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A COURSE OF STUDY ON BIKING MEDICINE

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SCHOOL OF MEDICINE

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Chapter 1: Patient Assessment

The management of someone injured is probably the most important topic in all of biking medicine. There are **four effective survey techniques** that you use in your initial assessment of a sick or injured biker. These four survey techniques are: scene survey, primary survey, secondary survey, and ongoing survey.

SURVEY TECHNIQUES

Scene Survey

The first survey technique is the scene survey. When you first approach a scene, the tendency is to approach the patient immediately and start rendering aid. Don't. You must first make sure that the scene is safe before you enter to assess the victim. Potential hazards include bikers on single track that could come around a corner and hit the rescuers and injured biker. This survey should take only a few moments. This can effectively be performed while discovering the mechanism of injury (MOI) and the nature of the illness (NOI).

Primary Survey

The second survey technique is the primary survey. The purpose of the primary survey is to keep the victim alive. To help prioritize the treatment of injuries during the primary survey, refer to the table below which uses the **MARCH** acronym. It's important to note that preventing major hemorrhage is the top priority, even coming before Airway.

Primary Survey prioritization using MARCH

M	Massive hemorrhage
A	Airway (with C-spine precautions)
R	Respiration
C	Circulation
H	Hypothermia/Hyperthermia or Hike vs. Helicopter

Anytime there is major bleeding you should always take steps to stop the bleeding first. Typically, direct pressure is done to stop heavy bleeding. Away from help however, don't hesitate to use a tourniquet. It is a fast and simple method to stop a major bleed.

If a victim is unresponsive, assume there is a C-spine injury even if there is no clear mechanism. Therefore, for Airway, you should hold the C-spine as a precaution during your primary assessment. If the patient becomes responsive later, you can re-evaluate the need to hold C-spine.

Next, you can quickly check for a victim's Respiration before evaluating their pulse. Checking the pulse falls under Circulation when using MARCH. If they are not breathing or if they do not have a pulse, you will need to initiate CPR at this time.

Hypothermia/Hyperthermia refers to making sure that the patient is warm and dry and whether the patient will need to be evacuated or not (thus the alternative of Hike vs. Helicopter). Using the MARCH prioritization as you quickly go through the primary survey ensures your patient is alive and as stable as possible. Learn it well.

Secondary Survey

The third survey technique is the secondary survey. This survey is done after the Primary survey and can be remembered using the **SAMPLE** acronym.

Secondary Survey using SAMPLE

S	Symptoms/Subjective
A	Allergies
M	Medications
P	Prior medical history
L	Last oral intake
E	Events leading up to illness/injury

Address these items to the victim as questions and pay close attention to what they say. It they cannot answer, ask if family, friends, or people at the scene might be able to help with some or all the questions. As well, you can look for medical alert tags and bracelets on the victim. Check backpacks, purses and wallets for medical information too.

Ongoing Survey

The fourth survey technique is the ongoing survey. You should repeat this survey as often as needed. If the patient is unstable, go through the survey more frequently. Until the patient is in the hands of medical help, you should continue assessing them with the Ongoing survey.

If at any time, there is a change in the patient's status you should always go back and repeat the primary assessment. This is essential to determine what caused the change in the patient's medical status.

Ongoing Survey using AVPU

A	Alert
V	Verbal
P	Pain
U	Unresponsive

Scene Safety

In a case where the scene is not safe for the victim, you may need to move them to a safe location. For example, consider a situation where a biker falls in a race and is right on the trail. This fallen person is now in danger of being hit. Should you move the patient to a safer location and risk causing a potential spinal injury? Clearly, the scene is not safe. You need to move the injured person away from the trail. If you started treating the victim here, you would be subjecting the victim, yourself, and other rescuers to additional injury.

When considering scene safety, it is important to keep in mind the risk-to-benefit ratio. Moving the victim(s) may result in spinal injury but keeping them at the base of the cliff could result in more

injury or even death if there is rockfall. In this case, the risk of rockfall outweighs the risk of spinal injury in moving the patient. Be careful of the spine!

Blood Sweep

A crashed biker could easily have cuts on their skin. A quick look will determine if they are bleeding. This is known as the blood sweep and allows you to identify any major bleeding. It's important to look under layers of clothing when doing your sweep, as blood can collect between these layers. It's recommended to perform the sweep in small segments to determine where the blood is coming from.

The blood sweep also allows you to find deformities in the musculoskeletal system. A crashed biker might have internal bleeding. There is little you can do if someone is bleeding to death inside their body, other than evacuate them very quickly. At least you will know to do this. Remember also, that people will often bleed on the 'street' or they will bleed in one place and then stumble to another place. Be sure to look on the ground or the street for blood.

Chapter 2: Vital Signs

What are vital signs?

The word "vital" refers to items that are essential for life. The vital signs are measurements. Some vital signs are easy to measure, like pulse. Some require instruments like a blood pressure cuff to measure the blood pressure. Most people don't carry a blood pressure device with them. So, most often we must rely on other measurement. Some are subjective such as the level of consciousness. The main vital signs are:

- Level of consciousness / level of responsiveness (LOC / LOR)
- Heart rate (HR) or pulse
- Respiration rate (RR)
- Skin color, temperature, and moisture (SCTM)
- Body temperature (T)

Taking a patient's vital signs is part of the physical exam. Trending consecutive sets of vital signs over the course of time will help to tell you how the patient is doing. When vitals are measured, it is important that they are performed by the same individual for the sake of consistency and reliability. The second set of vitals is often more important than the first, the third set is more important than the second, etc. This is a good way to follow how a patient is progressing. Make sure you document the time each set of vital signs was taken.

Level of Consciousness / Responsiveness

This is a measure of the brain's ability to relate to the outside world. It is important for many reasons. It is the first vital sign to change. It is usually subjective. The acronym that is most often used is:

- A - Alert
- V - Verbal
- P - Pain
- U - Unresponsive

Alert

This looks at whether the patient is awake and able to answer questions appropriately. You should ask if the patient is "oriented" to who they are as well as basic situational information.

Each question they answer correctly = oriented by X / 4

- What's your name?
- Where are you?
- What day is it?
- What happened?

If they answer all 4 correctly, they are oriented by 4 / 4 but if they only know their name, then they are oriented by 1 / 4. Patients most commonly lose the ability to recall this information in reverse of the order presented above.

Verbal

Verbal indicates that the patient is not spontaneously interacting with either you or their environment without first being verbally addressed. The patient needs continued verbal stimulation in order to remain engaged.

Pain
This assesses that if the patient does not react to talking but does react to painful stimuli. A sternal rub is a common way to assess for response to pain.

Unresponsive
This look at if the patient does not respond to any stimuli, to include verbal and painful stimulation.

Heart Rate / Pulse

Normal pulse is 60-100 bpm in adults. The heart rate can be taken anywhere you can feel a pulse. The radial pulse at the wrist is usually the easiest to check. Children typically have a higher heart rate with newborns ranging from 100-150 bpm. Count the pulse for 15 seconds and then multiply by four. If the patient is unconscious, assessing for pulse via the carotid artery in the neck is preferred method.

Respiratory Rate

Normal between 12-20 breaths per minutes. Breathing in and out counts as one breath. Count the number of breaths for 30 seconds and multiply by two. You should make a comment about the quality of the breathing, such as labored, audible wheezing, or shallow breathing.

Skin Color, Temperature, Moisture

The color of the skin in non-pigmented areas hold a key to that patient's status. Red skin could mean fever or hyperthermia. Blue skin could mean hypothermia or a lack of oxygen in the blood. You can feel the skin to check temperature. And you can feel for moisture. If your patient is sweating it could mean fever or hypethermia.

Body Temperature

Most people don't take thermometers with them. But if you do, a thermometer that does not break and one that reads lower temperatures is the best.

