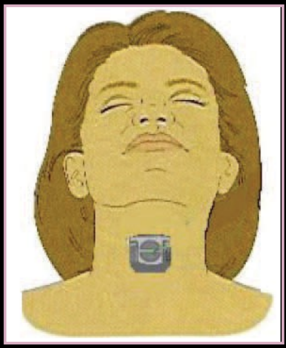
A limited number of blue tags can go in the few tubes available on the ambulances, but you will likely have many more blue tags than stasis tubes. Avoid the temptation to get caught up reprioritizing blue tags to the extent that red tags become neglected. In most cases, your best course is to just fill up the tubes available and down check your other blue tags to black. There are other wounded that need your attention.

## Treat ABCs

### A is for Airway

Airway management is one of the most crucial tasks in trauma management. If there is no airway to the lungs, and one cannot be established, most species will be beyond hope. Even though IV tri-ox or Blood Gas Infusers can be a bridge therapy, the body will eventually lose its ability to break down the tri-ox compound and use it for oxygen. If an airway hasn't been established by then, it is too late.

## Intubation



The process of securing the airway with a tube is called intubation. In the field, this is most often done with the combitube: a flexible, expandable assembly that can be inserted into the airway without visualizing the vocal chords. The shape of the combitube then seals off the esophagus so that air entering the tube will flow only down the trachea and into the lungs instead of down the esophagus and into the stomach. Since the tube doesn't enter the trachea to any significant depth, the combitube isn't always efficient, but it is extremely easy to insert, especially on the battlefield under fire, or in route via ambulance. In these cases, traditional intubation can lead to inadvertent damage to the airway and severe complications.

The traditional method of intubation is to use a laryngoscope and an endotracheal (ET) tube. This is a complicated and delicate procedure usually reserved for doctors, respiratory therapists, anesthetists, and I-Medics. Use of an ET tube establishes a much more reliable airway, but is contraindicated if intubation must be performed "on the fly" where the patient can't be held still or when the vocal chords cannot be visualized.

## Cricothyrotomy

Severe facial injuries or trauma to the upper neck or pharynx can make intubation impossible. In this case, the next best route to the airway is through the trachea in a procedure known as a cricothyrotomy, or simply, crike. In this procedure, a tube is placed directly into the trachea to act as the patient's airway.

The most common crike method is to use a specialized surgical instrument known in the vernacular as a "crike spike." This instrument appears as a cube about two centimeters on a side. One face has a circular aperture with a nub in the center. The opposite face has indicator lights and an activation switch. The crike is accomplished by positioning the nub over the cricothyroid membrane (a green indicator light comes on when the device is in position). Touch the switch, and the device transmits a sterile field, makes a laser incision, and inserts a small crike tube into the incision. The crike spike can be left in place to serve as a microventilator for the tube, or can be removed and a traditional ventilator attached.

The other two methods of cricothyrotomy are much more archaic and should only be attempted by highly trained professionals under extreme emergencies. The first is similar to the crike spike, except that the incision and tube insertion are accomplished by hand. The second is known as a needle cricothyrotomy and is accomplished by inserting a large gauge needle into the cricothyroid membrane. Obviously, these procedures can cause more problems than they solve if not done well.

## Pulmonary-Thoracic Airway

The last resort for opening and maintaining an airway is directly through the chest wall and into one or both lungs. This procedure is known as a Pulmonary-Thoracic Airway, and can only be accomplished by a surgeon with proper SSF equipment. A PTA is highly risky, and should only be used when there is severe damage to the trachea itself.

## B is for Breathing

The next vital step is to ensure that air flows through it and into the lungs in order to get oxygen into the blood. If the patient is not breathing on his own, you will have to breathe for him. If you have not yet intubated, you will use standard rescue breathing (which you learned in Basic Training), or an ambu-bag or microventilator (see below) with a mask. This will only be effective for a short time as much of the air in these methods is being pumped into the stomach or is escaping around the sides of the mouth. If breathing does not spontaneously restart, you will have to intubate.

### Ventilation

Once intubated, you have three options: ambu-bag, microventilator, or ventilator. The ambu-bag is a collapsible bag that is squeezed by hand to push air into the breathing tube. A microventilator does the same thing on its own with a micropump. A ventilator does it with a standard long-life pump. All three can be easily connected to combitubes, ET tubes, and crike tubes with the same standard fitting. Ambu-bags and microventilators have the same disadvantage: they use ambient air. Ventilators can be hooked to a specific mixture of gases, which is much more beneficial in many cases.

### Aspiration

Aspiration is what happens when the contents of the stomach are vomited, and the vomitus is then inhaled into the lungs. When a patient aspirates, they may literally drown in their own vomitus. Aspiration can happen spontaneously, so the airway must always be monitored so that the medic can suction the vomitus. Aspiration can also be a side effect of artificial respiration, since air is sometimes inadvertently forced into the stomach where it creates pressure that can only be relieved back through the esophagus. This is why the overwhelming majority of CPR recipients usually vomit at some point in the procedure. Be aware of this risk.

### IV Tri-Ox Therapy

In extreme emergencies when no airway can be established, IV tri-ox therapy may be initiated. Here, a bag of IV tri-ox solution is piggybacked onto normal IV fluids. The patient's body can then use the tri-ox as its oxygen source for a few hours until an airway can be established. There can be problems with this therapy though.

The most common problem with IV tri-ox for extended periods is that eventually the body loses its ability to break down the tri-ox into usable oxygen. No one is really sure why this happens, but it can occur anywhere from two to 10 hours after therapy starts. Another problem often seen is one of drug interaction: tri-ox easily coagulates when administered IV with certain other solutions. For instance, never piggyback tri-ox onto a Micatropha IV as the tri-ox will precipitate in the tubing and clog the IV.

### Blood Gas Infuser Therapy

Some of the problems of IV tri-ox can be avoided with a Blood Gas Infuser. A BGI infuses gases into the blood directly and avoids drug interaction problems. However, the body will eventually reject this therapy as well. A BGI will usually last longer than IV tri-ox, though, providing anywhere from eight to 72 hours of therapy depending on the species.

BGI therapy can only be administered by a doctor, and is not a field procedure.

Unless and until a usable airway can be established (or the patient's lungs repaired or replaced if the problem lies there), the patient is tied to the SSF that contains the infuser. This takes up a biobed that may be needed, and drains resources that may be better used on other casualties. This makes BGI therapy a last resort only when there is a good chance of quick success. Rapidly establishing an airway is still a critical priority.

### C is for Circulation

If A and B have been looked after, you have a supply of oxygen in the blood. Now, you must make sure the blood circulates to transport that oxygen to the brain, heart, and other organs. Most humanoid brains cannot go more than a few minutes without profound damage or even death.

There are several conditions you will find on the battlefield that deal with profound problems with the circulatory system. Common problems such as arrhythmias and fibrillation are covered elsewhere in this book (see "EKG" under "Life Signs" and the description of the portable defibrillator in the "Field Equipment" section). The most serious problem you encounter in this area will undoubtedly be cardiac arrest.

### Cardiac Arrest

When the heart stops beating altogether, the patient is said to be in cardiac arrest. When it accompanies respiratory arrest, it is termed a full arrest (when the heart stops, not much else keeps going for long). An arrest is also called a "code" in the vernacular. Obviously, an arrest is a serious problem.

If you encounter a casualty on the battlefield in full arrest, you must quickly determine his chances of survival versus the amount of other wounded requiring your attention. You can't drop everything to run a code resuscitation when you have 30 other casualties with a better chance of survival. For more on this, see "Triage."

In the field, especially by yourself, you have little chance of successful resuscitation even with modern equipment and plenty of time (and you'll rarely have enough of either). You can attempt defibrillation if V-Fib precedes the arrest, and you may administer tricordrazine and inaprovaline. If you have the training and equipment, you may even try cortical stimulation to provoke the heart into beating via the CNS.

However, you will most likely wind up simply performing CPR until you can get the patient to at least a Field Aid Station. Better still, get some other Marines to perform the CPR since all Marines are trained in the technique in basic training.

An emergency thoracotomy with internal cardiac massage may be necessary if the patient in cardiac arrest does not respond to fluid replacement and external CPR.

In a medical facility, running a code resuscitation has a much better chance of success if for no other reason than the greater resources available there. If standard resuscitation measures are unsuccessful here, there are more options: The heart can be stimulated with an external pacemaker via the SSF, or a thoracotomy may even be attempted.

### Thoracotomy

In a thoracotomy, the chest is surgically opened to provide direct access to the heart. The heart can then be massaged by hand or electronically stimulated directly. This is obviously an extremely invasive procedure that only a physician may attempt. A thoracotomy in and of itself is a major trauma to the patient, and its medical management is delicate.

Even if all these measures are unsuccessful and the heart completely fails, the major medical facility usually has the further option of placing the patient in stasis until he can be fitted with an artificial heart.

## Stop Bleeding and Treat for Shock

It is said in the medical profession that all bleeding stops. But your goal is to make sure it stops because of proper treatment, not because the patient expires. The most severe bleeding is known as hemorrhage-a huge amount of blood lost in a short period of time (internally or externally). It is all too common in battlefield trauma. Symptoms of hemorrhage are related to hypovolemic shock, and include hypotension, tachycardia and others (see Shock). If bleeding is contained in a cavity or joint, pain will develop as the cavity or joint is stretched by the rapidly expanding volume of blood.

Treatment effort is directed to stopping the hemorrhage. In external hemorrhage, pressure is applied directly to the wound or to appropriate pressure points. The body part involved may require elevation. Ice on the wound may slow bleeding due to its vasoconstriction effects (body temp must be carefully maintained). Vasoconstrictive drugs may work as well.

### Trauma Dressings

Trauma dressings are specially designed absorbent bandages and pads that come in a wide variety of shapes and sizes. Today, most are treated with artificial coagulants that aid in surface clotting and slow bleeding.

When applying trauma dressings for bleeding, direct pressure should be used whenever possible (either by physically holding the dressing, or by taping or wrapping it in place). Once applied, a trauma dressing should not be removed until the patient arrives at a facility with proper equipment to handle such a removal. Should the dressing soak-through with blood, simply place another on top of the first and reapply pressure.

In an emergency, any absorbent cloth can be used as a trauma dressing. When possible, sterilize it first by treating it with sterilite or some other compound. However, if a dirty old rag is all you have, it's better than nothing. Bleeding kills faster than infection.

### Vasoconstrictive Drugs

Drugs that cause the blood vessels to contract are called vasoconstrictive drugs. By cranking down the blood vessel apertures, these drugs reduce the amount of blood that is being pushed through the system at any given time. This will slow bleeding. The most common drug of this type used by the SFMC is dobutamine hydrochloride (see Pharmacopeia).

### Shock

Shock is an abnormal condition of inadequate blood flow to the body's peripheral tissues, with life-threatening cellular dysfunction. There are many types of shock, each named for the source of the shock. The most common type of shock seen on the battlefield is hands-down hypovolemic shock, which is caused by low blood volume (usually due to bleeding). Other common types of shock are neurogenic, relating to the nervous system; cardiogenic, relating to the heart; septic, relating to infection; and anaphylactic, caused by severe allergic reactions.

### Recognizing Hypovolemic Shock

Symptoms of hypovolemic shock include elevated pulse and respirations. The BP may decline after an initial slight increase. The patient may show signs of restlessness and anxiety due to decreased blood flow to the brain. There may also be weakness, lethargy, pallor, and cool moist skin. As shock progresses, temp may fall and respirations will become rapid and shallow.

### Treatment
Fluid volume must be restored to the patient quickly. This is most efficiently accomplished by an IV solution or with PRF. Supplemental oxygen should also be given. Anti-shock garments or force fields may also be employed. Warmth and rest will also help.

### Anti-shock Garments and Force Fields
To keep blood in the upper body where it is needed, anti-shock trousers may be used. These inflate air bladders around the legs and lower abdomen to squeeze the blood out of the lower extremities. Most biobeds and litters have a force field for this function. Obviously, you need proper training in the use of these devices to use them correctly.

### Warmth
One common treatment for shock, or to prevent its occurrence, is simple warmth. Any candidate for shock should be kept comfortably warm-they should not be sweating or overheated.

### Rest
Another important treatment is to make the patient as comfortable and calm as possible. If it is not contraindicated by injuries or bleeding (especially cranial or spinal injuries), you may elevate the patient's legs slightly to aid in vascular return of blood into the upper body.

## Start an IV
The basics of IV fluids have been discussed in "Pharmacopeia," but there are still several items regarding IVs with which to familiarize yourself.

### Why start an IV
To prevent or treat hypovolemic shock, you will almost always start an IV on a casualty. Hypovolemia requires a rapid infusion of fluid to compensate for the blood volume lost (usually to bleeding). Even when hypovolemia is not a threat, IVs are commonly started to provide a direct and easily accessible intravenous line for drug administration. Later in the treatment process, an IV may also be used to provide parenteral nutrition as well.

### Preparing the IV Solution
Almost all field IV solutions come in a powdered form, which must be reconstituted. This allows the Medic to carry many more IV bags. To reconstitute, you will need a supply of sterile water. If you are carrying bottled sterile water, you can simply screw the bottle top onto the filler cap of the IV Bag, twist the seal ring on the cap neck to open the two barrier disks (providing a sterile connection), and then fill the bag until the water level reaches the 1000ml line. Disconnect the bottle and mix well before using.

If you don't have a ready supply of sterile water, connect the field water sterilizer to the bottleneck and then pour in whatever water supply you have. The FWS can sterilize up to 1000 liters of water before being replaced. It uses an advanced and complex system of chemicals and filters to completely sterilize the water, so it is not susceptible to power interruptions, dampening fields and other interference.

### Starting the IV
IVs are usually established through venipuncture, the practice of inserting a needle into a vein (known in the vernacular as a "stick"). The most common method of venipuncture today is the autoinitiator unit. The

autoinitiator is placed over a vein, a sterile field is projected, a topical anesthetic is sprayed onto the skin, and then sensors in the unit pinpoint the exact location and depth of the vein and insert a sterile needle/catheter (20 are pre-loaded). The needle/catheter has a valve end that is easily connected to IV tubing.

When the unit is empty, you can easily refill it with a needle/catheter magazine from stores (replicator code SFMCMD-9810778-6752). The magazine contains the topical anesthetic ampule as well, so both materials are refilled simultaneously.

### Emergency Alternatives

Occasionally it will be necessary to start an IV in a patient, and it will be impossible to pierce through the skin and into a vein. If the autoinitiator "red lights" at every vein location you try (meaning the sensor has not been able to detect an adequate vein), it is time to think about a cutdown or central line. Don't waste time attempting a manual stick. This is one case where even the best instincts and touch cannot outdo the machine. If the autoinitiator can't find a vein, neither can you.

### Central Lines

A central line is an IV started in one of the major vessels located in the central circulation system rather than the peripheral circulatory system (i.e. in the extremities). This usually means the great veins of the neck, upper chest, or inner thigh. With several critical collateral structures in these areas, inserting a central line is a difficult and tricky procedure. It should only be performed by doctors or I-Medics. Central lines are usually used only in emergencies when peripheral veins are in a state of collapse.

### Cutdowns

Another procedure for extreme emergencies is a cutdown, so called because the skin is actually cut open so that the doctor or I-Medic can dig down to find a vein. This is often the only way to start an IV with some species, especially the reptilian humanoids such as Gorns or Saurians. This is an extremely invasive procedure and runs the same risks as minor surgery (which, in a manner of speaking, it is).

### Arterial Line

A line directly into an artery is called an arterial line. This is commonly done to accurately monitor blood pressure in the absence of medical scanners. It also provides direct access to arterial blood for lab tests. Arterial lines can be a tough stick since in most species the arteries are more internal, thicker, and more, well protected by other structures than the veins are.

### Cardiac Line

In species with extremely low normal BPs (usually the reptilian species), it is possible to start a line directly into the heart. A Saurian's BP is so low, even when normal, that you can draw blood with a needle from the heart without the heart even leaking on removal of the needle. Still and all, this should be reserved for emergencies only. As with an arterial line, a cardiac line cannot technically be referred to as an "IV" since it is not an intravenous line, but the convention is to refer to both under the general heading of IV therapy.

## Administering IV Meds

When you administer solutions or medications through an IV line, you are said to be infusing the solution into the patient. The IV line may also be referred to as an infusion line. The infusion line can provide valuable access to the circulatory system for the administration of medications.

To deliver IV meds, you have several alternatives. You can directly inject the drug into the vein via hypospray, you can inject the drug directly into an IV solution (with a special IV adapter for the hypospray), you can directly infuse a bag of IV meds through a second line, or you can piggyback a bag of IV meds onto an existing IV.