Recording Vital Signs

Here is an example of what you might record if you took vitals on a young, healthy person with normal vitals.

- LOC = Awake and oriented to person, place, time and events (A+O×4)
- HR = 70 bpm, regular, strong
- RR = 15 breaths per minute, regular, unlabored
- SCTM = pink, warm, dry

Chapter 3: Wound Management

TYPES OF ISSUES IN WILDERNESS WOUND MANAGEMENT

Exposure

The first step to any wound management after the primary survey is to have exposure to the injured area. You may have to first remove equipment from the patient, such as a backpack, helmet, or gloves. You may need to cut, or tear open the patient's clothing near the affected area(s).

Stop the bleeding

The next step is to stop the bleeding. Direct pressure is the first step in stopping any blood loss. The application of direct pressure controls bleeding from most wounds. Use the cleanest materials available and apply direct pressure to the source of bleeding. This may take several minutes. Scalp wounds may require continuous, direct pressure for 30 to 60 minutes.

If direct pressure does not stop the bleeding, use a tourniquet. Rapid arterial bleed can cause a patient to go into shock very quickly. If a tourniquet is used for more than several hours, it places the patient at risk for limb loss. However, if a tourniquet is used to control arterial bleeding, it should only be removed once the patient is assessed by medical professionals.

How to Place a Tourniquet

- Place the tourniquet over clothing, if possible, about two to four inches above the wound.
- Do not place the tourniquet on a joint or directly over a wound or a fracture.
- Once the tourniquet is in place, it should be tightened so that all bleeding stops. Secure the windlass so that it does not unwind.
- Mark the time that you placed the tourniquet on the patient's forehead, so it is rapidly visible to other personnel when the care for the victim.
- There is no need to intermittently loosen a tourniquet for "perfusion" of an extremity.

Cleaning/Debridement

All wounds need to be cleaned. "High-pressure" irrigation is the most important intervention to prevent infection and decrease bacteria content for most wounds.

Irrigate the wound with a solid stream of the cleanest water available. You can use a syringe with a catheter tip to create a high-pressure stream of water, or you can fill a plastic bag filled with water. Use your plastic water bottle that has an adjustable top or remove the mouth piece on the hose of your hydration pack.

Dressing a Wound

Dressing a wound is difficult on the trail but very important. Cover the wound with an absorbent gauze dressing, then secure with tape. If the injury is on a flexible part of the body, you might want to immobilize the joint using a splint to prevent the wound from reopening.

Topical antibiotics are appropriate. Bacitracin is a good choice. Neomycin is less ideal because it is associated with allergic reactions. A great topical ointment is honey.

Scabs

Scabs slow the wound healing process. A scab forms a barrier to the generation of new tissue. Wounds should be kept moist for the entire duration of healing. This can be accomplished by routinely applying thin layers of topical antibiotic ointment or Vaseline over the wound and covering with a nonadherent dressing.

Closing a Laceration

Closing a laceration in the wilderness is difficult. Closing the wound with sutures, staples, tape, or tissue adhesive has the advantage of immediate treatment with better mobility and less pain. However, the risk of infection is higher.

<u>Steri-strips or tape:</u> Closure may be simply achieved by placing steri-strips or tape of some kind over the wound and pulling the wound together. If necessary, trim the hair around the edges of the wound so the tape will adhere better. Duct tape can be used.

If an injury is on a flexible part of the body, such as an elbow or a finger, immobilize the joint with a splint to prevent reopening of the wound.

Blisters

The most common causes of blisters are friction (i.e. from poor fitting shoes), freezing of the skin (frostbite), and burns.

The blister bubble is formed from the epidermis, the outermost layer of skin. Its purpose is to protect and cushion the layers underneath. Blisters can be filled with serum, plasma, blood, or pus, depending on how and where they are formed. Friction blisters usually form a 'hot spot' (sore spot) first.

If a small blister or hot spot forms, place a dual-layer pad over that area. Blist-o-ban is one such material. These pads address the two causes of friction blisters, the friction and shear forces on the skin. The dual-layer will allow the bandage to glide smoothly in all directions, deflecting friction and shear forces away from the skin. The key to preventing blisters is to reduce 'hot spots' by properly breaking in boots and reducing moisture by wearing wool socks.

You can treat a blister that has already formed, by cutting a hole in the moleskin and placing the ring of moleskin around the blister. This reduces the pressure placed on the blister. This should help reduce the pain. It is not recommended to pop or drain blisters that are small (<2cm or <0.75 in).

When should a blister be opened? The answer is not clear. In general, if the blister is 2 cm in

diameter or larger, then it is likely to rupture spontaneously therefore it can be opened. Cut flap of skin from the blister, apply an antibiotic ointment, and cover the blister with a sterile dressing.

What Ointment should be used on a wound?

Honey has been used in wound care for thousands of years to prevent infection and speed the healing process. contains methylglyoxal. This helps it to fight a broader range of bacteria strains.

Topical First Aid Antibiotics are available over the counter. These include **bacitracin**, **neomycin**, and **polymyxin B sulfate**. Some also contain the anesthetic lidocaine for pain relief. There is a large allergic reaction rate to neomycin. Make sure someone is not allergic to sulfa, as bacitracin is sulfa-based.

Silvadene Cream 1% (silver sulfadiazine) is good for the treatment of wounds and burns. It helps ease the pain.

Chapter 4: Bleeding and Shock

Everyone reading this chapter has cut or scraped themselves and has bled. Bleeding is also called hemorrhage. It can happen inside the body where it is called internal bleeding, or outside of the body, where it is called external bleeding. When you look at someone bleeding you can usually tell which type of vessel has been ruptured.

- Capillary bleeding – slow oozing and bright red in color
- Venous bleeding – steady flow and dark maroon (due to lower oxygen in the veins)
- Arterial bleeding – under high pressure, often spurting and brighter red in color

Most capillary and small venous hemorrhaging will stop bleeding without your assistance. However, larger wounds and arterial damage will usually require your assistance to stop the bleeding.

How to Stop External Bleeding

First Step: Direct Pressure

The first method is to apply direct pressure on the wound.

When applying direct pressure, remember to follow these rules:

- Use gloves and sterile dressing if available to reduce infection
- Apply pressure with the heel of hand directly onto wound

Certain wounds are more difficult to control the bleeding, such as large wounds because of the large number of blood vessels involved. And it is harder to put pressure on the entire wound. Scalp wounds bleed a lot and are thus more difficult to control the bleeding.

Second Step: Pressure Dressing

A pressure bandage should be applied if there is continued bleeding or if you need your hands to provide other care to the patient. Wrap and hold the dressing in place with an elastic bandage (Ace® wrap) or tape that you wrap around the extremity. If the patient continues to bleed through the pressure dressing, then you should remove the elastic bandage and place additional dressing on top of the dressing that is already on the wound. After applying a pressure bandage, be sure to check to see if they have blood flow at the fingertips. You can do this by squeezing the patient's fingertip until it turns white, and then noting the amount of time it takes for the fingertip to return to its original color. A well perfused finger should take less than three seconds to return to its original color.

Third Step: Using a Tourniquet

While widely viewed as a last resort, in the wilderness a tourniquet can be used initially to stop bleeding. It will hurt where you apply it, but it might save a life. After it is on, you can assess the wound and determine the best approach of treatment and evacuation. If you have tried the other methods to stop the bleeding and the wound continues to bleed through the dressing, then you should consider placing a tourniquet. Always note the time the tourniquet was applied. Writing the

time on the victim's forehead is very effective because it is obvious to other rescuers and to the providers who receive the victim as they are brought into a hospital setting.

How to Manage Internal Bleeding

Internal bleeding

Bleeding into a body cavity is life-threatening, so getting the patient to surgical help is essential. Patients can bleed internally anywhere, but there are specific areas of the body (CARTS) that more easily allow for life threatening bleeding

- **C**hest (from a broken rib)
- **A**bdomen / Pelvis (usually due to a spleen and/or liver injury or pelvis fracture)
- **R**enal/Retroperitoneal (in the space surrounding the kidneys)
- **T**high (From a broken thigh bone)
- **S**kin / Street (Blood is seen on the skin or the ground, primarily indicates external bleeding)

Patient may lose a lot of blood before you are aware of any bleeding because it is not obvious to you.

You should look for external bruising, guarding, and an increasingly severe abdominal pain. There is little treatment that can be done while in the field for internal bleeding. You need to get them to help quickly.

Chapter 5: Airway and Breathing

The Airway

You will hear the expression "open airway.' This term means that air can flow freely from the mouth or nose to the lungs. A lot of things can block the airway, including debris, blood, teeth, and dentures. Here are ways you can help to keep an airway open.

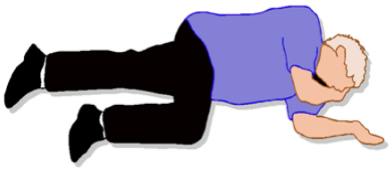
If the person appears unresponsive, ask them loudly if they're OK and if they can open their eyes. If they respond, you can leave them in the position they're in until help arrives. While you wait, keep checking their breathing, pulse, and level of response:

- Are they alert?
- Do they respond to your voice?
- Is there no response to any stimulus (are they unconscious)?

If there's no response, leave the person in the position they're in and open their airway. If this is not possible in the position, they're in, gently lay them on their back and then try to open their airway. Open their mouth and make sure there is no blood, debris, broken teeth, or something blocking their airway. If there is something there, carefully remove it.

Sometimes the tongue is blocking the airway. It simply falls backward and obstructs the throat. In this case you will need to do one of two things. The first method is to place hand on the person's forehead and gently tilt their head back while lifting the tip of the chin using two fingers from your other hand. This is known has the head tilt-chin lift technique. This moves the tongue forward, away from the back of the throat.

The second method is used if you think the person may have a spinal injury, in which case you must be more careful. It is known as the jaw thrust technique. You will place your hands on either side of their head and use your fingertips to gently lift the angle of the jaw forward and upwards, without moving the head, to open the airway. Take care not to move the person's neck. However, opening the airway takes priority over a neck injury.



To check if a person is breathing:

- look to see if their chest is rising and falling
- listen over their mouth and nose for breathing sounds
- feel their breath against your cheek for 10 seconds

If they're breathing normally, place them in the recovery position depicted above so their airway remains clear of obstructions, and continue to monitor normal breathing.

Gasping or irregular breathing is not normal breathing. If the person isn't breathing or is not breathing normally, call for an ambulance and then begin CPR.

Rescue Breathing Review

In most situations, hands only CPR should be performed without any rescue breathing. If the patient is either not breathing or is gasping and has no pulse, initiate chest compressions immediately. It is recommended that only individuals with proper training perform rescue breaths.

1. Pinch the patient's nostrils and hold the mouth open.
2. Take a deep breath away from the patient's mouth. Seal your mouth over the patient's mouth.
3. Give two breaths over one second each making sure to see the chest rise for each one.
4. If you cannot see the chest rising, reposition the airway and try again.
5. Check for pulse: If it is present, continue breathing. If there is no pulse, start CPR.
6. Use a ratio of 30 compressions followed by 2 breaths
7. Rescue breathing can be done mouth to mouth or mouth to nose if necessary.

Chapter 6: Musculoskeletal Injuries

Sprains

A sprain involves the ligaments (tissue that connects bone to bone) of a joint and means that the ligaments have been stretched or torn. A sprain usually occurs when a joint is twisted or bent beyond the normal range of motion which causes the ligaments to stretch or tear. While sprains can occur in any joint in the body, they happen most often in the knees and the ankles. Symptoms include pain, swelling, and discoloration of the injured joint. Sprains can be difficult to differentiate from fractures, due to the fact that they share many of the same signs and symptoms.

Strains

Strains, unlike a sprain, involve tendons which are the fibrous bands that connect muscles to bones and facilitate the movement of our limbs. A strain, simply put, is fatigue due to overuse or strenuous movements. While strains are usually considered to be minor injuries, they can cause pain and discomfort.

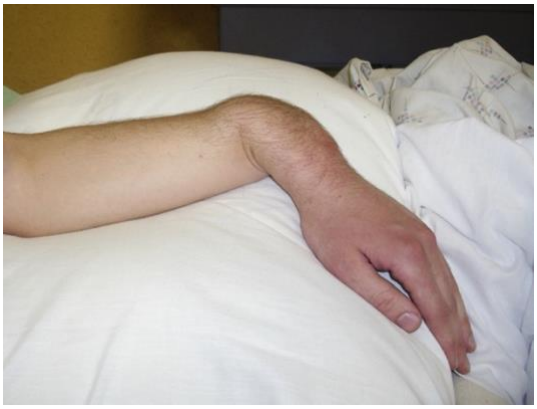
Dislocations

A dislocation occurs when a sufficient force is placed on a joint which causes a bone to come out of its socket. Dislocations are most common in the shoulder, elbow, finger, and kneecap. While dislocations themselves can create quite an ordeal, the real damage is usually caused to adjacent blood vessels, nerves, muscle, and ligaments which can be stretched or compressed.

Fractures

A fracture is any break or crack in a bone. Since fractures can be difficult to diagnose without x-rays, the following signs may help to indicate where there is a fracture.

- Point tenderness - pain and tenderness at a very localized point of the body.
- Deformity – our bodies are symmetrical so if there is an abnormal shape, position, or motion of a bone/joint as compared to the opposite side then a fracture could be present.
- Inability to use the extremity – a bone fracture can most likely render the limb unusable. If a victim cannot move the limb or joint, or cannot bear weight on it, a fracture should be suspected.
- Swelling and bruising – at or around the fracture site.
- False joint – the ability to move a limb at a point where no joint formally exists.
- Audible snap – sometimes the victim will hear or feel a bone snap which can help to diagnose a fracture.
- Crepitation - the sensation of grinding between the ends of a fractured bone that may be felt or heard with movement.



The image to the right is a fracture of the radius and ulna bones in a 17-year-old biker who fell in a

competition. Note the 'false joint' that is typical for this injury. It is swollen and tender.

Pelvic Fractures

Fractures sustained to the pelvis or pelvic area is serious because they are usually accompanied by significant internal bleeding. This bleeding can result in shock or even death. Along with internal bleeding, pelvic fractures can also cause damage to other internal organs such as the intestines or bladder. Symptoms of a pelvic fracture include pain in the pelvis, hip, or lower back with the inability to bear weight or with significant pain around the hip or waistline. And there will be pain and/or abnormal movement when you push (gently) on the pelvis from the front.

Femur (Thigh Bone) Fractures

Due to the presence of very large thigh muscles and arteries that surround the femur, a broken femur can be life threatening due to bleeding. They are very painful. When the bone breaks, the thigh muscles strongly contract and force the broken bone ends into the muscle, which causes extreme pain and increased blood loss.

Treatment

General

If the mechanism of injury is unknown or such that a neck or back injury is suspected, immobilize the neck immediately upon reaching the victim. Uncover the injured area to look for deformity, swelling, discoloration, breaks in the skin consistent with an open fracture, and other associated injuries. Gently feel the injured area for tenderness, abnormal movement, and crepitation. Check for numbness or altered sensation beyond the injury. Check circulation beyond the injury by pinching the fingernail or toenail bed (if the injury is to an arm or leg) and see how long it takes for the color to return to normal (from white to pink). It should be less than three seconds.