### Direct Injection

Injecting medication directly into the patient or into the infusion line all at once is known as an IV push. The dose, or bolus, can be administered into the IV line with a special adaptor for a hypospray. A dose of medication can also be administered into the IV bag with the adaptor for gradual infusion. When adding medications to an IV bag, be aware of drug incompatibilities, and be sure to mix well to avoid inadvertent drug concentrations.

### Piggybacking

When a smaller IV bag of medication is hung along with a standard IV fluid, it is known as piggybacking. There are several important considerations when piggybacking an IV. First, be sure there are no drug interactions between the med to be piggybacked and the IV solution. Make sure there are no interactions between drugs if more than one drug is to be piggybacked. If any meds are to be injected directly into the IV line, make sure they do not interact with the med that is piggybacked. Unless an IV pump will be used, you must be sure to hang the piggybacked med higher than the IV solution, or it will not run into the IV line. Also, the dosage will likely be ordered in mikes (micrograms) or mls per kilogram (weight of the patient) per minute or hour. Be sure you can convert that to drips per minute if setting up the line manually.

## Complications of IV Therapy

There can be many complications in invasive procedures like IVs. The two most common are infiltration and incompatibilities between medications.

### Infiltration

Infiltration is the complication with perhaps the greatest risk in IV therapy. An IV is said to have infiltrated when the needle/catheter either punctures through the vein wall and out the other side, or when it migrates back out of the vein but stays inside the body. This results in a leaking of infused fluid into the surrounding tissues. Infiltration is most often caused by patient movement or problems with the patient's vessels. IVs placed at flexion sites, like inside the elbow, are more likely to infiltrate than those placed elsewhere. An infiltrated IV must be restarted with a fresh needle/catheter.

### Incompatibilities

Incompatibilities can occur when drugs are mixed in an ampule or IV bag, or during delivery of an IV drug through an existing infusion line. Several factors can affect drug incompatibilities:

*Order of Mixing*

Chemical changes in an IV solution can occur after each drug if you add. A drug that is compatible with the IV solution alone may be incompatible with the IV solution and another drug. Changing the order in which you mix the drugs can avoid incompatibilities.

*Drug Concentration*

The higher the concentration of drugs in a solution, the greater the potential for incompatibility. When mixing drugs into an IV bag, make sure to invert the bag after each drug is added to distribute it evenly and avoid concentration buildups.

*Contact Time*

The longer drugs are in contact with each other, the greater the chance they will interact to form an incompatibility. Therefore, drugs should not be mixed until just before the solution will be used.

*Temperature*

Higher temperatures promote chemical reactions. Keep drugs and solutions as cool as possible until ready to use.

*Light*

Prolonged light exposure can affect the stability of certain drugs. Check for this possibility and protect against light exposure if necessary.

*pH*

Generally, drugs mixed together should have similar pH values.

Certain drug incompatibilities will cause a precipitate to form in the IV line, thus clogging it and rendering it useless. A new line with fresh meds must be started.

This condition can easily be avoided by administering the meds on opposite sides or in opposite extremities of the body. Once properly diluted in the blood stream, the meds are not capable of the precipitating reaction. It is only in their concentrated form where they are a problem.

# Part 8 - Aerospace Medicine

The practice of aerospace medicine involves physicians and other professionals of many disciplines, all striving to help lifeforms adapt to air and space operations. In no other field of medicine are your patients so much like you. They are intelligent, witty, controlling, and presumptuous. In no other field of medicine do physicians end up identifying so strongly with their patients, often changing their outward personality, so that they begin thinking of themselves more as fliers than as doctors. The Aerospace Medicine program exists to achieve this goal and to reap the benefits of this association.

## What is Aerospace Medicine?

Put simply aerospace medicine is a branch of preventative medicine that is concerned with the physiological and psychological stresses on the humanoid body during flight.

## History of Aerospace Medicine

On earth aerospace medicine can be traced back to the early 18th century and the physiological studies conducted on balloonists. In 1784, a year after the first balloon flight by the French physicist Jean Pilatre de Rozier, a Boston doctor, John Jeffries, made the first study of upper-air composition from a balloon. It wasn't until 1878 that French doctor Paul Bert published the effects of altered air pressure and composition on humans in La pression barometrique. This publication is regarded as the first comprehensive study on the health effects of flight and Paul Bert has become known as the father of aerospace medicine. Twenty-one years later in 1894 Herman Von Schrotter designed an oxygen mask that was later used by Artur Berson, a meteorologist, who later set the altitude record of 30,000 feet.

Following the advent of the powered aircraft standards for military pilots were established in 1912. Theodore Lyster, an American doctor, performed significant work in this area. In the early 1900's Theodore Lyster established the Aviation Medicine Research Board, which in January of 1918 opened a research laboratory at Hazelhurst Field in Mineola, New York. This laboratory was dedicated to studying the effects of flight on the human body. Continued study brought about numerous technical advances, such as the pressurized suit.

Wiley Post, an American aviator, wore the first pressurized suit in 1934. Eight years later in 1942 W.R. Franks working in Great Britain created the first anti-gravity suit.

It was also during the 1940's that spaceflight started to become reality with the creation of large ballistic rockets. In Germany under the direction of Hberus Strughold test animals were launched aboard these newly invented rockets. During their flights information was gathered as to their performance during flight. These tests are considered the first experiments in which information was gathered about human performance during space travel. After World War II experiments in human spaceflight continued, but it was the United States and the Soviet Union that carried them out not Germany. Both the United Stated and the Soviet Union carried out independent experiments using test animals and continued to gather data about the biological effects of spaceflight. Their experiments showed that there were few biological dangers in space. These findings were later confirmed when on April 12, 1961 the Soviets launch cosmonaut Yuri Gagarin into orbit. Even during the Apollo missions that were flown by the United States the biological effects of spaceflight seemed negligible. Long-term effects of spaceflight began to be studied by the United States in the 1970's with the successful Skylab series of spacecraft. But it wasn't until the 1980's when Soviet cosmonauts began setting records for time spent in the "microgravity" of space that the effects of long-term weightless began to be viewed as a serious problem. Much of the proceeding decades were devoted to combating the wasting of the human body that occurred in this environment.

As humans started to explore the planets of their solar system they devised spacecraft with sections that would spin, thus generating artificial gravity. This helped to alleviate the problems with a "microgravity" environment but did not stop the effects entirely and had the tendency to make individuals prone to motion sickness sick. It wasn't until the late 21st and early 22nd centuries that artificial gravity systems came into use. These systems generated gravity without the spinning sections of earlier craft and because they accurately mimicked natural conditions the adverse effects of spaceflight have all but disappeared.

While the larger starships no longer need a doctor that specializes in aerospace medicine, there still is a need for those specially trained doctors, especially in the SFMC fighter squadrons.

## The Two Faces of Aerospace Medicine

While on the surface it appears that aerospace medicine is a single unified discipline it is not. Aerospace medicine is actually split into two different types: aviation medicine and civil-aviation medicine. Aviation medicine focuses on the effects of high speed and high altitude on lifeforms and usually involves the study of such factors as acceleration, deceleration, atmospheric pressure, and decompression. Civil-aviation has the added focus of passenger airsickness.

## The Flight Surgeon

Put simply a flight surgeon is a doctor who is trained in aerospace medicine. Flight surgeons have many responsibilities and their decisions can mean life or death for a pilot, crew and/or passengers. As such flight surgeons tend to be no-nonsense and take their job seriously.

Civil and military flight surgeons work together to establish and apply medical standards for the selection and certification of pilots and other flight personnel to assure that they have no physical limitations or medical conditions that could impair their performance. Flight surgeons also help plan and carry out flight-crew training in first aid and in the prevention of illness and injuries among passengers. Paying particular attention to the principles of preventative medicine to avert the spread of disease by air/space travel. Flight surgeons also assist in the training of paramedical personnel in the aerial transportation of patients. Flight surgeons also regularly conduct pre and post flight medical exams on pilots and crew to identify any medical problems.

Aside from the clinical work that most flight surgeons perform on a regular basis they may also help develop vehicles, emergency systems, procedures, and protective equipment used in aerospace flight.

## The Atmosphere

Note: While the composition and parts of a planets atmosphere differ from planet to planet we will be using the typical Class M planet model for the purposes of this manual.

The atmosphere of a Class M planet is a mixture of gases and trace quantities of liquids and solids held closely to the planet by its gravity. The gases that make up the greatest percentage of the atmospheres of Class M planets are nitrogen and oxygen. While the exact percentage ratio varies from planet to planet, the percentage remains fairly constant up to an altitude of approximately 60 miles where atmospheric laying begins. Water vapor in the atmosphere varies with time, location, and meteorological conditions as well as with altitude, since the presence of water vapor is governed by temperature.

The typical Class M planet has an atmosphere that is divided into several different layers, each with its own characteristics. These layers are Troposphere, Stratosphere, Ionosphere, and Exosphere. The first layer that is closest to the planet surface is the troposphere. This layer extends from ground level to approximately 30,000 feet at the poles and 60,000 at the equator. Most SFMC and civilian aerospace operations take place at this level. This level is characterized by a relatively constant decline in temperature with increasing altitude. Atmospheric pressure is greatest at sea level and then declines logarithmically the farther towards space you go. The troposphere on a Class M planet has a constant composition of approximately 21% oxygen, 78% nitrogen, and 1% of other trace gases (argon, carbon dioxide, etc…).

In the aerospace environment it is the lifeform's relation to that environment that is of primary concern. Therefore it is important to understand the different physiological responses at various levels of the atmosphere. To do this we will divide the Class M atmosphere into 3 different physiological zones.

1+ **Physiological Zone:** This is the region of the atmosphere on a Class M planet that most humanoid lifeforms are adapted to. This layer extends from sea level to approximately 10,000 feet. The oxygen level within this layer is sufficient to keep a humanoid alive without the aid of special equipment. Rapid changes in pressure that are encountered with rapid ascents or descents in this zone can produce ear or sinus difficulties.

2. **Physiologically Deficient Zone:** This region starts at 10,000 feet and extends to about 50,000 feet. Supplemental oxygen is required in this zone. At 15,000 feet oxygen must be put under pressure. Trapped gas in the intestinal tract, lungs, and other gas problems occur in this zone. Protection must be used against the rapidly decreasing temperature.

3+ **Space-Equivalent Zone:** This region starts at 50,000 feet and extends to 120 miles. Supplemental oxygen even under pressure no longer protects humanoids from hypoxia. Bodily fluids will boil at 63,500 feet. Humanoids need space suits in this region to protect them.

## The Atmosphere in the Cockpit and Cabin

While the atmosphere outside of the cockpit is of importance, so to is the atmosphere inside the cockpit and cabin of the vehicle.

### Heat in the Cockpit and Cabin

One of the concerns in the cockpit and cabin of any aerospace vehicle is heat or lack thereof. Too much or too little heat can be disastrous for pilot, crew, and passengers. That is why both SFMC flight suits and vehicles have extensive systems that are dedicated to heat regulation. While for the most part these systems works perfectly and you'll never have to worry about them, but there still have been instances where these systems have failed. So it is imperative that you learn the effects of heat on mental performance. Knowing these will help you recognize and take corrective action. The effects on mental performance are;

1. Shorter reaction time
2. Higher error rate
3. Narrowed attention with neglect of secondary tasks
4. Diminished capacity for learning or response to unusual events

### Atmospheric Pressure

Another concern in any aerospace vehicle is the atmospheric pressure inside the vehicle itself. Too little pressure can be just as deadly as too much. Rapid changes in pressure can cause some individuals sinus and ear discomfort. But more extreme changes in pressure can cause an aeroembolism (the bends) and left untreated can cause permanent tissue damage or death. If the pressure in the cabin decreases to a certain point bodily fluids will boil leading to death.

If for some reason an aerospace vehicle experiences a decompression event (the most common type of atmospheric pressure problem), you as a flight surgeon must check the pilot, flight crew, and passengers for signs of physical problems stemming from the decompression event (see Aeroembolism).

### Breathable Atmosphere

Of the utmost concern in any aerospace vehicle is the breathable atmosphere. These are the gasses that the pilot, crew, and any passengers must breathe in order to survive inside the vehicle. In the event of a decompression event you must look for signs of hypoxidosis (see Hypoxidosis).

## The Physiological Effects on the Body

Flight is one of the most demanding activities that the humanoid body can endure. Atmospheric pressure fluctuations, high-g maneuvers, and a multitude of other factors take their toll on the body. Below are some of the conditions that can occur in certain circumstances.

### Aeroembolism

#### Clinical Definition

An aeroembolism is a medical condition caused by gas bubbles in the bloodstream. This condition usually occurs when gasses normally diffused in the blood come out of solution and form bubbles, which lodge in various parts of the body.

#### Symptoms

Symptoms vary depending on where the bubbles lodge themselves in the body. They range from skin rashes, joint pain, visual disturbances, balance disturbances, breathing difficulties, extreme fatigue/lack of strength, numbness, paralysis, unconsciousness and death. If the embolism occurs in the coronary arteries of the heart, a heart attack will occur. If it lodges in the lungs, a pulmonary embolism will occur, resulting in shortness of breath and chest pain.

### Treatment and Prevention

Oxygen first aid should be given immediately on a suspected aeroembolism followed by placement into a recompression chamber. Recompression is the only lasting treatment of an aeroembolism. Normally this is carried out in a recompression chamber.

## Airsickness/Motion Sickness

### Clinical Definition

As a flight surgeon, this condition is the one that you will most often see and treat, especially when dealing with fighter pilots. Another situation in which you will see this is when the inertial dampeners fail or when they fall behind in compensating for the movements of the aerospace vehicle.

This condition occurs when the body is subjected to accelerations of movement in different directions where visual contact with the actual outside horizon is lost. The balance center of the inner ear then sends information to the brain that is in conflict with the visual clues of apparently staying still in the interior of the aerospace vehicle.

### Symptoms

Symptoms generally include dizziness, fatigue, and nausea, which in some individuals may lead to vomiting. If vomiting does occur, it tends not to relive the nausea and the sufferer will frequently vomit within twenty minutes of the initial onset of airsickness/motion sickness.

### Treatment and Prevention

Preventing airsickness/motion sickness can be accomplished by seeking areas of lesser movement in an interior section of the larger aerospace vehicles or by facing forward and looking outside of the vehicle. Of course, this may not be possible at all times so medication may be necessary. Medications containing scopolamine or some antihistamines can alleviate the symptoms of airsickness/motion sickness in humans.

## G-forces

### Clinical Definition

G-forces are the effects of gravity on the humanoid body during flight maneuvers. One g is approximately what a person feels when standing motionless on Earth. On various other planets 1 g may vary slightly, so the gravity of Earth was chosen as the standard on which to base all measurements. G-forces come into play with high-speed maneuvers and so are usually experienced by fighter pilots. Different species are tolerant of different g forces, but the average human can only withstand 5 g. But most pilots can handle 9 g with anti-g suits. Humans can for a very limited time survive a 20 to 40 g acceleration. 100 g's is almost certainly fatal to humans. Inertial dampeners for the most part will compensate and reduce the amount of g-forces that a pilot, crew, and passengers will experience. Usually there is a lag from the time of the maneuver to the time the inertial dampeners compensate. Depending on the maneuver this time can be several seconds. It is in these several seconds that the pilot, crew, and passengers are most susceptible to the effects of g-forces.

#### *Everyday g-forces*

Below is a listing of some everyday g-forces that you experience;

- 10.4 g when plopping down into a chair
- 8.1 g when hopping off a step
- 3.5 g during a cough
- 2.9 g during a sneeze

## Symptoms

The symptoms of g-forces vary depending on whether the body is taking positive or negative g's. But regardless either condition is called g-loc and the result, if nothing is done to counter the g-forces, is loss of consciousness. Also in either case if the pilot does not regain consciousness there is high probability that a crash will occur.

### *Black Out*

An individual "blacks out" when they take positive g's in excess of what the body can accommodate. Blood is forced from the brain which leads to a loss of consciousness. Pilots experiencing a black out will lose all vision. If corrective action is not taken at this point the pilots vision will go black and the loss of consciousness will take place soon thereafter.

### *Red Out*

An individual experience a "red out" when they take negative g's in excess of the body can accommodate. Blood is forced toward the brain which leads to a loss of consciousness. Most pilots experiencing a red out will have their vision go red, if corrective action is not taken at this point the pilot will experience a loss of consciousness.

### *Grey Out*

A grey out occurs somewhere around 6 to 8 g's. This condition is not a total loss of consciousness but is characterized by a temporary loss of colored vision and/or tunnel vision, or even a complete loss of vision temporarily, while consciousness remains. During this condition an individual may also be unable to interpret verbal commands.