Splinting Basics

The main reason for splinting an injury is to immobilize a limb to not worsen the injury. Splints can also help to reduce pain that accompanies various musculoskeletal injuries. It is only a preliminary treatment used to evacuate a victim to seek further medical care. General principles regarding splinting include:

A splint should be long enough to immobilize the joints both above and below the fracture, sprain, or site of dislocation. The splint should immobilize the fractured limb in its functional position.

- The leg should be splinted with a slight bend at the knee.
- The ankle and elbow should be splinted with the joints flexed at a 90-degree angle.
- The wrist should be splinted straight or slightly bent backwards (extended).
- The fingers should be bent in a position like that of holding a can of soda and should have loose swath or cloth in between each finger to ensure proper blood flow.

General guidelines for splinting

- Remove ALL (including sentimental) jewelry and accessories, such as watches, bracelets, and rings, before applying a splint. Swelling will make these objects very hard to remove if left in

place.

- Use padding within the splint to make it as comfortable as possible for evacuation. Use plenty of padding at bony protrusions, such as elbows, knees, and ankles.
- Splints should be made from rigid, sturdy material. Examples are sticks, boards, skis, paddles, heavy cardboard, and rolled up magazines or newspapers. Be creative when finding materials for a splint.
- Secure the splint in place with pack or lifejacket straps, tape, belts, strips of cloth, webbing, or rope. Tie securely, but not tightly enough to inhibit distal function or blood flow to the limb. Secure the splint in several places, both above and below the fracture, sprain or dislocation.
- Mold the splint on the uninjured limb or body part first and then transfer it to the correct site.
- After splinting, elevate the injured body part to minimize swelling.
- Always recheck sensation and circulation beyond the site of injury after placing a splint. If distal sensation and circulation is inhibited due to splinting, redo the splint.

Sprains

RICES was the acronym that is used to treat sprains: Rest, Ice, Compression, Elevation, and Stabilization. This is not used anymore. The problem is that prolonged ice application may prevent blood flow to the area and slow healing, therefore ice should only be applied initiall. Compression may restrict blood flow into the injured area, so this is discouraged. Stabilizing the injury is important and elevation will help with the swelling. Rather than rest, a patient can start to use the injured area as tolerated as the pain subsides.

Realignment of a Fracture

It is not necessary to realign a fractured limb unless circulation is restricted or in the case that the deformity makes it impossible to splint and transport. However, if it can be easily realigned the following are important points to consider:

- Numbness, tingling, and/or blue discoloration of the skin beyond the injury, all of which indicate poor blood flow (circulation) indicate the need to realign the fractured limb.
- Realignment is easier if it is done soon after the injury. As time passes, surrounding muscles contract and pain increases.
- Straighten the limb by pulling on it below the fracture in a direction that will straighten it. This should be done while someone else holds the limb above the fracture.
- While continuing to hold the limb straight, apply a splint to prevent further motion.
- Reassess circulation beyond the injury. Continued absence of a pulse indicates immediate intervention at a hospital is necessary in order to prevent irreversible damage to the limb.

Dislocations

After a dislocation occurs the muscles that surround the joint will begin to spasm making it harder to reduce the dislocated limb. If you know how to reduce a dislocated limb, attempt to do so soon after the injury as it becomes increasingly difficult with time. Reducing a limb will also be helpful to the victim as dislocations are very painful and reducing them can provide relief.

- Splint the joint with plenty of padding.
- Ice the joint to minimize swelling.
- Check for sensation and circulation distally of the injury.
- Take them to the hospital

Strains

While strains are not as severe as the other injuries that have been mentioned previously, there are treatment options for them. The best way to deal with strains is to try and minimize the use of the limb or area that is causing pain. Anti-inflammatories such as ibuprofen can help to combat both the inflammation and pain that accompany strains.

Chapter 7: Medical Problems

By being able to recognize the signs and symptoms of serious medical conditions, you can provide a proper treatment plan that may potentially save your patients life.

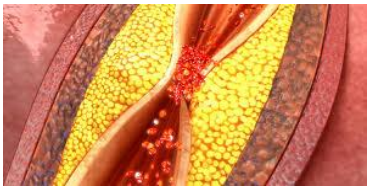
Heart Problems

Angina
Angina is the term given to chest pain that is associated with diminished blood flow to a portion of the heart that does not cause actual damage. It is cardiac ischemia (low blood flow) but not infarction (death of heart muscle). Angina results from the heart not getting enough oxygen. For example, there is an increased exertion that causes that heart to work more with getting enough oxygen.

There are two types of angina. Stable angina is chest pain that is well known to the patient for a period of several weeks, months, or even years. The patient knows the symptoms and usually knows what level of activity causes these symptoms. Unstable angina is new chest pain that is felt when the patient is at rest.

Treatment for angina includes any steps to reduce the oxygen demand of the heart muscle. So, rest is the key to the recovery of anginal pain. Medications can be used, as well. The patient might have been prescribed a drug called Nitroglycerin (NTG). It is given under the tongue. This may be repeated every 5 to 10 minutes until the pain is relieved or until three tablets have been given. Aspirin helps also. It is better that it is chewed as it works faster. These people need to go to the hospital.

Heart Attack



Acute Myocardial Infarction (MI or heart attack) is the term given to chest pain that is associated with a completely clogged heart artery. If that clog is not open, the patient could die quickly. Chest pain or pressure is one defining difference between MI and angina. This is often described as a squeezing or tightness. The pain may radiate to the arms, jaw, neck, or back, frequently towards the left side. Other symptoms are shortness of breath, nausea or vomiting, lightheadedness, and a feeling of impending doom.

Treatment of an MI is immediate evacuation. This is the most critical priority for the patient with a suspected MI. The fastest way to the hospital is the best way to the hospital. This means that you may be required to put a patient through some exertion-such as walking out-in order to get him/her evacuated instead of waiting for evacuation. You can give them an aspirin to chew as they are going to the hospital.

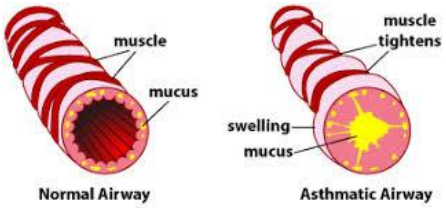
Cardiac Arrest
Cardiac arrest in a high school athlete is most commonly caused by structural or electrical abnormalities, as compared to myocardial infarction in adults. This means that early intervention

with EMS activation and high-quality CPR increase rates of survival among this group. It is imperative that a cardiac arrest is identified rapidly and that there is no delay in initiating CPR or calling 911.

Breathing Problems

Asthma

Asthma is airway inflammation. Asthma can be triggered by a multitude of potential etiologies such as increased strenuous activity, exposure to cold, changes in humidity, exposure to environmental allergens, and exposure to camp smoke.



Patients who have asthma usually know that they have it and are taking medication. They will have shortness of breath on exertion, wheezing, or a dry cough. Most patients will know when they are having an asthma exacerbation based on their previous episodes. They should also be able to tell you whether their current symptoms are mild, moderate, or severe in comparison to previous episodes. This is useful in terms of judging their response to treatment and the need for evacuation.

If the patient can speak in full sentences, then this is a mild exacerbation. If the patient can only speak a few words at a time, they are having a severe exacerbation. An epi-pen is a significant consideration if the patient is not responding to the inhaled medications.

Patients with severe exacerbations of asthma must be evacuated. Those patients with mild to moderate exacerbations must be monitored closely and should have their activities limited. They do not require evacuation unless their symptoms do not resolve with field treatment.

Pulmonary Embolism (PE)

Pulmonary Embolism (PE), or a blood clot to the lung, can be seen in outdoor activities. Traveling a long distance, trauma to the legs, dehydration, oral contraceptives, and a history of cancer or recent surgery. Many of these risk factors are present in athletes traveling to or from competition.

They may have a sudden onset of chest pain that may be dull or sharp and may have a cough that may be dry or productive of bloody sputum. There may be shortness of breath, an increased respiratory rate, or swelling in one leg. There is no specific treatment that can be administered in the field to help these patients. All patients with suspected PE or DVT should go to the hospital.

Neurological Problems

Seizures

Seizures are an uncommon medical problem in the wilderness because most people with this disorder tend to avoid wilderness activities. Either that or they are well controlled. Treating a seizure can challenging in a remote setting. The seizure may occur while the patient is performing a technical activity, such as biking. It is possible that the seizure occurred while the patient was riding, causing them to crash. When treating a seizure, look for trauma. The following are important points and steps to take if you witness a seizure:

- Most seizures will resolve spontaneously within 1 – 5 minutes.

- Allow the seizure to run its course.
- Do not attempt to place anything in the patient's mouth or straighten their extremities.
- If there are no signs of significant injuries, you can roll the patient on their side. This is known as recovery position and can prevent saliva and vomit from entering the lungs.
- Obtain additional history from friends or family. You likely will need to get them to the hospital.

Diabetic Problems

People with diabetes have problems regulating their blood sugar. Most diabetics know their diabetes well and are usually able to manage it appropriately on their own. Diabetics should carry a method to measure their glucose level. Hypoglycemia (low blood sugar) is common in diabetic athletes. It occurs when a person's blood sugar becomes too low. It could be the result if the patient:

- took too much insulin
- ate too little prior to starting the activity
- exertion level is much higher than usual, resulting in higher glucose metabolism than expected.

Rapid onset of confusion, lethargy, irritability, combativeness or agitation, or the loss of coordination, or inability to walk may all indicate that the patient has low blood sugar. They can have a headache, slurred speech, weakness or numbness, tremors, and sweating. Nondiabetic cyclists may appreciate these signs and symptoms as they are similar to those experienced while "bonking," which is also caused by low blood sugar levels.

The treatment for hypoglycemia is sugar. Give it immediately as hypoglycemia in a diabetic patient is a true emergency where minutes count. An easy option on the trail include gel packets. Check their packs as many diabetics are prepared for these events with easy to eat snacks that contain high amounts of sugar. If the patient is unable to eat, you may rub the sugar on their gums. Once they wake up, feed them. Give them a meal that has complex carbohydrates and protein that will last for a longer period. These patients must be monitored closely. They should recover completely in a few minutes. If not, go to the hospital.

Allergic reactions and Anaphylaxis

Allergic reactions are common in the backcountry. On a spectrum, there are three types of allergic reactions that exist: **local**, **generalized**, and **anaphylaxis**. Any of these reactions can occur within seconds of exposure.

Local reactions are very common. They are characterized by red and swollen areas of the skin that are usually itchy. Topical corticosteroids like hydrocortisone cream provide relief and should be carried in a first aid kit. Benadryl may be useful for the itching, but has a side effect of fatigue and drowsiness. Cold packs may alleviate some of the pain or discomfort.

A **generalized** reaction can come from any source. Symptoms include itching, hives, redness, and possibly difficulty breathing. Any of these may begin immediately or hours after the exposure occurs. Treatment is to remove the patient from the allergen and to treat them with antihistamines and possibly prednisone.

Anaphylaxis is a real life-threatening emergency. It begins as a generalized reaction but rapidly results in respiratory and/or circulatory collapse. These reactions are not subtle and include pruritus, hives, flushing, and swelling of the tongue and lips. The patient will have shortness of breath, wheezing, and tightness in their chest. A drop in blood pressure may also occur.

Treatment for anaphylaxis must be immediate. An EpiPen® (epinephrine auto-injector) is the primary treatment. This auto-injector also comes in both adult and junior forms. Every medical medicine kit should carry one of these. Give the IM injection directly into the thigh muscle, through pants if necessary. A second dose of epinephrine may be required within 5 - 20 minutes after the first dose. Antihistamines need to be given. There is no best antihistamine, although non-specific antihistamines such as Benadryl are most used.

All patients with anaphylaxis require immediate evacuation. Although the patient may rapidly improve with epinephrine and other medications, they are at risk of rebound anaphylaxis that could be worse than the initial reaction. Those with local and generalized reactions do not usually require evacuation unless their symptoms do not resolve with treatment, or they have worsening symptoms.

Abdominal Emergencies

There are some causes that are more common in the backcountry. It can be a challenge to know what is causing the pain, and if a person should be evacuated out of the backcountry.

Gastritis / Gastroenteritis
This is a very common cause of abdominal pain. It is often caused by a virus that someone ate on bad food. Symptoms include nausea, vomiting, and abdominal pain or discomfort. The patient often has, or will have, diarrhea that may be watery and contain mucus and blood. Patients may have significant malaise and fever. Dehydration may occur from an inability to take liquids and considerable fluid loss from diarrhea.

Treatment is large amounts of fluids that contain sugar and salts. This should be given frequently in smaller than usual amounts due to nausea/vomiting. Most patients with gastroenteritis will resolve their symptoms in 24 to 48 hours with symptomatic treatment.

Appendicitis
Appendicitis is difficult to diagnose. It's difficult to diagnose appendicitis in the hospital setting, even with diagnostic testing, so you can imagine the difficulty with making a diagnosis. All patients whom you suspect of having appendicitis should be evacuated. Typical symptoms include fever,

fatigue, lack of appetite, and abdominal pain that progresses from diffuse to localized in the right, lower abdomen.

Kidney stones

Kidney stones can occur while preforming and possibly with more frequency in people who are prone to them. The most common precipitating factor is dehydration. People will who have had kidney stones should make sure they stay well hydrated. Symptoms sudden sudden onset of severe pain in the flank or back or unilateral abdominal pain with radiation of the pain towards the groin. Treat them with pain relief and evacuation.

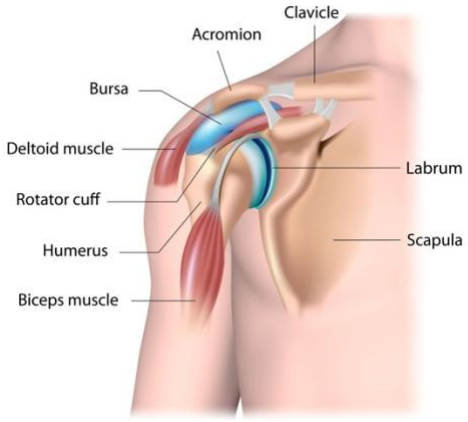
Chapter 8: Shoulder Injuries

Introduction

During a mountain bike race a 17-year-old crashed on some rocks. He lands on his right shoulder. You approach the patient, and he is awake. He has not lost consciousness. He is experiencing a lot of pain in his shoulder and there is a visible deformity around the affected shoulder. You immediately determine that he has not dislocated anything as the shoulder is not flattened and he has some mobility his right arm. Next, you examine his collar bone by gently running your fingers along the bone. You feel a bump in the middle of his collar bone and determine he has fractured his clavicle. Finally, you immobilize his arm using a sling fashioned out of a spare tube and help him down the trail and to a hospital.