## Treatment and Prevention

To help prevent a black out SFMC pilots and aircrew wear anti-g suits. These suits use air-inflated sacs around the legs and abdomen to increase blood flow from the lower legs to the upper extremities. Newer suits that are currently in testing phases use micro force field generators to replace the air-filled sacs. Pilots and aircrew are also trained to strain, forcing blood to and from their extremities and head to help remain consciousness.

During extreme deceleration it is also imperative that the pilot properly supports their head. Doing so avoids swelling of the sinuses and has been known to cause severe headaches.

## Hypoxidosis

### Clinical Definition

Most humanoid species that the Federation has encountered have all had a requirement to breathe oxygen. So as with air travel on earth of centuries past, the physiological requirement for oxygen is still the most critical consideration when traveling via aerospace vehicles. Therefore aerospace vehicles have several redundant systems devoted to supplying oxygen to the pilot, crew, and passengers.

But in the case where the individuals on board are deprived of oxygen a condition called hypoxidosis can occur. Hypoxidosis is the condition in which the body as a whole is deprived of adequate oxygen supply. Hypoxidosis is not a condition for which the onset is instantaneous, muscles can function temporarily without oxygen, but the buildup of toxic products soon limits activity. Brain and Eye tissues are the most sensitive to oxygen deficiency and as such it does not take very long before an individual deprived of oxygen is rendered unconscious. Total brain death will generally occur in humans if they are deprived of oxygen for more than 4 minutes.

### Symptoms

Symptoms of generalized hypoxia depend on its severity and speed of onset. They include headaches, fatigue, shortness of breath, nausea, unsteadiness, and sometimes even seizures and coma. Severe hypoxidosis induces a blue discoloration of the skin. A tricorder scan will also reveal that the oxygen levels in the blood are extremely low.

### Treatment and Prevention

To treat an individual suffering from hypoxidosis first give them oxygen first aid and then treat any other effects or injures that they may have.

## The Flight Surgeons Role in Investigations

One of the many duties that a flight surgeon has is that of aiding investigators in any aerospace accidents. If you have been asked to aid investigators you'll most likely be brought in during the response phase, which is the most critical phase of every aerospace accident investigation.

During the investigation you'll have to use military intelligence to help the investigators determine whether or not the accident was the fault of the pilot. Medical Intelligence requires foreign epidemiology; public health standards and capabilities; and quality and quantity of military and civilian medical personnel, training, supplies, facilities, and health services; foreign animal diseases, health problems related to using local food supplies, and medical effects of and prophylaxis against chemical and biological agents.
Below are some common reasons that have been found to be contributors to crashes.

## Spatial Disorientation

Spatial disorientation is an individual's inability to determine his or her position, attitude, and motion relative to the surface of the earth or significant objects; for example, trees, poles, or buildings during hover.

## Physiologic Episode

A physiologic episode is an in-flight event of a physical, physiological, medical, pathological, psychological, pharmacological, or toxicological nature which compromises performance, confuse, disorient, dull, distract, pain, endanger or incapacitate.

# Underwater Medicine

Just as aerospace medicine strive to assist in the adaptations to air and space operations, underwater medicine assist the maritime branch and its sailors and divers in achieving their operations. In many ways, members of the medical branch in both aerospace and underwater medicine are very similar as they both end up identifying strongly with their patients.

## What is Underwater Medicine?

Underwater medicine is the diagnosis, treatment and prevention of conditions when operating in underwater environment. In SFMC context, it also includes all other conditions related to maritime operations and includes hyperbaric medicine.

Technically hyperbaric medicine strictly deals with the administration of hyperbaric oxygen as a medical treatment for certain diseases and conditions that may apply to both underwater and aerospace medicine. For example, a diver suffering from air embolism will be administered with hyperbaric medicine. Hyperbaric oxygen is also used for decompression illness by both aviators and divers due to the rapid changes in altitude and or cabin pressure.

## The Physics of Diving

Understanding the physics of diving is the first step in the study of underwater medicine. It refers the laws of physics in relation to diving, or more specifically, it explains the effects of those laws that the divers and their equipment are subjected to underwater. Topics such as pressure and buoyancy, gases and moisture, gas laws and gas flows are included for a better understanding.

### Pressure

Pressure refers to the amount of force applied over a specific area. It is measured as pounds per square inch absolute (psi) or kilograms per square centimeter absolute ($kg/cm^2$ absolute) and also known as Barometric pressure.

When diving underwater, the diver are subjected to environmental forces which are a result of the weight of the water known as hydrostatic pressure and the weight of the atmosphere over the surface of water, known as atmospheric pressure. Hydrostatic pressures increases by 0.455psi per foot of depth in salt water. These two pressures simultaneously act upon the diver and are referred to as known as absolute pressure.

### Buoyancy

Buoyancy refers the force that acts upon all submerged bodies and is best explained by Archimedes' Principle which states that:

*"A body immersed in a liquid, either wholly or partially, is buoyed up by a force equal to the weight of the liquid displaced by the body."*

It can be represented as:
Weight of displaced liquid - Weight of the body = Buoyancy of a submerged body

Therefore based on the formula, the body will suspend if buoyancy is neutral (bodyweight = weight of displaced liquid. It will float if the buoyancy is positive (bodyweight < weight of displaced liquid) or it will sink if the buoying is negative (bodyweight < weight of displaced liquid).

## Gas Laws and Gas Flow

Divers are essentially dependent on the supply of breathing gas, therefore understanding the behavior of gas is vital to underwater medicine. Three factors affect the behavior of gas, the temperature, the pressure and the volume. These factors have a special relationship known as the Gas Laws of which five of them, are of special importance in diving medicine. These laws and its formula are shown below. P, denotes absolute pressure, V, denotes volume of the gas while T, denotes the absolute temperature of the gas. Subscript indexes distinguish the values at different moments such as initial, final, etc.

**Dalton's law states:**

**The total pressure exerted by a mixture of gases is equal to the sum of the pressures that would be exerted by each of the gases if it alone were present and occupied the total volume+**

$$(P_{Total} = Pp_1 + Pp_2 + \ldots + Pp_n)$$

*Pp denotes the partial pressure of the particular gas component*

**Simplified:** The pressure of any gas mixture (e.g., air) is equal to the sum of pressures exerted by the individual gases (e.g., oxygen, nitrogen, and each of the minor gases).

**Boyle's law states:**

$$(P_1V_1 = P_2V_2 = \text{constant})$$

*At constant absolute temperature*

**At constant temperature, the volume of a gas varies inversely with the pressure, while the density of a gas varies directly with pressure+**

**Simplified:** If temperature is kept constant, as air pressure increases the volume of a gas decreases, and vice versa. This is important to divers as it relates to changes in the volume of a gas to changes in pressure (depth) and defines the relationship between pressure and volume in breathing gas supplies.

$$\frac{P_1}{P_2} = \frac{T_1}{T_2} \text{ at constant volume} \qquad \frac{V_1}{V_2} = \frac{T_1}{T_2} \text{ at constant pressure}$$

**Charles's law states:**

**At a constant volume, the pressure of gas varies directly with absolute temperature+**

**Simplified:** Given a constant volume of gas, the higher the temperature the higher the gas pressure, and vice versa. In relation to diving medicine this is an important aspect to divers, as the temperature of the deep water is different from the temperature of the air at the surface.

$$\frac{V_g}{V_L} = \alpha P_1$$

Vg volume of the gas dissolved at STP (standard T and P)

$V_L$ volume of the liquid

$\alpha$ Bunson solubility coefficient at specified temperatures

$P_1$ partial pressure in atmospheres of the gas above the liquid

**Henry's law states:**
**The amount of any gas that will dissolve in a liquid at a given temperature is a function of the partial pressure of the gas in contact with the liquid and the solubility coefficient of the gas in that particular**

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

**liquid.**

**Simplified:** As the pressure of any gas increases, more of that gas will dissolve into any solution with which it is in free contact. This is an important law during decompression of the divers.

△

### General Gas Law

$$V_2 = \frac{\Delta P r^4 \pi}{8L\eta}$$

When Boyle's and Charles Laws are combined, we achieve the General Gas Law as shown mathematically below.

### Gas Flow

Being able to determine the rate of gas flow through hoses or orifices is crucial to diving as there might be occasions where it is necessary to determine the gas flow for different depths. The gas flow can be estimated for a given gas by using Poiseuille's equation for gas as shown below. V refers to gas flow in cm3 x sec-1, while P represents the pressure gradient between the 2 ends if the tube. R and L represent the radius and length of tube in centimeters respectively.

## Possible Conditions and Illness in Diving

Understanding the physics of diving will allow us to better understand the possible conditions and illness in diving. It tells us what to look out for, the cause of the condition and illness and how to best go about treating it. Below are some of the possible conditions that may arise from diving.

### OXYGEN TOXICITY

Oxygen toxicity is any injury or discomfort to the body from inhaling too much oxygen. High concentrations of oxygen delivered at atmospheric pressure can harm the lungs. When diving, any given concentration of oxygen comes under higher pressure than atmospheric, thus increasing the amount inhaled and the potential for toxicity. This is due to the effects of Dalton's Law which states that on descent, the partial pressure of all component gases increase in the same ratio as the total pressure. Above atmospheric pressures, oxygen can also affect the central nervous system, and cause seizures and convulsions. Thus oxygen toxicity is a major potential hazard in some diving. 2

Pulmonary effects (can occur at atmospheric pressure; threshold about 0.6 atm. 0   )

- burning sensation on taking a deep breath
- cough
- pneumonia
- permanent lung damage
- Central nervous system effects (requires pressures above atmospheric; threshold about 1.3 atm. 0   )
- muscular twitching
- vomiting
- dizziness
- vision or hearing abnormalities
- anxiety, confusion, irritability
- seizures

Oxygen toxicity is also the direct cause of nitrogen narcosis and along with Boyle's law is the cause of decompression sickness.

## NITROGEN NARCOSIS

This is also called "the rapture of the deep" and "the martini effect," and results from a direct toxic effect of high nitrogen pressure on nerve conduction. It is an alcohol-like effect, a feeling often compared to drinking a martini on an empty stomach: slightly giddy, woozy, a little off balance. Nitrogen narcosis is a highly variable sensation but always depth-related. Some divers experience no narcotic effect at depths up to 130 fsw, whereas others feel some effect at around 80 fsw. One thing is certain: once begun, the narcotic effect increases with increasing depth. Each additional 50 feet depth is said to feel like having another martini. The diver may feel and act totally drunk. Underwater, of course, this sensation can be deadly. Divers suffering nitrogen narcosis have been observed taking the regulator out of their mouth and handing it to a fish! However, as depth DECREASES, so does the narcotic effect. I know a few Marines that would call it a cheap no hangover drunk. What a group!

Henry's and Dalton's Laws predict that, as the diver descends, excess nitrogen will enter the blood and all body tissues. These laws also predict that, on ascent (as ambient pressure decreases) the extra nitrogen that

| A COMPARISON OF ARTERIAL GAS EMBOLISM (AGE) AND DECOMPRESSION SICKNESS (DCS) | | |
|---|---|---|
| **Characteristic** | **AGE** | **DCS** |
| **Cause** | Pulmonary Expansion barotraumas | Excess nitrogen leaving tissues too quickly |
| **Risks** | Breath-hold ascent; non-communicating air spaces | Exceeding prescribed limits for depth and time under water |
| **Location and natures of bubbles** | Air bubbles in arterial circulation | Nitrogen bubbles in tissues and venous circulation |
| **Onset of symptoms** | Within a few minutes of surfacing | Ranges from a few minutes to 48 hours after surfacing, but usually within 6 hours |
| **Clinical syndrome** | Unconsciousness; discrete neurological injury; or a cardiac event | Variable. Usually pain or paresthesia's initially; can progress to paralysis, shock. May mimic AGE. |
| **Effect of first aid, Including oxygen** | Symptoms may improve or go away altogether | Variable, Often no effect |
| **Definitive treatment** | Recompression in a hyperbaric chamber | Recompression in a hyperbaric chamber |

accumulated will diffuse out of the tissues and into the circulation.

Decompression sickness (DCS) arises when excess nitrogen leaving tissue forms bubbles large enough to cause symptoms. Size of bubbles is important, since small bubbles can often be found in divers with no symptoms (detection of bubbles is with Doppler ultrasound). DCS arises when the pressure gradient for nitrogen leaving the tissues is so great that large bubbles form, probably by coalescence of many smaller bubbles. Large bubbles within tissues and the circulation cause the symptoms and signs of decompression sickness.

These are only some of the risks if the marine happens to have a diving "accident".

### Barotraumas

This refers to injury to the body tissues due to the large difference between the ambient pressure and that of the body's cavities or space containing air. It is likely to occur during the diver's descent and ascent. Boyle's law states that the volume of gas varies inversely with the pressure which in this case refers to the atmospheric pressure. This occurs because the body cavities are compressible while the tissues are not, when atmospheric pressure increases, the internal cavity containing air provide the surrounding tissues with little support to resist the higher external pressure. The reverse occurs during decreases in atmospheric pressure where the higher pressure of the gas inside the air spaces gets trapped and cause damage to the surrounding tissues.

### Baroitis Media

Also known among divers as middle ear squeeze, it is the inflammation of the middle ear due to the insufficient pressure equalization normally due to a blockage in the Eustachian tube that runs from the middle ear to the back of the nose. It is characterized by earaches, a feeling of fullness and reddened eardrum.

Barotitis (BEAR-o-TI-tis) media (me-DEE-uh) is an injury to the middle ear (the area behind the eardrum) that results when a blockage develops in the tube that normally equalizes pressure within the ear (the Eustachian tube that runs from the middle ear to the back of the nose). When normal air flow is blocked, pressure can build in the ear. The condition is not serious, and usually clears up in a few hours or days. In some cases, however, it may last a long time.

### Causes

The problem can result from air pressure changes that occur during scuba or sky diving, airplane flights, or trips through the mountains. Barotitis media can also be caused by an injury to the ear.

## Part 10 - Surgery

Surgery is done in military medicine to stabilize people, life saving medical interventions to prevent bleeding, repair damaged organs and remove projectiles and other shrapnel in the body.

For the SFMC Medical Branch, surgery works under more limited conditions. Surgical capabilities and focus in the first two echelons of care are not intended to fully repair and heal patients, rather, their role is to first stabilize and enable patients to continue healing or evacuate to the third echelon of care.

### Brief History of Surgery

Surgery is the branch of medicine concerned with diseases and conditions which require or are amenable to operative procedures. Simply, it is the work done by a surgeon that deals with the physical manipulation of a bodily structure in order to diagnose, prevent or cure an ailment.

The word "surgery" began with the Greek word "cheirourgia" which combined "cheir" (the hand) and "ergon" (work) and meant "handwork, work done with the hands." The Greek word "cheirourgia" was taken over by the Romans as "chirurgia" and was further transformed in France about in 1171 to "cirurgie." (In French, surgery is now "chirurgerie.") By 1387 Chaucer could write in The Canterbury Tales:

*With us ther was a doctour of phisik;*
*In al this world ne was the noon hym lik,*
*To speke of phisik and of surgerye*

The five reasons to perform surgery as stated by French surgeon, Ambroise Pare, in the 16th century were:

1) to eliminate that which is superfluous,
2) restore that which has been dislocated,
3) separate that which has been united,
4) join that which has been divided and
5) repair the defects of nature.

The Industrial Revolution helped advanced the field of surgery through the advent of better surgical tools. Advances in the treatment of bleeding, pain and infection during surgery - the three principal obstacles which had plagued the medical profession helped transformed surgery from a risky "art" into a scientific discipline capable of treating many diseases and conditions. During the development of modern medicine, both disciplines were taught together and one could obtain the qualifications to practice medicine and surgery.

### The Origins of Surgery

The earliest evidence recorded for surgery was the act if trepanation in which a hole is created either by drilling or scrapping into the skull and exposing the dura mater. This was done in the belief that it could treat health problems related to intracranial pressures and other diseases. An extension of this known as bloodletting is also a very ancient medical practice that bas been practiced by many ancient civilization. It became so popular that during the Renaissance period, bloodletting were believed to be a cure for various diseases and conditions such as inflammation, infections, strokes and many more. Evidence shows that one of the earliest surgical techniques ever recorded is anesthesia. Alcohol is possibly one of the oldest forms of anesthesia, and was used thousands of years before our time.