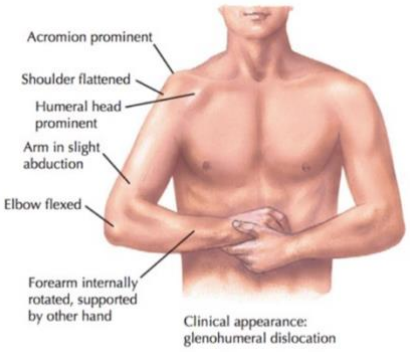
Anatomy

The shoulder is a ball and socket joint. The scapula (shoulder blade) forms a socket that your humerus (upper arm bone) fits into. In-between the shoulder socket and the humerus is the glenoid labrum, this tissue is designed to cushion your humerus in the shoulder socket and provide shock absorption. Additionally, the shoulder employs the use of 4 tendons that are collectively referred to as the rotator cuff. Each tendon in the rotator cuff starts in different locations, ranging from your chest to your back, and meet at the humerus essentially tugging on the bone from 4 different locations around your shoulder to keep it in the socket. Finally, you have your clavicle (collar bone) running from the top of your shoulder blade to your sternum at the base of the neck. This bone provides extra structural support.



Dislocation

Anterior shoulder dislocations usually result from abduction, extension, and external rotation, with forces typically coming from the front as the arm is outstretched to break a fall. Common indications of a shoulder dislocation include exquisite tenderness within the joint, along with a visible step-off of the joint. While it is not uncommon for patients and friends to reset the shoulder without medical assistance, evacuation is necessary for definitive care. Depending on the position of comfort for the patient, a sling and swath are often beneficial in stabilizing and protecting the injured joint. Be sure to check circulation and sensation before and after the application of the splint.



Clavicle fractures

Clavicle fractures often occur when a cyclist is thrown off their bike forward over the handlebars and suffers a direct blow to the shoulder area. Symptoms include a visible deformity in the collar bone area, a grinding sound when moving your shoulder, shoulder stiffness, along with pain and swelling that increases with shoulder activity. If you suspect that you, or someone else, has a fractured collar bone you should first stabilize and secure the shoulder with a sling so that the arm of the affected shoulder is wrapped across the chest with the hand resting on the opposite shoulder. After the shoulder is secured, immediate evacuation and medical attention is required.

AC separation

An AC separation is when the clavicle detaches from the scapula on the top of the shoulder. This typically happens when a cyclist falls onto their shoulder or receives a direct blow to the shoulder while on their bike. The clearest indicator of an AC separation is a bump like deformity on the top of the shoulder, usually accompanied by bruising and swelling. In the case of an AC separation, the affected arm should be put in a sling in order to stabilize the shoulder and minimize discomfort. Once the shoulder is secure, evacuation and immediate medical attention is required.

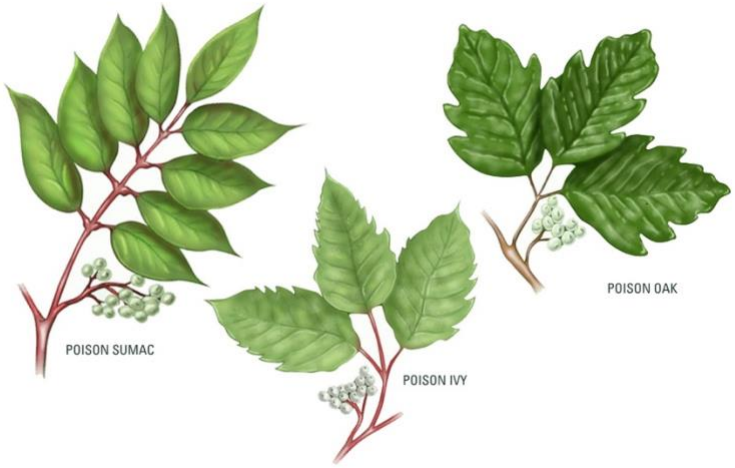
Chronic Injury Prevention

When cycling, there is a constant dislocating force being pushed up on your shoulder from the weight of your upper body resting on the handlebars. This upward force on your shoulders can be massive, potentially 2-3 times the riders body weight when considering the force generated from pedaling. For the most part, the brunt of this axial force is placed on the rotator cuff. Consistently exposing the rotator cuff to these kinds of forces without proper care has been linked to SLAP tears and other chronic shoulder pain. To prevent, it is recommended that consistent cyclist train both shoulder strength and shoulder mobility semi-regularly.

Chapter 9: Skin Problems

Things that Irriate the Skin

Poison ivy, oak, and sumac



These plants all contain a toxic resin called urushiol, which is responsible for the characteristic reaction. Urushiol is contained within the leaves, fruit, root, and stem of the plant. The urushiol compound is not a defensive measure. Rather, it helps the plant to retain water. The plant must be broken open to release the resin. It is not difficult to do this, even raindrops can release the resin. Urushiol is remarkably adhesive and can cling to pets, garden tools, and clothing. Urushiol is very heat stable and can attach to smoke particle making it possible for people who burn these plants to breath it into their airway and lungs causing a frightening possibility. The toxin is resistant and last on objects for months and even years

These three plants are mostly found throughout the continental United States. In general, poison ivy grows east of the Rocky Mountains, poison oak west of the Rocky Mountains, and poison sumac in the southeastern United States. Poison sumac is much less common than poison ivy or poison oak. It has 7 to 13 leaflets on each leaf stem. The leaves have smooth edges and pointed tips. It grows as a shrub or a small tree.

The most common reaction from exposure to one of these plants is an itchy red rash on the skng that that touched the plant. The rash often includes fluid-filled vesicles or bullae in a linear arrangement. The vesicles do not contain urushiol and rupture of the vesicles does not spread the disease. In a first-time exposure, the appearance of skin lesions is commonly within 24 to 48 hours but may be delayed up to 21 days.

Avoidance of these plants is the way to prevent the rash. If you are exposed, wash the area with warm or cold water. Soap is very useful. Rubbing alcohol is very effective at getting rid of the resin.

When cleansing, take special care to remove resin from the fingernails to prevent further spread of the resin.

If needed, you an apply a topical steroid cream. Rub it on three times per day directly to the rash. This will also help to get rid of the rash. Antihistamines will help also. Calamine lotion, Aveeno oatmeal bath soaks will help with the rash as well. Some people use burrow's solution or Domeboro astringent. Most rashes will get better on their own in 1-3 weeks, but this is along time for some to have that itching. If the rash is severe and these don't work, you might need to take oral steroids.

Zanfel® Poison Ivy Wash is a product that studies have shown to remove urushiol from the skin after an outbreak. It can provide relief of itching and pain. Zanfel works by binding to the urushiol oil, and, when rinsed off, takes the oil with it. Tecnu Extreme® works in a similar fashion.

Sunburn

Sunburn is inflammation of the skin that is caused by overexposure to the sun's ultraviolet (UV) rays. Generally, there are two classes of UV rays are clinically important in sun exposure: UVA and UVB. UVA rays penetrate the skin deeply. They damage the DNA of the skin cells, contributing to the development of skin cancers. UVB rays affect the more superficial layers of the skin and are the chief cause of skin reddening and sunburns. They also play a role in the development of skin cancer. The tanning effect of the skin is also a response to UVA and UVB exposure. Ultraviolet light is not safe for the skin. UV rays strike the skin and cause multiple effects. Skin redness appears as the local blood vessels dilate and inflammatory mediators (including histamine) are released. Fair-skinned people are particularly susceptible to sunburn because their skin produces only small amounts of the protective pigment, melanin. Even dark-skinned people, while they have a lower risk, can develop skin cancer.

The best way to treat a sunburn is to avoid one. In the wilderness, a sunburn can cause significant problems including ending someone's trip. People should limit sun exposure to eary in the day or late in the evening. Keep contact time to minimum.

Covering up is the best. Wear breathable full-length clothing, use wide-brimmed hats, and seek shade. When the sun cannot be avoided, sunscreen should be worn. Everyone six months of age and older should use sunscreen. Infants younger than 6 months of age should be kept out of the sun because their skin is thin and susceptible to burning. Sunscreens have not been approved for infants.

When choosing sunscreen, it is important to find options labeled as "broad spectrum." The FDA requires a sunscreen to effectively protect against both UVA and UVB in order to be labeled as broad spectrum. This is an important detail as UVA is implicated in the development of skin cancer and sunscreens that only block UVB rays will not afford appropriate protection.

Sunscreen effectiveness is defined by the SPF. Even though very few people know what it is, SPF is actually pretty straightforward. SPF stands for "Sun Protection Factor" and is a measure of the sunscreen's ability to protect your skin from UVB rays. The basic calculation works like this. If it takes 1 minute for your unprotected skin to start turning red in the sun, using an SPF 15 sunscreen theoretically prevents reddening 15 times longer. Let's say that someone purchases an SPF 30 sunscreen. If it typically takes 10 minutes until that person's skin starts to burn, by using the SPF 30, they are theoretically protected from the sun for 300 minutes, or 5 hours. Unfortunately, sunscreens wash off the skin easily. Even sweat will cause them to wear away. There are no such thing as waterproof sunscreens and the definitely do not last all day.

The mainstays of therapy are pain control and skin care. Pain control can be achieved with acetaminophen or with Ibuprofen. Benadryl has shown so benefit for itching relief. Cool soaks in water, cold showers, or applying moisturizers such as aloe vera are excellent. Topical steroids show little to no benefit at all. Stronger pain medicine may be needed.

Chapter 10: Eye Problems

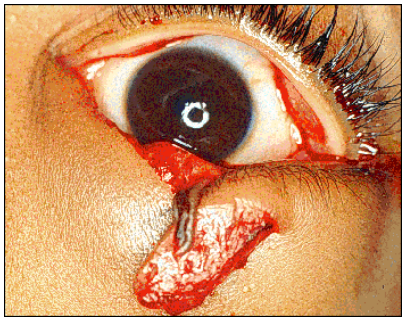
Our eyes are our windows to the world, and although most of us go through life with nothing worse than a speck of dust causing problems, some injuries can occur to the eye that needs to be addressed. Some of these injuries are minor but will necessitate treatment. However, others will be so serious that they carry with them the potential for loss of eyesight.

EYE INJURIES

Eye Lid Laceration

A superficial eye lid laceration does not cut through the full thickness of the eyelid and does not include the lid margins or the eye itself. Treatment of superficial lid lacerations is the same as that for other minor lacerations. Place some clean gauze to apply pressure to the wound to stop the bleeding. However, it is important not to put much pressure on the eye, but rather on the surrounding bones. After the bleeding stops, irrigate the wound with clean water to remove dirt or foreign objects. The wound may then be closed with tape.

Complex Lid Laceration



A complex lid laceration cuts through the full thickness of the lid, includes the lid margins. When looking at these, make sure there is no damage to the globe. You can use sterile gauze to stop the bleeding. Then, irrigate the laceration with clean water. Patients with complex lid lacerations should go to the hospital.

Blunt Orbital Trauma

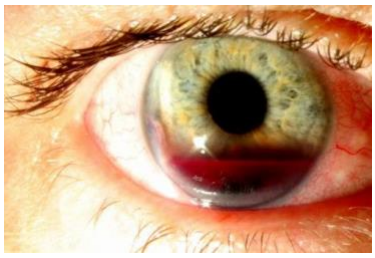
Blunt force to the bone around the eye (the orbit) can fracture the thin bones that hold the eye in place. This would likely be obvious, as significant periocular bruising and swelling will occur. More concerning is that there may also be restriction of eye movements, due entrapment of muscles involved with eye movement within the fracture. This most commonly affects the inferior rectus muscle as the floor of the orbit is much weaker. Significant swelling, restricted eye movements, clear fluid leaking from of the nose, and decreased vision following blunt trauma to the orbit suggest considerable damage. The victim should be evacuated for evaluation and treatment.

Corneal Abrasion

Abrasions occur when the top surface of the cornea is scraped. People may tear and experience sensitivity to light. Patients often say that they have a foreign body sensation in their eye.

To treat this, you will place some antibiotic or saline eye drops in the eye. You might want to patch the eye for comfort. This is done by tightly taping a piece of gauze from the forehead to the cheekbone. Eye patching is not a necessity and does not decrease time to recovery, but some victims report that this provides relief from their symptoms. These usually heal within 24 hours.

Hyphema



A hyphema is a collection of blood in the anterior chamber of the eye and is usually caused when someone is hit in the eye. Hyphemas are best examined when the patient is sitting or standing, as the blood in their eye will settle, resulting in the formation of a meniscus in the anterior chamber. Small hyphemas can be difficult to see when the patient is lying flat. This is a serious condition that mandates evacuation. Avoid using aspirin, ibuprofen, or any other medications that may cause more bleeding. Activity should also be restricted as much as possible during the evacuation. Do not lower the head below the heart for the same reason.

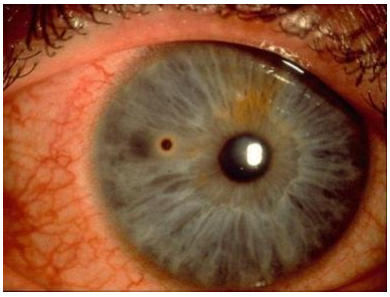
Subconjunctival Hemorrhage

This is an accumulation of blood in the space between the conjunctiva and the sclera. This results in an extremely red-looking "bloodshot" eye but is not a serious condition**.** This condition may occur spontaneously or because of increased intrathoracic pressure, which occurs with straining or coughing and can occur at altitude. They normally resolve over a period of a few days to two weeks without treatment.

UV Keratitis (Sunburn of the eye)

This is best described as a sunburn on the surface of the eye caused by UV exposure. Symptoms begin about 6 to 10 hours after sun exposure, and victims typically are not aware that damage is occurring during the time of actual exposure. People with this are usually very uncomfortable, and their pain is worse with light exposure. Sunglasses or eye patching may help with the discomfort. Prevention is the key to this type of exposure. When traveling on snow or water, it is essential to wear sunglasses or glacier goggles to prevent corneal damage.

Foreign Body



Foreign bodies are common in the eye in backcountry activities. When a person has one, it is important to find it and remove it. This includes everting the upper and lower lids. If you cannot find a foreign body, you can irrigate the eye with water. You can also sweep the eye with a cotton swab. After removal, the eye should be treated for a corneal abrasion. Evacuation will be necessary because corneal foreign bodies can cause permanent scarring, and conjunctival foreign bodies can become infected.

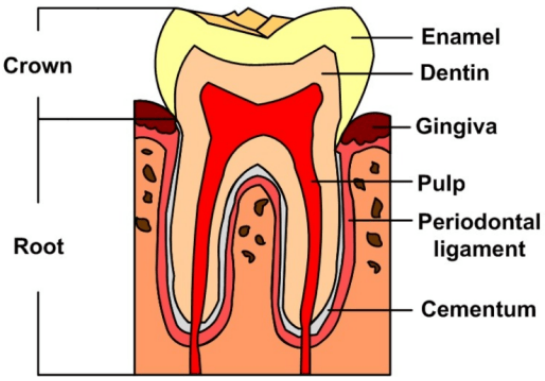
Chapter 11: Dentistry

Dental problems are common athletic event and provoke considerable anxiety. Most people don't even think to learn about dental problems and procedures beforehand. Teeth may be subject to trauma as well. This chapter is to teach dental first aid, to help get a person back home where a dentist can take care of the dental problem.

Basic Dental Anatomy

Let's start with basic anatomy. This will help you as you learn how to treat dental problems. Each tooth is made up of the same four components: **enamel**, **dentin**, **cementum,** and **pulp**.