### Father of Surgery

One of the great, but now largely forgotten, pioneers of surgery was El Zahrawi (936 - 1013), also known as Albucasis (Abu al-Qasim Khalaf ibn al-Abbas Al-Zahrawi). A physician and scientist of Andalusian-Arab descent, he practiced near the city of Cordoba when Spain (Andulesia), was part of the Islamic empire. He is considered a great medieval surgeon, whose comprehensive medical texts, combining Islamic medicine with Greco-Roman and Indian teachings, shaped European surgical procedures up until the Renaissance. He is often regarded as the Father of Surgery. Patients and students from all parts of Europe came to him for treatment and advice so much so that Cordova was in this period the favorite resort of Europeans for surgical operations.

### Father of Modern Surgery

Ambrose Pare (1510 - 1590), a French Surgeon, was a leader in surgical techniques and battlefield medicine, especially the treatment of wounds. He was the inventor of several surgical instruments and largely considered the Father of Modern Surgery. Ambroise Pare, discovered that an ointment made up of egg yolk, oil of roses and turpentine were far more effective in treating war wounds than the traditional boiling oil and cauterization due to the antiseptic properties of turpentine. He also introduced the ligature of arteries instead of cauterization during amputation with injured soldiers.

## Principles of Asepsis

The single most important life saving intervention in the operating theatre, rivaled only by the discovery of antibiotics and blood products in Earth medical history was the discovery of the principles of asepsis (The process of removing pathogenic microorganisms or protecting against infection by such organisms). Below is a short list of the principles, along with other methods of preparing asepsis

(Dirty= Refers to a product that may be contaminated with microorganisms. Clean are items that aren't contaminated with micro-organisms. Sterile= free from microorganisms by means such as chemical, radiological or heat.)

### Principles:

1. When in doubt, item is dirty.
2. Anything below the waist or above the shoulder is dirty.
3. Anything behind your back is dirty.
4. Items beyond your visual field are treated as dirty/clean.
5. Items that are wet are considered dirty.
6. Items that have been exposed to air for over 30 minutes are no longer sterile.
7. Items in their packaging which is torn soaked or show signs of discoloration are dirty.
8. Items which have touched the patient is clean or dirty (if in contact with bodily fluids or other reservoirs of micro-organisms).

9. Clean touch clean= clean. Dirty touch clean= dirty.
10. Crossing the sterile field= area is dirty.

Other means of reducing the risk of infection involve

- Skin preparation of the patient using appropriate antiseptics.
- Surgical hand washing with appropriate antiseptic agents and allowance for sufficient time for drying.
- The use of a surgical gown and cap.
- The use of drapes and other barriers to create a sterile field, and techniques to protect and maintain the sterility of the field (Principles of asepsis).

## Roles of the Surgical Team

### Surgeon

The surgeon is the medical professional responsible for an invasive procedure for opening up the body or using probes to explore, collect tissue, remove body parts, amend body tissue shapes or insertion of some medical device/parts. Apart from doing the actual operation, they are responsible for documentation of the surgery, documenting and planning post-operative care, along with pre-operative assessment of the patient. In surgery, its common for major operations to require two surgeons, with the junior surgeon assisting in the more minor aspects of the surgery such as by suturing and cauterizing blood vessels. All SFMC surgeons must be board certified in either thoracic or abdominal surgery followed by an additional surgical subspecialty. A large majority are certified in both. Other common surgical specialties are cardiovascular, neurosurgery, and orthopedic surgery.

### Nurse Anesthetist

An anesthetist is a medical professional responsible for general anesthesia used during an operation. The use of anesthesia involves

- Pain relief
- Muscle relaxation
- Memory loss/Unconsciousness.

The Anesthetist roles involves

- Assessing the patient and medications
- Prescribing the anesthesia.
- Delivering the anesthesia via the appropriate delivery means(intubation, iv or etc).
- Monitoring and documentation of the usage of anesthesia, along with sedation charts.
- Inducting the patient to a state of unconsciousness, assisting in awakening the patient post anesthesia via the delivery of the antidote/cessation of anesthesia and other methods.

### Scrub nurse

A scrub nurse is a surgical nurse who operates in the sterile field of an operating theatre, along with the surgeons. As part of the sterile team, their job is to assist the surgical team as well as monitor sterility and the patient. Their roles involve:

- Prepping the surgeon for operation.
- Preparing the sterile field and surgical instruments, monitoring sterility.
- Handing over instruments and aiding the surgeon in tasks.

### Circulation Nurse

A circulation nurse is not a surgical nurse but usually a more experienced nursing officer learning to be a surgical nurse. The circulation nurse is also considered part of the operating theatre but operates outside the sterile field. As a non sterile member, she cannot venture directly into the sterile field. Their roles are:

- Monitoring the patient during surgery.
- Monitoring the use of equipment and instruments, pre, during and post op.
- Introducing new supplies/equipment into the sterile field.

## Different Areas of Surgery

A surgical theatre or operating theatre (Ots) is split into various areas to easily receive and treat patients. Despite the advent of biofilters and other advanced medical devices, SFMC still advises surgical teams to stick closely to the principles of asepsis and differentiation between "clean" and "sterile" areas so as to reduce the risk of infection in an operation. This has the additional advantages that OTs would not have to be equipped with additional equipment such as heavy power generators and biofilters, containment fields for safety. As such, staff operating in the theatre are advised to:

- Wear different shoes when entering the OT .
- To cover their hair.
- To remove extraneous insignia, allowable jewelry and equipment on their persons.

Additional steps involve frequent hand washing, cleansing of the theatre daily with the appropriate solutions and appropriate disposal of waste materials.

| Normal | Clean | Sterile |
|---|---|---|
| Reception | Equipment room (for general use) | Operating Theatre |
| Exit | Recovery room | Equipment room (For surgical use) |
| | Peri-operative room | |

The workflow of a patient in surgery begins from reception→ peri-operative room → Operating table → Recovery (PACU)→ General Ward/Transported to other secure facilities/returned to field

A patient is thus prepared for surgery in the preparation room, receiving anesthesia via the appropriate delivery device and put under appropriate IV/oxygen support and monitoring. After the operation is done in the Operating Theatre, the patient is sent to the Recovery (post anesthesia care unit) area where he is awakened from anesthesia and monitored for post operation complications before moving on to other medical facilities as required. These facilities are separated by normal, clean and sterile areas.

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# Appendix A - Glossary of Terms, Slang, and Acronyms

**A-fib**
slang: Shortened form of atrial fibrillation.

**A-tach**
slang: Shortened form of atrial tachycardia.

**A & O**
Alert and oriented.

**ABCs**
A pneumonic to remember the priorities of emergency treatment:

- Airway
- Breathing
- Circulation

**ABG**
Arterial Blood Gas

**Acidotic**
The state of having low pH, as in blood or tissues being acidotic.

**AKA**
Also Known As

**ALS**
Advanced Life Support

**ALSTTAR**
Advanced Life Support for Trauma, Transportation And Resuscitation.

**AMA**

Against Medical Advice.

**Ambu Bag**
A collapsible bag used to ventilate a patient who is not breathing.

**Ampule**
A small, sealed container for liquid medication.

**AMS**
Altered Mental Status (or State)

**Antibacterial**
Something that kills or hinders the growth of bacteria.

**Antibiotic**
Something that kills or hinders the growth of bacteria.

**Anticoagulant**
Something that hinders the clotting of blood.

**Antidiarrheal**
Something that prevents diarrhea and/or solidifies stool andpromotes its retention.

**Antidiuretic**
Something that hinders the removal of fluid from the body.

**Antifungal**
Something that kills or hinders the growth of fungi.

**Antiseptic**
Something that prevents or hinders sepsis.

**Antiviral**
Something that kills or hinders the growth of viruses.

**Arrest**
The failure of a key system of the body. The most common types are cardiac, respiratory, and full.

**Arrhythmia**
An abnormal heart rhythm.

**Assessment**
The process of evaluating a patient's medical condition.

**Atrium**
The compartment(s) in the heart, usually at the top, where blood is collected from major vessels in preparation for delivery to the ventricles.

**AWI**
Alpha Wave Inducer

**BAS**
Battalion Aid Station

**BOU**
Battle Dress Uniform

**Bleeding Always Stops**
slang: Self-explanatory.

**BGI**
Blood Gas Infuser. See text under "Field Equipment".

**Bolus**
1. A dose of medication, especially of IV drugs.
2. A small, round lump or pill.

**Bone-Knitting**
The process of rapidly healing bone fractures through use of a special tissue regenerator and/or drug therapy designed for the purpose.

**BP**
Blood Pressure

**BSS**
Behavioral Science Specialist

**Bullet**
slang:
1. The packet of medical information concerning a patient that is critical for other medical staff to know before treating the patient.
2. A projectile fired from a weapon designed for the purpose.

**Cardiac Arrest**
When a heart stops pumping-i.e. the patient has dropped dead. See also arrest, code, and full arrest.

**Cardio**
Prefix relating to the heart.

**Cardiovascular**
Relating to the heart and circulatory system collectively.

**Casualty**
A person killed or injured in an accident or in combat.

**CMO**
Chief Medical Officer

**CNP**
Composite Neural Profile. A graphic representation of CNS activity.

**CNS**
Central Nervous System. The brain and spinal cord.

**Code**
slang: To go into Cardiac Arrest. When announced with a specific location, it means a patient there has gone into arrest and needs resuscitation.

**Corpsman**
Colloquial term for Medic, once used on Old Earth and briefly revived as a job title during the period of Earth's Colonial Marines.

**CPR**
Cardiopulmonary Resuscitation. The practice of squashing the chest of a dead person in hopes of squeezing enough blood to his brain to keep him alive for a few more minutes until help arrives.

**Crack the Chest**
To surgically open the chest in order to stop massive bleeding or to perform open-heart massage. See also thoracotomy.

**Crash**
slang: When a patient suddenly turns bad and starts to die.

**CSC**
Combat Support Command

**Cutdown**
When it is impossible to stick an IV through the skin and into the vein, it becomes necessary to cut open the skin and dig down to the vein.

**Osw**
Dextrose 5% in Water

**Defibrillation**
Using an electric charge to shock a heart that is quivering (not beating) in order to try and normalize the heart's electrical activity into a regular beat again.

**Oermal**
Relating to the dermis or skin.

**Oialysis**
The process of filtering waste products from the blood via machine, thus bypassing the kidneys, which normally perform the function.

**Oiastolic**
Pressure of blood in the circulatory system during the heart's resting phase.

**ONR**
Do Not Resuscitate. See also no code.

**OOA**
Dead On Arrival

**Orip**
To deliver medication slowly over time by IV.

**EEG**
Electroencephalogram. A graphic representation of brain activity.

**EKG**
Electrocardiogram. A graphic representation of cardiac activity.

**Electrolyte**
Any of several chemicals in the blood that are capable of conducting electrical impulses (usually in cellular activity).

**EMS**
Emergency Medical System

**EMU**
Emergency Medical Unit

**Endo**
A combining form meaning within or inner; i.e.- endotracheal meaning within the trachea.

**Esophagus**
The tube like structure in the body through which food passes from mouth to stomach.

**Esophageal-Tracheal Tube**
A tube that covers both esophagus and trachea, usually blocking off the former and allowing airway access to the latter. Not to be confused with Endotracheal Tube.

**Extubate**
To remove an endotracheal tube. See also intubate.

**FAS**
Field Aid Station -OR- Federation Association of Surgeons

**FE**
Field Equipment

**FH**
Field Hospital

**Fibrillation**
A nonproductive quivering, especially of heart muscle.

**Flail**
slang: A resuscitation that goes badly.

**Flatline**
When the heart monitor tracing no longer shows heart blips, but only a flatline tracing reflecting the absence of a heartbeat.

**Flea**
slang: An internist, particularly one who orders multiple tests to establish a list of multiple possible diseases so that multiple further tests can be done, thereby sucking a lot of blood from the patient with no discernible benefit.

**FLC**
Fleet Liaison Command

**FST**
Field Stasis Tube

**FTO**
slang: Fixin' To Die

**FwS**
Field Water Sterilizer

**Full Arrest**
A combination of cardiac and respiratory arrest. It may indicate a patient is STBD.

**Gangrene**
Decay and/or necrosis of tissue in an area of the body where blood supply has been cut off.

**Golden Hour**
slang: The first 60 standard minutes after trauma, the course of which largely determines prognosis.

**GSw**
Gunshot Wound

**Hematoma**
A blood-filled lump that forms after trauma.

**Hemo**
Prefix relating to blood and/or blood vessels.

**Hemoglobin**
The chemical in the blood that physically transports oxygen. Its elemental base largely determines the color of blood as well.

**Hemopneumothorax**
A condition in which air and blood fill the chest cavity normally occupied by a lung. This has the effect of collapsing the lung and causing pulmonary distress.

**Hemorrhage**
Severe bleeding over a short period of time.

**Hepa**
Prefix relating to the liver.

**Hyper**
Prefix meaning over, above, excessive.
**Hypertension**
High blood pressure.

**Hypo**
Prefix meaning under, beneath, below.

**Hypotension**
Low blood pressure.

**Hypovolemic**
Low volume. Usually refers to abnormally low blood volume.

**Hypodermic**
Under the skin. Usually refers to drug administration.

**Inoculation**
To inject a serum, vaccine, etc. into a living being in order to create an immunity.

**Intra**
Prefix meaning inside or within.

**Intracellular**
Inside the cells.

**Intravenous**
A route of administration for meds where the med is injected directly into a vein.

**Intubate**
To insert a tube into a patient's airway to ventilate them. See also extubate.

**Isotonic**
A solution that maintains the balance between fluid inside the cells (intracellular) and outside the cells, but still

inside the body (extracellular usually refers to the blood stream).

**Labs**
Colloquial term used for medical tests whether they are today performed in a laboratory or not.

**Laceration**
A cut through the skin. May be superficial or deep.

**Laryngoscope**
A metal blade used to push the tongue aside and lift up the throat so that the trachea can be seen.

**Line**
An IV line for access to circulating blood.

**Line 'Em Up**
slang: To insert multiple lines in order to resuscitate and monitor a critically ill patient.

**Litter**
Colloquial term for a stretcher, specifically, a gravitic stretcher.

**LR**
Lactated Ringers

**Lytes**
slang: See electrolytes.

**MO**
Medical Doctor

**Med**
slang: Shortened form of medicine or medication (depending on context).

**Medially**
toward the centerline of the body.

**Microdeckia**
slang: "Micro" meaning small, "deck" as in a deck of cards, hence, playing with less than a full deck: "The patient is suffering from microdeckia."

**Microneedle**
A microscopic, hollow hypodermic for administering drugs. Usually arranged in large numbers on a patch stuck to the skin.

**Micropowder**
An ultrafine powder, usually a drug.

**MIPPA**
Marine Individual Personal Protective Armor

**MORE**
Mobile Operating Room Equipment

**MSG**
Marine Strike Group

**MSH**
Mobile Surgical Hospital

**MUC**
Medical Unit Command

**Myo**
Prefix relating to muscles or muscle tissue.

**Myocardial**
Specifically relating to heart muscle.

**Myocardial Infarction**
Death of or damage to heart muscle, also known as a heart attack.

**NAI**
Neural Activity Index

**NBC**
Nuclear, Biological, Chemical

**Necrosis**
Death of tissue.

**Neonate**
An infant less than a month old.

**Neuro, Neural**
Relating to the neurological system (the brain and nerves).

**No Code**
A classification of a patient (with the patient's and family's approval) that if the patient should arrest, no effort should be made to resuscitate him. See also DNR.

**NS**
Normal Saline

**Occlusive**
To close, shut, or block (a passage). Often refers to a type of dressing that prevents further entry of air into a sucking chest wound.

**On Ice**

slang: To put a patient in stasis as in, "Put him on ice."

**Op Area**
slang: Shortened form of Area of Operations.

**PACC**
Portable Advanced Command and Control structure.

**Paramedic**
Refers to auxiliary medical personnel with extensive trauma medicine training. Performs certain procedures independently of a physician, and others with approval and direction of a physician.

**Pericardium**
The membrane surrounding the heart.

**Peripheral**
On the outside, or toward the exterior. Away from the center.

**Plasma**
The liquid component of blood, in which the formed elements (blood cells, etc.) are suspended.

**Pneumo**
Prefix relating to the lungs or respiratory system.

**Pneumothorax**
See hemopneumothorax.

**Porcelain Level**
slang: A term that stems from porcelain crockery, or a "crock," as in "a crock of s---." This is a fictitious blood test ordered at bedside to communicate to a coworker that you think the patient is malingering or being intentionally untruthful. See also terrasphere.

**Positive Pressure**
Making the air pressure inside a structure higher than the air pressure outside. This prevents dirt and other contaminants from blowing into the structure when a door is opened.

**PPG**
Personal Protective Gear (Garment)

**Prepositioned**
Put in position ahead of time. Usually refers to resources stationed in a place in advance of the personnel who will make use of them.

**PRF**
Pseudohematic Replacement Fluid. Artificial blood.

**Prognosis**
A prediction of the probable course of disease or injury and the chances of successful outcome.

**PT**
Physical Therapist

**PTO**
Post Traumatic Drinking Disorder

**PTS**
Post Traumatic Stress disorder

**Pulmonary**
Relating to the lungs. See also pneumo.

**Push**
slang: To administer a dose of intravenous medication all at once as in, "SOOml tri-ox IV push."
**PVC**
Premature Ventricular Contraction. Often a signal in an EKG that a potentially lethal arrhythmia may develop.

**RT**
Respiratory Therapist

**RH/Rhesus Factor**
A group of antigens found in the blood. Named for its discovery on Earth in rhesus monkeys.

**Saline**
Characteristic of or containing salt, especially sodium chloride.

**Scoop and Run**
slang: Stabilizing and transporting a patient rapidly.

**Sepsis**
Infection. The condition of being infected.

**Shock**
An abnormal condition of inadequate supply of oxygenated blood to the peripheral tissues.

**Sinus Rhythm**
The normal beat of the heart.

**Spota**
slang: Soldiers who report to sick call to obtain an excuse for not doing whatever it was that they were "spota" be doing: "I spota be at the motor pool, but my hand feels funny."

**SPSL**
Standard (ized) Portable Structure, Large

**SPSS**

Standard (ized) Portable Structure, Small

**SSF**
Surgical Support Frame. The detachable frame or clamshell frame that assists in biobed surgical procedures.

**Stat**
Colloquial term for at once or immediately.

**STBO**
slang: Soon To Be Dead

**STSB**
Starfleet Thoracic Surgeons Board

**Subcutaneous**
Beneath the skin. Usually refers to drug administration.

**Sub-Q**
slang: Shortened for of subcutaneous.

**Suture**
To close a wound with clips, staples, tape, thread, etc.

**Survey**
see Assessment.

**Systolic**
The pressure of blood in the circulatory system during the height of cardiac contraction.

**Tachycardia**
An abnormally rapid heart rhythm.

**Tension**
When used with hemopneumothorax or pneumothorax, describes a condition in which the amount of air and/or blood filling the chest cavity begins to displace the internal organs.

**Terrasphere**
From the Latin "terra," meaning earth, and "sphere," meaning ball; i.e., a "dirtball."

**Thaw**
slang: To remove a patient from stasis.

**Thrombo**
Prefix relating to blood clots or clotting.

**Thoracic**
The upper torso or chest region, above the abdomen.

**Thoracotomy**
To surgically open the chest between the ribs, usually in order to gain access to the heart.

**Trachea**
The tube like structure in the body that allows air to pass from nose & mouth to lungs.

**Train wreck**
slang: A patient with severe multisystem disease or injury.

**Transit Package**
The container a portable structure is stored and transported in. Usually becomes the center of the structure once deployed.

**Trauma**
Medically, any injury, accidental or intentional, caused by a harsh object or instrument.

**TVO**
Through-Visor Display

**V-fib**
slang: Shortened form of ventricular fibrillation.

**V-tach**
slang: Shortened form of ventricular tachycardia.

**Venipuncture**
The process of inserting a needle into a vein, as in starting an IV.

**Ventricles**
The large, muscular chamber(s) of the heart, usually at the bottom, from which blood is pumped out to the body and/or lungs.

**Venous**
Relating to the veins.

**wNL**
Within Normal Limits. Often used as a summary for a part of the physical exam,
but often sarcastically interpreted as "We Never Looked."

## Appendix B - Medication List

Adrenaline - Pharmaceutical based on the humanoid hormone epinephrine, used at one time for radiation sickness. (*See Hyronaline, polyadrenaline).

AOTH - A substance that may be pumped through the life support systems of a starship as a fast-acting stimulant.

Alizine - Medication used to counter allergic reactions.

Anabolic Supplements - Artificially stimulate the metabolic phase in which simple substances are synthesized into complex materials of living tissue.

Analeptic - Pharmaceutical used as a restorative.

Anesthezine Gas - Sedative gas used for crowd control and an anti-intruder defense used aboard starships and Federation facilities; a concentration of 70 parts per million is more than enough to render humanoids unconscious.

Anetrizine - Pharmaceutical used to anesthetize cranial nerves.

Animazine - Stimulant drug.

Anticoagulant - Chemical that prevents the clotting of blood.

Anti-Hallucinogen - A drug prescribed to alleviate hallucinations and, at times, depression.

Anti-Intoxicant - Medication taken to allow one to drink alcoholic beverages without becoming inebriated.

Anti-Psychotic - Psychotropic pharmaceutical used to reduce psychotic tendencies in sentient humanoid species.

Aphrodisiac - An agent (such as a food or drug) that arouses or is thought to arouse sexual desire. The use of triglobulin as an aphrodisiac is a common practice among many species. Humans historically used the bile of black bears and ground rhinoceros horns.

Arithrazine - Powerful pharmaceutical used to treat theta radiation poisoning.

Asinolyathin - Pharmaceutical used to relieve pain caused by muscle spasm.

Borathium - An experimental rybo-therapy treatment for neural metaphasic shock (Made to replace Leporazine & Morathial. See Morathial Series).

Benjisidrine - Drug treatment for Vulcan heart conditions.

Benzocyatizine -24, 25, 39 - A drug used to stimulate failing isoboramine levels in joined hosts to avoid late rejection of the symbiont. It can be administered in small doses, approximately 2 c.c.s for a crisis situation.

Bicaridine Treatment - Regenerative therapy for bone fractures also used for patients who are allergic to metorapan.

Cateline - Drug, simulates anaphylactic shock.

Cervaline - Anti-rejection drug.

Chloraxine - A chemical compound that is lethal in sufficient doses. Chloromydride - Second-line pharmaceutical used if Inaprovaline is ineffective. Cordafin - Stimulant.

Cordrazine - A potent stimulant used in Starfleet medical practice since at least the 2260s. A treatment of 25cc is considered to be a deadly dosage and usually used only as a last resort in life-threatening situations. Dosage examples: 25ccs in an attempt to revive a Klingon during a cardiac arrest, Usage 2ccs to stimulate falling neurotransmitter levels in a Bajoran was not successful. Administration of 25ccs, a deadly dose to humans, causes madness and hallucinations before death. 50 mg administered when Vulcans enter into convulsions under a mind-meld.

Corophyzine - Antibiotic also used to prevent a secondary infection when viral fever cannot be lowered.

Cortical Analeptic - Pharmaceutical used to reinvigorate the tissues of the cerebral cortex.

Cortolin - Resuscitative drug used to treat a wound inflicted by a compressor beam weapon. Example: 10cc of cortolin administered to Ferengi after wounded by a compressed tetryon beam weapon.

Cyoladin - Poison, used in the mass suicide by the adult members of the Starnes Expedition.

Cytotoxin - Biochemical substance, poisonous byproduct of cellular metabolism.

Oecon-Gel - A medicinal gel applied to the skin before returning to a sterile environment. Decon-gel is applied in the decontamination chamber, and there are various forms to combat various infectious agents.

Oelactovine - Systemic Stimulant, used to stabilize a patient undergoing seizures or shock.

Oeoxyribose Suspensions - A fluid that can be used to encode data into amino acid sequences, then injected making the body into an undetectable carrier of secret information.

Oermaline Gel - Medicinal material used in the treatment of burns.

Oermal Osmotic Sealant - Medicinal skin application used as a protection against epidermal irritation.

Oermatiraelian Plastiscine - Medication used to maintain the effects of cosmetic surgery.

Oesegranine - Cardassian Drug used to reverse memory loss.

Oesegranine-36 - A drug used by the Obsidian Order to erase the memory block imposed on its agents in case of capture. It usually works within hours.

Oeuridium - A rare substance used by the Kobliad people to stabilize their cell structures to prolong their lives.
Oexalin - Medication used to treat oxygen deprivation.

Oylamadon - A drug used in euthanasia for humanoid patients, believed to be painless. Lesser quantities can simulate death.

Elasian tears - The tears of women from Elas contain an unusual biochemical compound that serves as a powerful love potion.

Fanalian Toddy - Drink with cough suppressant attributes.

Felicium - A narcotic substance once used to cure a deadly plague on Ornara.

Felodesine Chip - A poison with no known antidote.

Formazine - Federation Standard stimulant.

Glucajen - Pharmaceutical used on earth in the 21st century as a treatment for hypoglycemia.

Genetic resequencing vector - Medical suspension formulated to shut down Borg nano-probes as they emerge from dormancy.

Hexadrin - Medication used in the treatment of Yarim Fel syndrome.

Hydrocortilene - Analgesic used to alleviate pain.

Hydrodizakatrine - substance found in many dermatologically administered medications and drugs. It is commonly used by beta-quadrant races and facilitates the administration of certain classes of drugs through the larger pores found on these species including, but not limited to the Romulan, Vulcan, Gorn, Klingon, and Andorian species, among others. Due to its properties it is not commonly used on Humans, Bajorans, Cardassians, Denobulans, and other races with similar dermal cell structures, and can occasionally cause a small rash or other dermal irritation.

Hyperzine - Cardiac Stimulant and anti-seizure medication.

Hyronalyn* - Medication for treatment of radiation sickness (*See poly-adrenaline) also, cure for one type of hyperaging disease.

Hytritium - Highly unstable substance not carried onboard Federation vessels, but the only known substance capable of neutralizing poisonous tricyanate. In its pure form must be shuttled from ship to ship because of its instability for transporters.

Hyvroxilated Quint-Ethyl Metacetamine - Anesthetic potion.

Immuno-Suppressant - Any of several drugs designed to limit immune response in humanoids.

Impredrezene - Cardiac Medication.

Improvoline - Medicine used as a sedative (Not to be confused with Inaprovaline, a cardiac stimulant.).
Inoprovalene - A cardiac stimulant.

Inpedrezine - A drug that is sometimes administered to humanoid patients following cranial trauma. A typical dosage: 2cc.

Intraspinal Inhibitor - Drug used to induce paralysis.

Invidium - A substance formerly used in medical containment field generation. Invidium fell out of general use in Starfleet during the 23rd century, although a few civilizations continue its application. Invidium had the unusual property of being undetectable by normal internal sensor scans aboard starships. It was
MD Manual

Mirazine - Pharmaceutical that reduces decompression time. Example: 40 milligrams of mirazine to cut the normal six-hour decompression time in half.

Morathial Series - A group of resuscitative drugs used aboard Federation starships. Also, a drug used to treat neural metaphasic shock when a patient's blood pressure is too low to use the standard remedy, leporazine.

Morphenolog - Pharmaceutical used to ease pain and stop convulsions.

Nasal Numbing Agent - This was given to Vulcans so they would be able to tolerate the smell of humans. Usually taken on a daily basis.

Neo-Analeptic Transmitters - Biochemical neuro-stimulants.

Neo-Oextraline Solution - Liquid medication administered intravenously for the treatment of severe dehydration.

Netinaline - Stimulant used to wake patients from unconsciousness.

Neural Paralyzer - A medication that can cause a cessation of heartbeat and breathing in a humanoid patient, creating the appearance of death.

Neurogenic Radiation - Form of electrical energy used in the practice of medicine to stimulate a patient's brain.

Neurotransmitter - Biochemicals associated with the propagation of electrical energy between neurons in humanoid nervous systems.

Neurozine - Anesthetic aerosol used for crowd-control.

Niaxilin - This drug is used to separate mating Denobulans, should they become too vigorous.

Nogatch Hemlock - A substance poisonous to humans, with no known cure.

Norep - A stimulant, derivative of Norepinephrine.

Norepinephrine - Hormone produced by the adrenal glands, chemically similar to Adrenaline and used to medicinally treat shock (*See Adrenaline, Polyadrenaline, Hyronalyn).

Ovarian Re-Sequencing Enzymes - Complex organic compounds used in a medical fertility treatment.

Peridaxon - A Palliative (meaning to cloak or lessen pain) treatment for Irumodic Syndrome.

Polyadrenaline - A synthetic pharmaceutical based on the humanoid hormone epinephrine.

Polynutrient Solution - A restorative formula given to patients suffering from malnutrition.

Priaxate - Medication prescribed to ease the symptoms of certain genetic diseases.

Psychoactive Orug - A Chemical substance that has the effect of producing delusional or hallucinogenic results when administered to humanoids.

Pulmozine - A pharmaceutical used to stimulate breathing in a patient having respiratory difficulties.

Retnax V - A medication used to treat certain forms of nearsightedness.

Retroviral Vaccines - Attenuated Retroviral compounds, used for preventative inoculation against certain agents used in biological warfare.

Rhuludian Crystals - A powerful narcotic.

Ryetalyn - A rare mineral substance use to cure Rigelian fever.

Serotonin - Biochemical substance that serves as a central neurotransmitter in humanoid nervous systems.

Sodium pentothal - A serum used as a truth-inducing drug, has no effect on Ferengi physiology.

Somatic Orugs - Prescribed for dream deprivation.

Stokaline - A medication used to treat Rigelian Kassaba fever.

Stenophyl - Pharmaceutical that can be used to treat anaphylactic shock in cytoplasmic life forms.

Terakine - Analgesic medication.

Tesokine - Pharmaceutical used for Bajoran women that are carrying non-Bajoran fetuses' in-utero, to help the fetus assimilate Bajoran nutrients.

Tetracyanate 6-2-2 - The disfiguring disease that some of the Akaali suffered from in 2151 was caused by contamination of the groundwater. They were being poisoned by tetracyanate 6-2-2; it was a toxic synthetic compound usually used as an industrial lubricant. The molecular structure has a highly branched structure and has three 6-sided rings.

Theragen - A nerve gas that is instantly lethal if used in pure form.

Tri-Ox Compound - Medication used to help a humanoid patient breath more easily in a thin or oxygen-deprived atmosphere. Typical adult dosage is 15 milliliters every four hours.

Trianoline - Pharmaceutical sometimes used to treat percussive injuries.

Triclenidil - One of several compounds used by the Angosians during the Tarsian War to improve their soldiers, making them more effective in combat, the effects of many of these drugs were irreversible.

Tricordrazine - A powerful neuro-stimulant.

Triglobulin - Material released into the Axanar bloodstream by their zymuth gland. It is similar to human lymphatic fluid and is used to create medicines, and vaccines. It is quite a common practice for some species to even use it as an aphrodisiac.

Trioxin - Medication used to treat severe lung damage.

Triptacederin - Analgesic medication.

Tropolisine - A psychotropic compound with hallucinogenic effects; it's normally found in certain flowering plants. It is carried on pollen. Each tropolisine atom contains an extra neutron. A submolecular scan would've detected them. When this neutron breaks down, a toxin is released that is fatal if not treated soon with inaproviline.

Trypto-Phan Lysine Oistillates - Cure for the flu.

Vasokin - Experimental drug that can increase blood flow to humanoid patient's organs, in 22% of the cases on record vasokin had the side effect of causing severe damage to the subject's lungs, kidneys, heart and brain.

Venus Orug - An illegal substance believed to make women more beautiful and men more handsome and attractive to the opposite sex.

Veridium Six - A slow acting, cumulative poison.

Vertazine - Medication used by Federation medical personnel to combat vertigo.

white - Slang for Ketracel-White.

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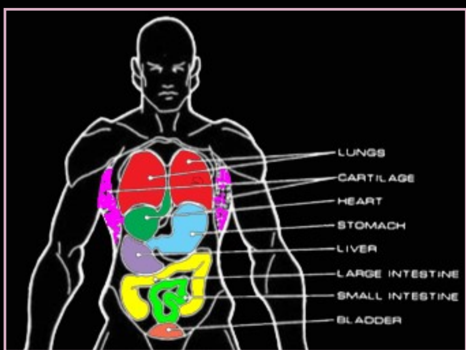
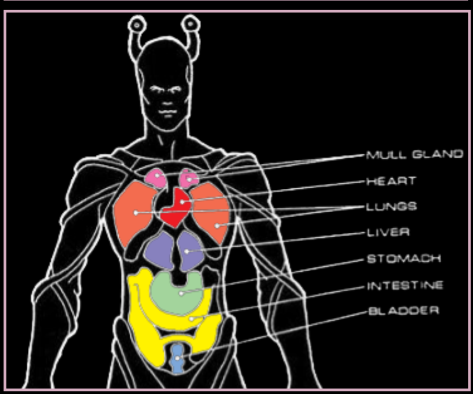



## Appendix C - Comparative Anatomy

Although comparative anatomy and physiology fill volumes of their own respective texts, it may be helpful for the new Medical Branch recruit to see just a few comparisons. Hopefully, this will give you a general idea of just how complex the topic is, and how much there is to learn. Since space here is limited, we will look at three species. Each is the majority example of their respective hemoglobin- base groups: Humans (iron-based blood), Vulcans (copper-based), and Andorians (cobalt-based). While hemoglobin-based, it is not necessarily an optimal defining characteristic for cross-species comparison — it is useful for our purposes here.

### Internal Arrangement

All three species compared share many similar organs: heart, lungs, liver, stomach, intestine, bladder, etc. However, there are many variations on the arrangement of these organs. For example, both the Human and Andorian hearts are located medially beneath the sternum, whereas the Vulcan heart is lower and more laterally located to the subject's right, allowing room for a larger lung assembly (needed for the rarefied atmosphere of Vulcan).

Another good example of variation is the Andorian Liver. While this structure is a large, multilobed organ in the Human and Vulcan, it has developed in the Andorian into two smaller redundant organs. This makes Andorians much more tolerant of liver damage.

In addition to the organs shared by all three species, there are uniquely developed structures as well. One of note is the Andorian mull gland (actually two redundant structures located in the upper chest). These are endocrine glands that seem to perform many of the same functions as the human thyroid and pancreas (neither of which is found in the Andorian).

## Structure and Functioning of Major Organs

An excellent illustration of the internal diversity of humanoids is exhibited by the hearts and brains of these three species.

### Human Heart

The human heart is four chambered: the right atrium perior and inferior vena cava; it passes the blood on collects unoxygenated blood from the body via the suto the right ventricle, which then pumps it to the lungs via the pulmonary arteries; the freshly-oxygenated blood returns from the lungs via the pulmonary veins to the left atrium; the left ventricle then takes the atrial blood and pumps it to the body via the aorta.

### Vulcan Heart

In the Vulcan heart, the left side pumps unoxygenated blood and the right side oxygenated. It also beats much faster and sends and supplies a larger lung assembly. Two inferior vena cava empty directly into the left ventricle to speed up collection of unoxygenated blood. The right atrium is larger than its human counterpart and is fed directly by two large pulmonary veins to collect large amounts of blood from the lungs.

### Andorian Heart

The Andorian Heart is the simplest structure of the three. It has no atria to speak of, providing only a two-chambered assembly wherein the right ventricle handles unoxygenated blood and the left ventricle handles oxygenated blood. The lack of atria has led to the development in the Andorian of much larger capacity great vessels (i.e. - Andorian pulmonary veins carry nearly twice the volume of blood as their Human counterparts).

### Human Brain

A very simplistic view of human brain divides it roughly into the medulla oblongata (brain stem), the cerebellum, and the cerebrum. The two former structures are relatively simple and control base metabolic, emotional, and involuntary functions, while the latter controls most of what is termed "higher brain functions". There are dozens of other structures and glands associated with and located in the brain, but for our general comparison, these three will suffice.

In the human, the cerebrum is highly convoluted to increase its overall surface area, and has several lobes that control various aspects of the higher functions such as speech & hearing, vision, abstract thought, etc.

### Vulcan Brain

In the Vulcan brain, there is an additional cerebral lobe located in the mastoidal area (down low near to the jaw joint), which has developed along with the Vulcan's telepathic abilities. Most of the telepathic abilities originate in this additional lobe.

There is also higher development in the cerebellum, which is related to the Vulcans' greater ability to consciously control their normally involuntary bodily functions. Additional structures in the medulla oblongata are thought to add a physiological component to the Vulcan process of repressing and controlling emotion.

### Andorian Brain

The Andorian cerebrum lacks the convolutions one finds in the Vulcan and Human; however, testing shows that this is not a sign of poor development in higher brain functions. The gray matter that composes the Andorian cerebrum is simply different from that of Humans and Vulcans.

The Andorian brain is also composed of more separate areas than the other two. For example, the cerebral cortex is topped by two smaller cortexes: one along the top of the skull (the anterior cortex), which seems to be devoted solely to abstract thought processes, and another toward the posterior (the visual cortex), which extends into the antennae slightly and is devoted solely to visual processing. Other notable differences are that the cerebellum is located anterially to the medulla rather than posterially, and the medulla's structures are quite different from the Human's.

# APPENDIX D - Nursing and Sample Career Progressions

Nurses form a silent but important cog of the medical framework. Generally found in larger and more permanent medical facilities, their roles remain the same since Florence Nightingale led a team of women in the Crimean War on Earth. Namely, to care for wounded soldiers, to assist in the execution of the medical plan by the team doctors and to coordinate the delivery of care. Nurses are generally deployed to more static or permanent medical facilities, with advanced first aid for military units provided by medics. However, medical staffs of a doctor backed up with nurses may provide field medicine to soldiers or to provide medical aid to civilians.

## Duties of a Nurse

MSH/MGH: At the ward level, nurses would be found coordinating and delivering nursing and medical care to patients. This would include basics such as caring for the person hygiene and other needs, changing patient dressings and other medical devices, monitoring the use of said devices and administrating medicines. Their role also involves coordinating care such as booking appointments for the use of advanced sensory devices for diagnostic tests, coordinating appointments for the medical specialists such as physiotherapists and coordinating with the military units for updates on the soldier status and movement. The marine officer would do well to approach the nurse head to coordinate the discharge of the soldier back into the service. Other roles for the military nurse would involve assisting or conducting research and managerial roles.

Nursing administrators bridge the gap between a specialist administrator and medical personnel, as they bring to the role knowledge of the necessary medical requirements. Therefore, they are better equipped than administrators to know and track how much supplies should be stocked, storage conditions and assist in facility design so as to promote better working processes. As marines are scattered throughout Starfleet territory, nurses may be required to follow up on patients who have been sent to a central holding station or their units had been moved off-site to other theatres of operations. Good communications, liaison with the respective units or departments taking over the patients and good leadership on both the part of nurse clinicians and marine officers are thus necessary to ensure good follow up care.

Advanced Aid Stations: Nurses at this level are expected to perform better in terms of clinical skills and assessment. Medics or Nurses may be the ones performing the initial triage and assessment. Due to the critical nature, senior nurses often have the authority to order basic medical scans. While policy differs, several units have adopted the position that senior nurses have the authority to interpret and then act on readings derived from tricorder and other medical scans at this level.

Due to the vast range of situations they’re exposed to, good clinical skills and a steady head is required here. Emergencies also stress leadership and managerial skills, as nurses handle a large stream of patients from the front. Charting critical patients so that medical care can reach them easily, stabilization and the dispatch of stable casualties to other facilities, intelligent management of supplies, beds and personnel are all necessary so that an advanced aid station can continue receiving more casualties. Lastly, nurse leaders at this stage are expected to provide psychological support to both nurses and casualties, as psychologists are not attached at this level.

## Sample Career Progression

### 2nd Lieutenant

Fresh Registered Nurses after completing The Basic School will be commissioned as 2nd Lieutenant and are known as Nursing Officers. They will spend one year on a general medical-surgical ward in both SFMC and STARFLEET to hone their clinical and time management skills. This first year is focused to develop the required foundation of techniques and knowledge that will guide them throughout their career and it is very likely that by the end of this first year they have been attached to every type of Medical Units in the Medical Branch. Within this first year, like all officers in the Medical Branch, they must complete, Basic Medical Officers Course and must additionally complete Basic Military Nursing Course.

### 1st Lieutenant

About a terran year later (or less if the Registered Nurses have already met all necessary requirements) Registered Nurses commissioned in the SFMC are guaranteed and will be promoted to First Lieutenant. This direct promotion is to reflect the high level of training that they have received prior to joining the SFMC. First Lieutenant of the Nursing Corps is considered fully trained and will begin their duty proper. Majority of First Lieutenants of the nursing corps will serve in a nursing capacity. More experienced Lieutenants might serve in other capacities, but they make up less than 10% of the nursing corps.

### Captain

It takes on average about 2-3 years to achieve the rank of Captain, and by this time, the nurse would have achieved at least one nursing specialty. This is the last guaranteed rank that a Nurse will be promoted to. This is the first level where Nurses might be rotated to different tours. Experienced captains are usually appointed as Charge Nurses. As Charge Nurse, they will be responsible for staff/patient care assignments, overall operations of the patient care ward, and be the "go to" person for any concerns or patient care/ward procedure questions. This role can best be compared to that of a Senior Platoon Leader.

### Major

A Nurse that is promoted to the first field grade rank of Major is likely to have served on average 4 to 6 years as a Captain and have served at least 2 tours as a Charge Nurse. They are likely to have earned 2 or more specialties or have been certified as either Surgical Nurse or Nurse Anesthetist. The most common first assignment as a Major is to serve as a Head Nurse, where they are totally responsible for all actions of the ward or clinical section that they are in charge of. Depending on their specialty and desire, the nurse may serve as Head Nurse for 3 or more assignments. Nurses with superior performance as Head Nurse at a Field Hospital, may even be appointed as Chief Nurse at a Mobile Surgical Hospital or Medical Strike Group or may be offered opportunities for graduate studies. This role can best be compared to that of a Company Commander.

### Lieutenant Colonel

This is the point, opportunities open up for most Nursing Officers to apply for graduate studies, specialty training, and staff officer position or duty assignments in education or administration. This is also the level where most Nursing Officers are attached out of SFMC to serve in nontraditional environments in Starfleet Medical or other agencies and departments of the Federation. It is not uncommon to see, SFMC nurses serving as the Chief Nurse onboard a starship and serve a 5 year tour with them. This is likely why they are so few Nursing Officers who hold the rank of Lieutenant Colonel are seen in the SFMC, those who still remain in the SFMC are likely serving a specific staff tour or are extremely outstanding nurses who have reached the pinnacle of nursing education and are serving as 240s, or Nurse Practioner, although this is uncommon.

### Colonels

Nurses Officers promoted to Colonel have already qualified as a Nurse Practioner or are working towards qualifying as one. Those who choose not become nurse practioners could also be gaining a different specialty and are likely to be working on postgraduate studies in medicine. They are likely to have served 14 to 16 years in the SFMC and might be involved in research or serving a staff tour. Positions that they are likely to hold would be:

- Clinical Section Supervisors
- Chief Nurse, Mobile General Hospital
- Chief Nurse, Hospital Ship
- Special staff officers

### Brigadier

This is the highest position a 245, Nursing Officer can go without qualifying as a Nurse Practioner, although previously all nurses who have been appointed as Brigadier have all qualified as Nurse Practioner. They are definitely considered for Hospital Command positions through the SFMC.

### General, Flag Ranks

Those who demonstrate extraordinary leadership and executive ability can be selected to serve as General Officers. General Officers do nothing less than run the Corps.

# Appendix E - Medical Specialist Sample Career Progressions

### 2nd Lieutenant

Medical Specialist who has completed The Basic School will be commissioned as 2nd Lieutenant and will than immediately proceed to the Basic Medical Branch Officer Course. Upon completion of the BMBOC will then be deployed to the respective therapy departments of medical units for a year, before they will then be posted to Starfleet Medical to serve 1 year in their respective fields. During this time, they will expect to further develop their clinical skills while under peaceful conditions.

### 1st Lieutenant

Medical Specialist is guaranteed promotion to First Lieutenant after completing 1 year with Starfleet Medical which makes it 2 years after commissioning. They will than return to SFMC to serve with their various departments in Field Hospitals are other units. Registered Physical Therapist like nurses will be promoted exactly 1 year after commissioning to reflect their extensive training.

### Captain

Unlike the nursing corps, Captain is not a guaranteed rank for Medical Specialist with the exception of the Physical Therapist who will be promoted to Captain exactly the same as Nursing Officers, although most if not all will achieve this rank with sufficient time in grade. On average it takes 2 to 3 years as a Lieutenant, before being promoted to the rank of Captain. Experienced medical specialist at this rank may serve as department heads at Field Hospitals.

### Major

A Medical Specialist that is promoted to the first field grade rank of Major is likely to have served on average 4 to 7 years as a Captain and have served at least 4 tours as a Physical Therapist and 1 to 2 tours in administrative, staff or instructional tour. Those who intend to serve longer in the SFMC are likely going for either graduate study in their fields or more importantly working in towards becoming a 260s or a Medical Specialist Officer. With the exception of Respiratory Therapist, most Physical and Occupational Therapist are also commonly attached out to Starfleet Medical for a tour.

### Lieutenant Colonel

Medical Specialist promoted to this grade, are usually serving as Department Heads, at Mobile Surgical Hospitals. Depending on their specialty and desire, the medical specialist may serve as Department Head for 3 or more assignments. Those who intend to serve longer in the SFMC are likely going for either graduate studies in their fields or more importantly working in towards becoming a 260s or a Medical Specialist Officer.

### Colonels

Medical Specialist promoted to Colonel has already qualified as a 260s, Medical Specialist Officer or are working towards qualifying as one. This is the highest grade that is possible for a Medical Specialist to achieve without qualifying as a 260. They are likely to have served 15 to 18 years in the SFMC and might be involved in research or serving a staff tour. Positions that they are likely to hold would be.

### Brigadier

Brigadiers have all qualified as Medical Specialist Officer and can be serving in various capacities they are definitely considered for Hospital Command positions through the SFMC.

### General, Flag Ranks

Those who demonstrate extraordinary leadership and executive ability can be selected to serve as General Officers. General Officers do nothing less than run the Corps.

# Appendix F - References and Further Reading

Bits and pieces of information from this manual came from many sources, but mostly I just watched "ER" a lot. Just kidding. Most of the information found in this book came from the sources below, which I highly recommend as starting points for further reading on this subject.

## Medical Texts


Harlan Gibbs, MD and Alan Duncan Ross, The Medicine of ER; or, How We Almost Die, Basic Books, New York, 1996.

Mark Brown, MD, Emergency! True Stories from the Nations ERs, Villard Books, New York, 1996

Edward Barnhart, Publisher, Physician's Desk Reference, 40th Edition, Medical Economics Company, New Jersey, 1986

Wynn Kapit and Lawrence M. Elson, PhD, The Anatomy Coloring Book, Harper Collins, New York, 1993

Bryan Bledsoe, DO, EMT-P, Paramedic Emergency Care 2nd  Edition, Brady Books, New Jersey, 1994


## Star Trek Texts


Eileen Palestine, Star Fleet Medical Reference Manual, Ballantine Books, New York, 1977

Franz Joseph, Star Fleet Technical Manual, Ballantine Books, New York, 1975

Rick Sternbach and Micahel Okuda, Star Trek the Next Generation Technical Manual, Pocket Books, New York, 1991

Michael Okuda, Denise Okuda, and Debbie Mirek, The Star Trek Encyclopedia, Pocket Books, New York, 1994

# Appendix G – EKG Reading

To briefly summarize the components of a normal EKG strip, it consist of components which indicate electrical events during one heart beat. These waveforms are labeled P, Q, R, S, T and U.

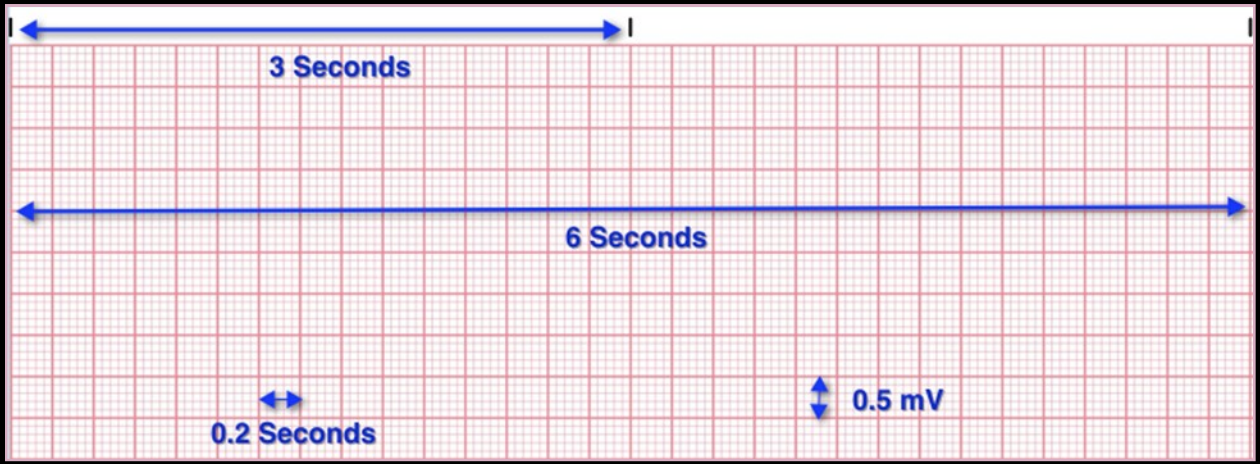

P wave is the first short upward movement of the ECG tracing. It indicates that the atria are contracting, pumping Blood into the ventricles.

The QRS complex, normally beginning with a downward deflection, Q; a larger upwards deflection, a peak (R); and then a downwards S wave. The QRS complex represents ventricular depolarization and contraction.

The PR interval indicates the transit time for the electrical signal to travel from the sinus node to the ventricles.

T wave is normally a modest upwards waveform representing ventricular repolarization.

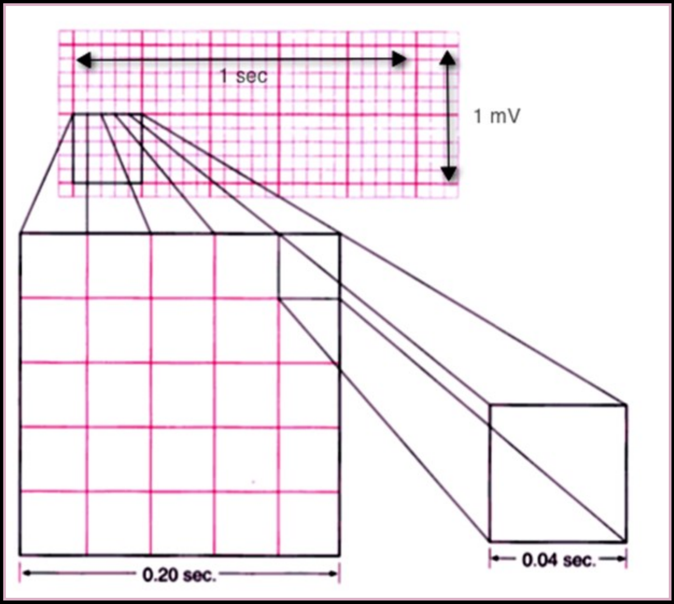
## EKG PAPER/ TRICORDER ANALYSIS SCREEN




ECG tracings are recorded on a grid/grid paper . The horizontal axis of the EKG paper records time, with black marks at the top indicating 3 second intervals.

Each second is marked by 5 large grid blocks. Thus each large block equals 0.2 second. The vertical axis records EKG amplitude (voltage). Two large blocks equal 1 millivolt (mV). Each small block equals 0.1 mV.

Within the large blocks are 5 small blocks, each representing 0.04 seconds




## EKG NOMENCLATURE

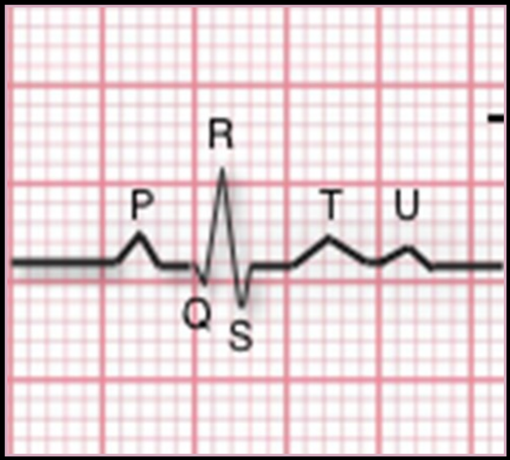
Normal EKG tracings consist of waveform components that indicate electrical events during one heart beat. These waveforms are labeled P, Q, R, S, T and U. The following descriptions are with respect to Lead II.

P wave is the first deflection and is normally a positive (upward) waveform. It indicates atrial depolarization.

QRS complex follows the P wave. It normally begins with a downward deflection, Q; a larger upward deflection, R; and then a downward S wave. The QRS complex represents ventricular depolarization and contraction.

T wave is normally a modest upward waveform, representing ventricular repolarization.

U wave indicates the recovery of the Purkinje conduction fibers. This wave component may not be observable.



## EKG Interpretation

EKG interpretation should be performed using a standard procedure. For this course, we are using an eight step procedure:

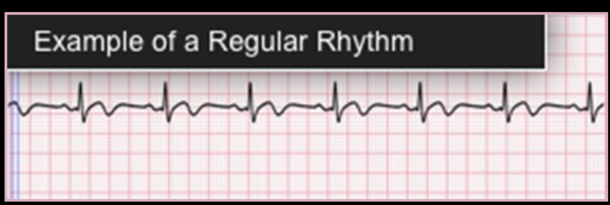
- Rhythm
- Rate
- P Wave
- PR Interval
- QRS Interval
- T Wave
- QT Interval
- ST Segment

### Rhythm

For ventricular rhythms, examine the R to R intervals on the EKG strip. Calipers or paper marks can be used to fix the distance for one R-R interval and then this distance can be compared to other R-R pairs.

Are they regular, meaning that each heart beat's R-R interval is equal? Small variations of up to 10% are considered equal. Is the rhythm regularly irregular? For example is there a pattern, such as increasing R-R durations? Or perhaps groups of similar intervals as illustrated on the right? Or are R-R intervals completely irregular?

For atrial rhythm, observe the P-P intervals. Are they regular (minor variations can be caused by the breath cycle)? If P-P intervals are irregular, is there a pattern?

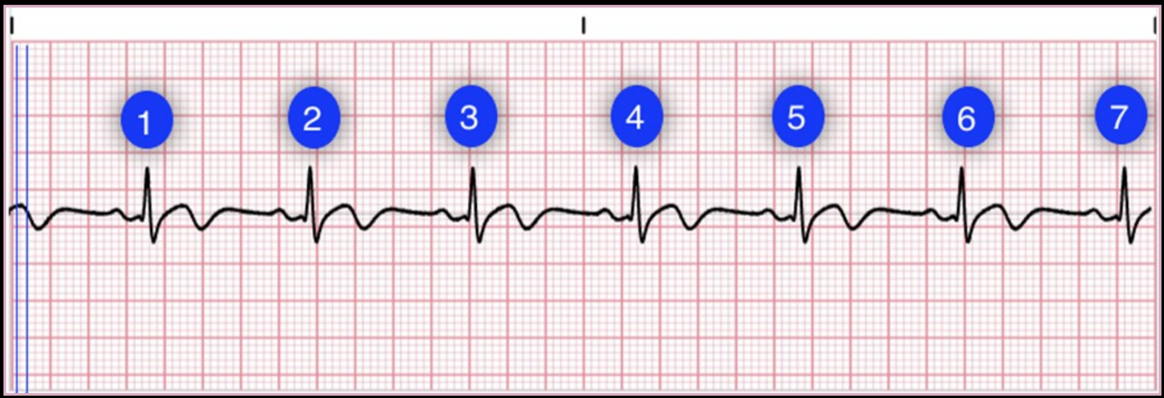




### Heart Rate

There are several methods for determining heart rate. The first method is simple. Count the number of QRS complexes over a 6 second interval. Multiply by 10 to determine heart rate. This method works well for both regular and irregular rhythms. In the first image, we can count 7 QRS complexes, so the heart rate is 70.

The second method uses small boxes. Count the number of small boxes for a typical R-R interval. Divide this number into 1500 to determine heart rate. In the second image, the number of small boxes for the R-R interval is 22.5. The heart rate is 1500/21.5, which is 69.8.




**P-WAVE**

The P wave represents atrial depolarization. In a normal EKG, the P-wave precedes the QRS complex. It looks like a small bump upwards from the baseline. The amplitude is normally 0.05 to 0.25mV (0.5 to 2.5 small boxes). Normal duration is 0.06-0.11 seconds (1.5 to 2.75 small boxes). The shape of a P-wave is usually Smooth and rounded.

P-wave questions:

- Are they present?
- Do they occur regularly?
- Is there one P-wave for each QRS complex?
- Are the P-Waves smooth, rounded, and upright?
- Do all P-Waves have similar shapes?

## PR Interval

The PR Interval indicates AV conduction time.

In this step you should measure the interval from where the P wave begins until the beginning of the QRS complex. Calipers, marked paper or counting small boxes methods can be used to determine PR Intervals. Normally this interval is 0.12 to 0.20 seconds (3 to 5 small boxes) in adults, longer in elderly people. This interval shortens with increased heart rate.

Also evaluate if PR Intervals are constant or varying across the EKG strip. If they vary, determine if the variations are a steady lengthening until the point where an expected QRS does not appear.

PR Interval questions to address:

- Does the PR-Interval fall within the norm of 0.12-0.20 seconds?
- Is the PR-Interval constant across the ECG tracing?


## QRS Complex

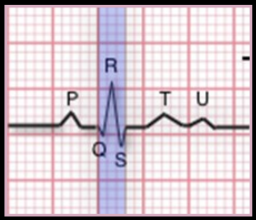
The QRS complex indicates ventricular depolarization. Depolarization triggers contraction of the ventricles.

Because of the larger tissue mass, the QRS complex is larger than the P wave. While the prototypical QRS complex consists of three wave components, one or two of these components may be missing.

In this step, measure the QRS interval from the end of the PR interval to the end of the S wave. Use calipers, marking paper or by counting small boxes. Normally this interval is 0.06 to 0.12 seconds (1.5 to 3 boxes).

QRS questions:

- Does the QRS interval fall within the range of 0.08-0.12 seconds?
- Are the QRS complexes similar in appearance across the ECG tracing?



### T Wave

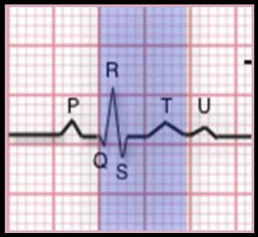
The T wave indicates the repolarization of the ventricles. It is a slightly asymmetrical waveform that follows (after a pause), the QRS complex. Take note of T waves that have a downward (negative) deflection or of T waves with tall, pointed peaks.

The U-wave is a small upright, rounded bump. When observed, it follows the T-wave.


### QT Interval

The QT interval represents the time of ventricular activity including both depolarization and repolarization.

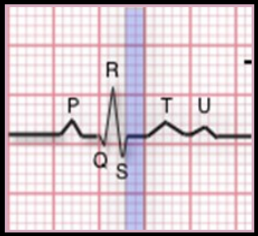
It is measured from the beginning of the QRS complex to the end of the T wave. Normally, the QT interval is 0.36 to 0.44 seconds (9-11 boxes). The QT interval will vary with patient gender, age and heart rate. Another guideline is that normal QT Intervals is less than half of the R-R Interval for heart rates below 100 bpm.




### ST Segment

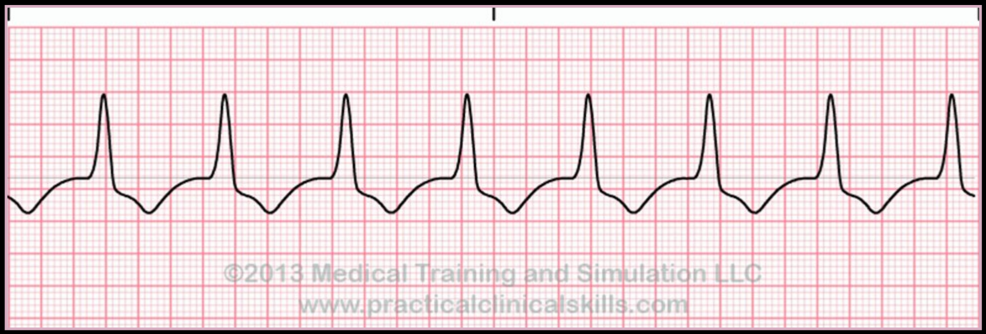
The ST segment represents the early part of ventricular repolarization.

The ST segment is the line that from the end of the QRS complex to beginning of the T wave. Normally the ST segment is flat relative to the baseline.



## EKG WAVEFORMS EXAMPLES

### Accelerated Idioventricular Rhythm




Rhythm Regular

Rate 50-120 bpm

P Wave Absent

PR Interval Not measurable

QRS Wide (>0.10 sec), bizarre looking

### Accelerated Junctional Rhythm


Rhythm Regular

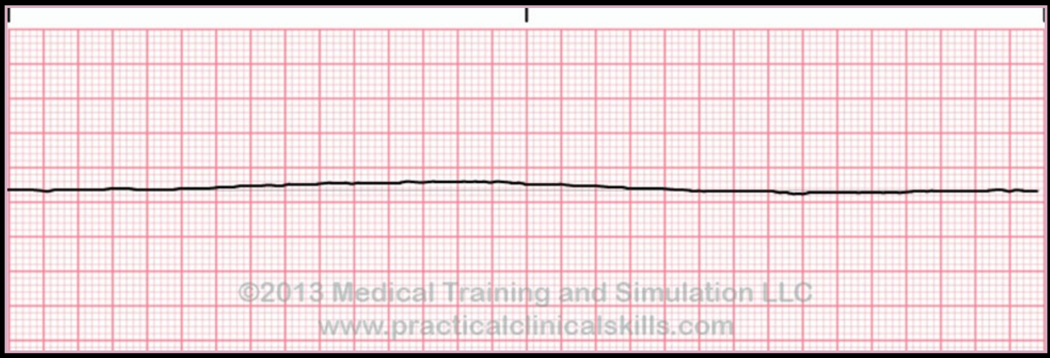
Rate Normal (60-100 bpm)

P Wave Present before, during (hidden) or after QRS, if visible it is inverted

PR Interval Not measurable

QRS Normal (0.06-0.10 sec)

## Asystole




Rhythm Not present

Rate Absent

P Wave Absent

PR Interval Absent

QRS Absent

## Atrial Fibrillation


Rhythm Irregular

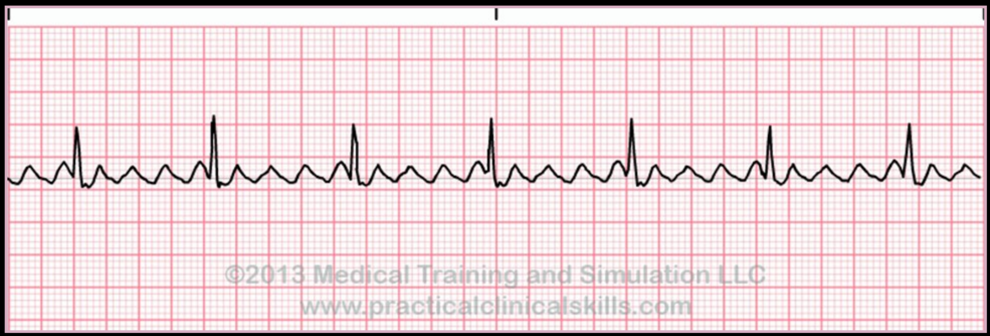
Rate Very fast (> 350 bpm) for Atrial, but ventricular rate may be slow, normal or fast

P Wave Absent - erratic waves are present

PR Interval Absent

QRS Normal but may be widened if there are conduction delays

## Atrial Flutter




Rhythm Regular

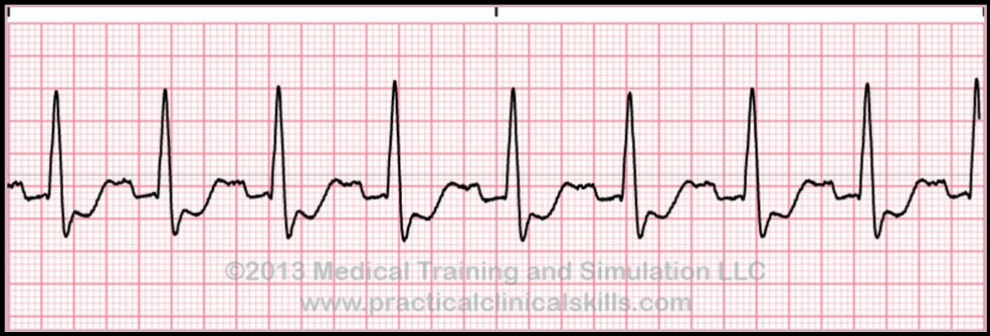
Rate The underlying rate

P Wave Normal

PR Interval Normal (0.12-0.20 sec)

QRS Wide (>0.12 sec)

## Bundle Branch Block




Rhythm Regular

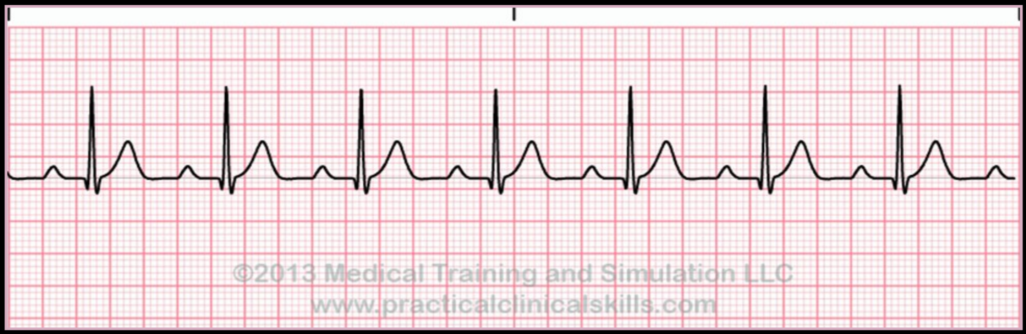
Rate The underlying rate

P Wave Normal

PR Interval Normal (0.12-0.20 sec)

QRS Wide (>0.12 sec)

## First Degree Heart Block




Rhythm Regular

Rate The underlying rate

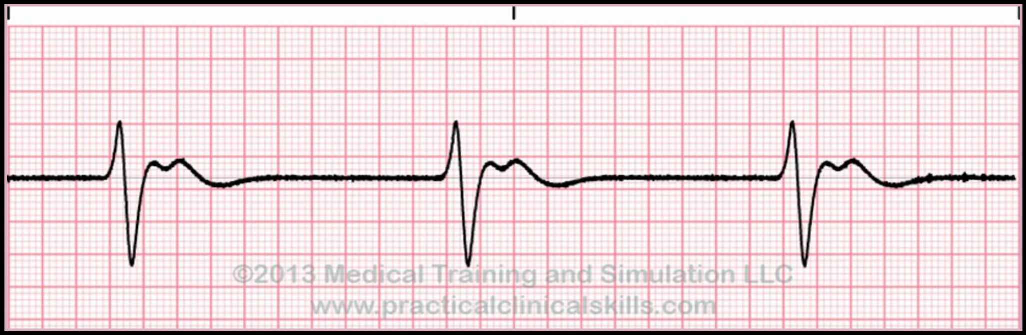
P Wave Normal

PR Interval Prolonged (>0.20 sec)

QRS Normal (0.06-0.10 sec)

**Notes** A first degree AV block occurs when electrical impulses moving through the Atrioventricular (AV) node are delayed (but not blocked). First degree indicates slowed conduction without missed beats.

## Idioventricular Rhythm




Rhythm Regular

Rate Slow (20-40 bpm)

P Wave Absent

PR Interval Not measurable

QRS Wide (>0.10 sec), bizarre appearance

## Junctional Escape Rhythm


Rhythm Regular

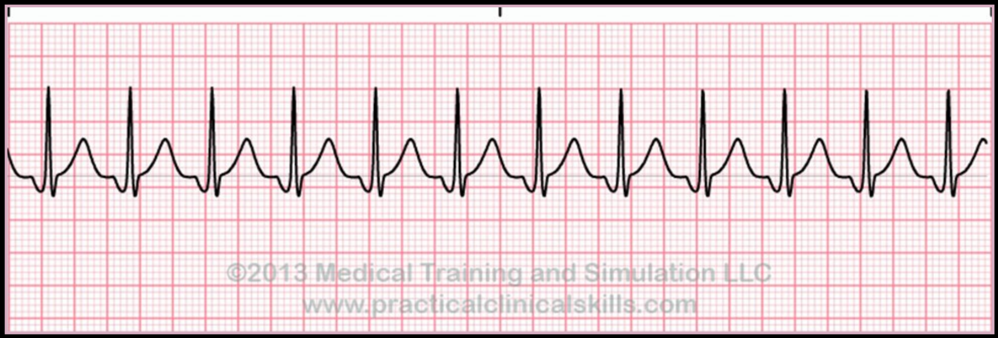
Rate Slow (40-60 bpm)

P Wave Present before, during (hidden) or after QRS, if visible it is inverted

PR Interval Not measurable

QRS Normal (0.06-0.10 sec)

## Junctional Tachycardia




Rhythm Regular

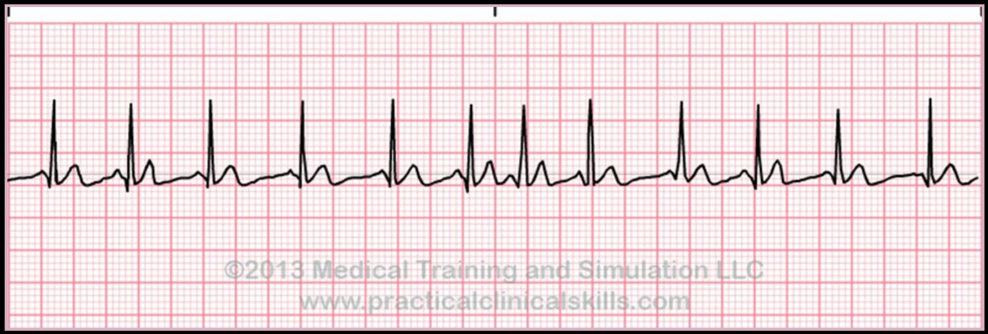
Rate Fast (100-180 bpm)

P Wave Present before, during (hidden) or after QRS, if visible it is inverted

PR Interval Absent or short

QRS Normal (0.06-0.10 sec)

## Multifocal Atrial Tachycardia




Rhythm Irregular

Rate Fast (> 100 bpm)

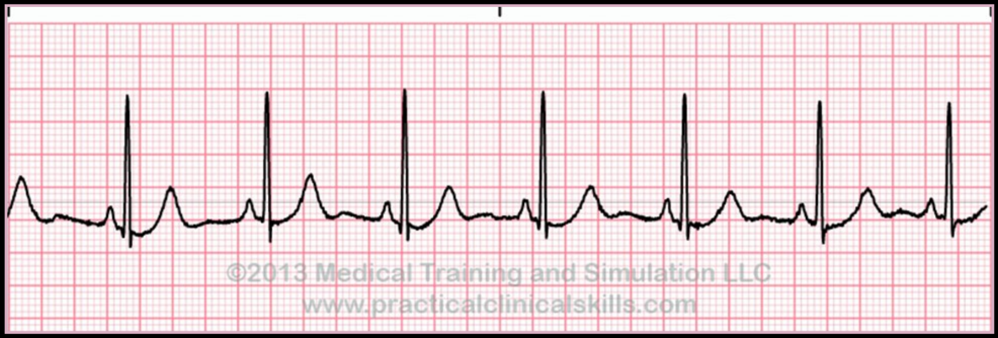
P Wave Often changing shape and size from beat to beat (at least three differing forms)

PR Interval Variable

QRS Normal (0.06-0.10 sec)

**Notes** T wave is often distorted

## Normal Sinus Rhythm




Rhythm Regular

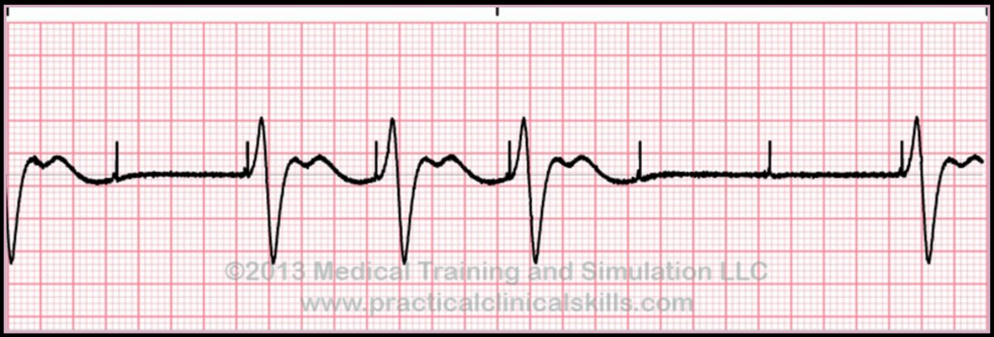
Rate Normal (60-100 bpm)

P Wave Normal (positive & precedes each QRS)

PR Interval Normal (0.12-0.20 sec)

QRS Normal (0.06-0.10 sec)

## Pacemaker Failure to Capture




Rhythm Irregular

Rate Slow or normal

P Wave

PR Interval

QRS

**Notes** Pacemaker spikes are not followed by P waves or QRS complexes

## Pacemaker Failure to Pace


Rhythm Irregular

Rate Slow or normal

P Wave

PR Interval

QRS

**Notes** Pacemaker spikes do not appear

## Pacemaker Single Chamber Atrial


Rhythm Regular

Rate 60 bpm

P Wave Normal

PR Interval Normal

QRS Normal

## Premature Atrial Complex


Rhythm Irregular

Rate Usually normal but depends on underlying rhythm

P Wave Premature, positive and shape is abnormal

PR Interval Normal or longer

QRS 0.10 sec or less

## Premature Junctional Complex


Rhythm Regular with premature beats

Rate The underlying rate

P Wave Present before, during (hidden) or after QRS, if visible it is inverted

PR Interval Absent or short

QRS Normal (0.06-0.10 sec)

## Premature Ventricular Complex


Rhythm Irregular

Rate The underlying rate

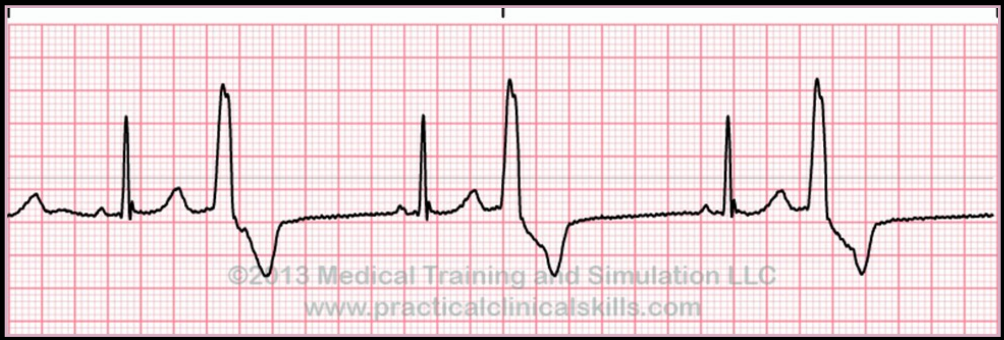
P Wave Absent

PR Interval Not measurable

QRS Wide (> 0.10 sec), bizarre appearance

**Notes** Two PVCs together are termed a couplet while three PVCs in a row with a fast rhythm is ventricular tachycardia

## Premature Ventricular Complex Bigeminy




Rhythm Irregular

Rate The underlying rate

P Wave Absent

PR Interval Not measurable

QRS Wide (> 0.10 sec), bizarre appearance

**Notes** PVC appears every second beat

## Sinoatrial Block


Rhythm Irregular when SA block occurs

Rate Normal or slow

P Wave Normal

PR Interval Normal (0.12-0.20 sec)

QRS Normal (0.06-0.10 sec)

**Notes** Pause time is an integer multiple of the P-P interval

## Sinus Arrest


Rhythm Irregular due to pause

Rate Normal to slow

P Wave Normal

PR Interval Normal (0.12-0.20 sec)

QRS Normal (0.06-0.10 sec)

**Notes** Pause time is not an integer multiple of the P-P interval

## Sinus Arrhythmia


Rhythm Irregular, varying with respiration

Rate Normal (60-100 bpm) and rate may increase during inspiration

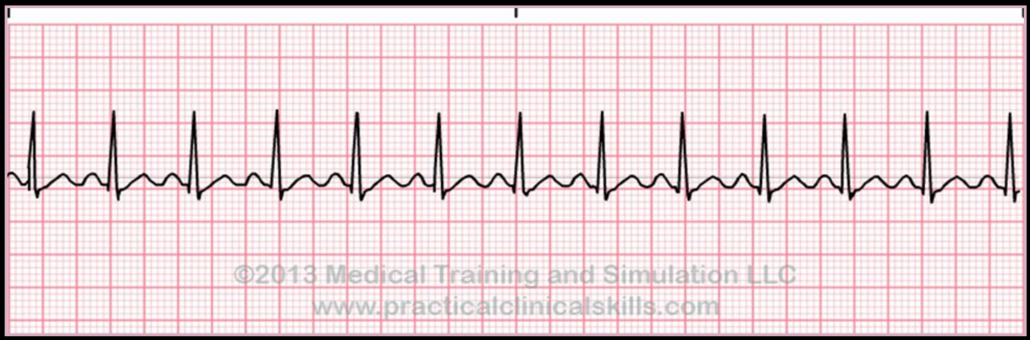
P Wave Normal

PR Interval Normal (0.12-0.20 sec)

QRS Normal (0.06-0.10 sec)

**Notes** Heart rate frequently increases with inspiration, decreasing with expiration

## Sinus Tachycardia




Rhythm Regular

Rate Fast (> 100 bpm)

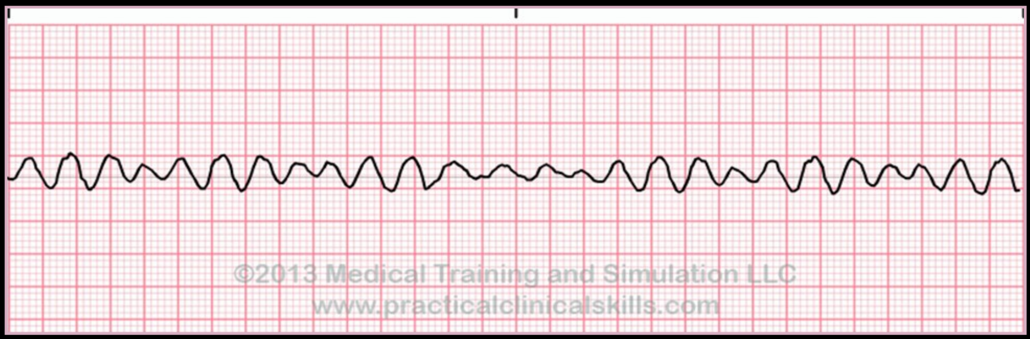
P Wave Normal, may merge with T wave at very fast rates

PR Interval Normal (0.12-0.20 sec)

QRS Normal (0.06-0.10 sec)

**Notes** QT interval shortens with increasing heart rate

## Ventricular Fibrillation




Rhythm Highly irregular

Rate Unmeasurable

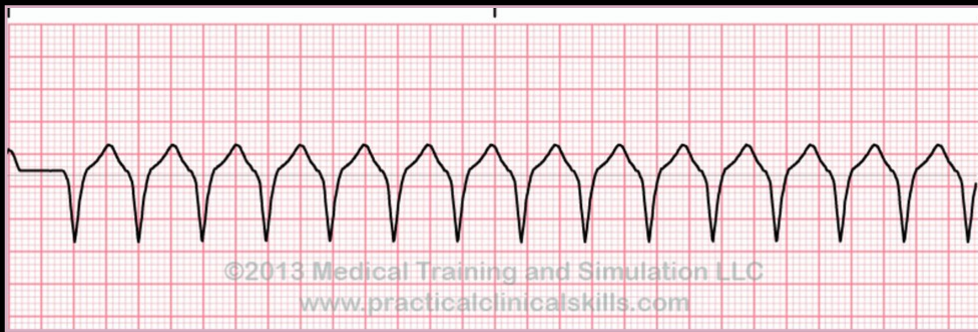
P Wave Absent

PR Interval Not measurable

QRS None

**Notes** EKG tracings is a wavy line

## Ventricular Tachycardia




Rhythm Regular

Rate Fast (100-250 bpm)

P Wave Absent

PR Interval Not measurable

QRS Wide (>0.10 sec), bizarre appearance

The Starfleet Marine Corps Academy was established by Commander Starfleet in 2164 when it was determined that Starfleet Academy could no longer adequately meet the needs of both services. The historical home of the United States' Navy and Marine Corps academies, Annapolis, was selected as the new home of the SFMCA. The head of the Academy is divided between the Deputy Commanding Officer - Training and Doctrine Command (DCOTRACOM) and the Deputy Commanding Officer - Administration Training and Doctrine Command (DCOTRACOM-ADMIN), both are still headquartered at the main campus in Annapolis.

The motto of the SFMCA is "Facta Non Verba" or, in Federation Standard, "Deeds not Words." This is reflected in the more informal academy slogan, "We lead by example... whether we mean to or not."

The Director SFMCA reports to the Commanding Officer of the Training Command (COTRACOM) who, in addition to the SFMCA, oversees branch schools, enlisted personnel training, advanced technical schools, and periodic skill re-fresher courses. Most of these courses are held either at one of the SFMCA facilities, or at one of the many training facilities in the New Valley Forge system which is home to TRACOM. These facilities, together with an Oberth-class spacedock serving as TRACOM headquarters, comprise Station Valley Forge.

Today, the SFMCA consists of 5 campuses, 8 training worlds, and 42 ranges and field courses throughout the UFP. Together with Station Valley Forge, the SFMCA comprises one of the largest and most advanced military training organizations in the known universe.