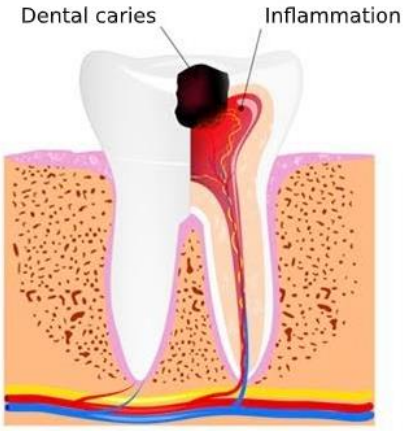
Enamel is the substance that covers the anatomic crown of the tooth. It is the hardest substance in the body. The enamel is the first line of protection for the tooth. It can withstand biting pressure but does not have the ability to regrow once fully formed. It chips easily. In fact, the entire enamel can be chipped off in a fall.



The **dentin** is the substance that lies beneath the enamel and the cementum. It is not as hard as enamel, and it makes up a significant portion of the tooth. The dentin is comprised of microscopic tubes. If the tubules become exposed, teeth become very sensitive to cold and air.
The **cementum** is the substance that covers the root of the tooth. It is also very thin and not as hard as the enamel but has a similar hardness to bone. The **pulp** is the final component, and it is where all the nerves and blood vessels that supply the tooth are housed. If the pulp is exposed, you get a toothache. If a filling encroaches on the pulp, that can hurt also. The supporting tissue consists of the **gingiva** (gum), **periodontal ligament**s (PDL), and **bone**.

Pulpitis (Tooth Ache)
Inflammation of pulp is the primary cause of most toothaches and is often the precursor for more serious dental and facial infections. The pain can range from mild to debilitating and can be steady or intermittent. Inflammation can arise from bacterial entry into the pulp from tooth decay, also called a cavity. Sometimes a filling has been placed near the pulp, and this can cause pain. Trauma can cause inflammation of the pulp, which causes pain. Early on, the tooth will be sensitive to a stimulus such as heat or cold, or sweet or sugary food placed on the tooth. Sometimes the tooth will frequently remain achy or painful after the stimulus has been removed.

Signs and symptoms of pulpitis may range from mild, intermittent pain to severe, constant pain. It will usually have sensitivity or pain to stimuli such as cold, hot, sweets, or tapping. In the early stages, it may be difficult to identify which tooth is causing the pain. In these cases, the tooth may look normal, or have a small cavitary lesion. In later stages, tooth decay may be obvious. The treatment of pulpitis is first to remove any irritants or debris, usually by swishing the mouth with warm water. You can give Ibuprofen, which is great in for reducing pain. All patients with pulpitis should see a dentist upon returning home.



When a Filling Falls out

When fillings or crowns fall out, the tooth can hurt. To correct the situation until you can get to a dentist, you should first remove any debris in or around the tooth. You can rinse the mouth or try to pick debris out if necessary. Once this is done, you need to fill the hole in the tooth with some temporary filling material.

There really are two products that you can choose to put in your first aid kit.

- **Cavit** comes pre-mixed and will harden once placed in the mouth. Cavit can be thinned, if necessary, by mixing it with petrolatum jelly (Vaseline).
- IRM comes in a powder/liquid form that requires mixing. The advantage of IRM is that it can be mixed to any consistency.

Dental Trauma

Injuries to teeth are common during high-adventure activity, such as mountain biking, skiing, climbing, or rafting. Trauma can be isolated to the tooth, but it often involves the soft tissue and supporting tissue as well. Clean the region well to remove blood or debris.

Chipped tooth

These are common in backcountry sports where almost anything can strike the mouth. When you look at it, you will see an obvious chip in the tooth. The pulp is usually not exposed, but it might still be sensitive to stimulus (hot, cold, sweets). The treatment is pain management. You can smooth sharp edges by placing temporary filling (IRM, Cavit, soft wax, or tape) over the tooth. Usually, you can wait until you get to the dentist.

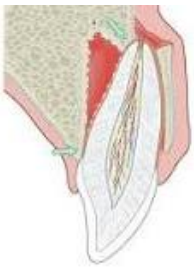
Tooth Fracture

A fracture is where a very large part of the tooth is broken. When you examine the area, there will be a loose piece of tooth, and there will be pain or irritation on biting. The treatment is to remove any loose fragment(s), and then cover the tooth with a temporary filling. This will help with pain, but you will likely need to give Ibuprofen. A temporary filling will help with the pain, but a dentist needs to repair this.

When a tooth is Knocked Loose

Trauma to the mouth may not fracture a tooth. Instead, damage may occur to the supporting structures around the tooth, in which case the tooth will be displaced from its normal position. The following are possible scenarios that can affect teeth and supporting tissues.

Subluxation (loose tooth)



Subluxation is where the tooth has increased mobility but has not been displaced from its original location. Symptoms may vary depending on the severity of injury to the supporting structures. Treatment consists of a soft diet, rest, and NSAIDs for pain management, if necessary. When injured teeth are painful, temporary splinting may ease pain and enhance the ability to eat. A dentist will need to realign the tooth.

When a Tooth is Knocked Out

Having a tooth knocked out on a wilderness trip is not uncommon. Bikers can fall on their faces. Quick action is needed to increase the survival of the tooth. The longer the tooth is out of the mouth, the less the chance for survival of the tooth.

The best thing to do is to try to put the tooth back in its socket, so be careful of the tooth. A tooth can survive with a high rate of success if reimplanted in the first 20 minutes after the accident. This isn't always practical when you consider the amount of time needed to assess the situation, secure the trail, survey the patient, find the tooth, prepare the tooth and socket, and get the tooth back into the socket. While not ideal, the prognosis is still good if this can all be done within the 1st hour. When handling the tooth, do not scrub, scrape, disinfect, or let the root surface dry out. Rinse the tooth with water to remove debris. Remove clotted blood from the socket, using gentle irrigation and suction. Replace the tooth gently with steady pressure to displace any accumulated blood. This will hurt. The tooth will then need to be splinted in place. This may be difficult but necessary. It may be necessary to improvise with material on hand. Fishing line or even floss could be bonded to splint teeth.

TRANSPORT SOLUTIONS

If you cannot reimplant the tooth, take it to the dentist as quickly as possible. Here is a quick rundown of what is good to use and what you should avoid. Unfortunately, there is not a good medium that is also commonly taken into the activity.

The Best Solutions

Hank's Balanced Salt Solution	While this is probably the best medium, it is mostly used in research application and not readily available. There are two companies that have such a kit (Save-A-Tooth and EMT), A tooth will last 24 hours in this solution.
Milk	Milk is everywhere and does an excellent job in maintaining a knocked-out tooth. Milk will help a tooth to last for about 6 hours. If you have a choice of milk products choose the one with the least amount of fat, in other words – skim milk.

Not Great Solutions

Salt water	This is great for irrigating but not good for tooth storage. It can be found in some First Aid Kits.

Saliva	Saliva will do in a pinch, but it has some limitations. There are enzymes and bacteria in our saliva that overtime will damage a tooth. This will protect a tooth for about 30 minutes.

Poor Solutions

Water	Water destroys the cells on the tooth. It can be used to rinse the tooth but isn't a good storage medium.
Sports Drinks	Sports drinks are not good and can damage a tooth.

Chapter 12: First Aid Kits

A frequent and relevant question asked is the type of first aid kit one should bring on a trip. It depends! This chapter covers helpful guidelines to assist us in choosing the appropriate items for that planned trip.

General Guidelines

General guidelines include asking yourself several questions to identify important aspects of your trip, such as:

- What type of activity or sport will your group engage in on this trip?
- How long is the trip going to be?
- How big is the group?
- Is this a group kit or your own individual kit?
- How far are you from help, and how easy will it be to evacuate if needed?
- What diseases are endemic to the area you're going to?
- What are the diseases and known conditions of the participants who are going?
- How far away from definitive care will you be on your trip?
    - For example, a backpacking trip of seven days over high, mountainous terrain far from civilization requires a medical kit that is lightweight and contains items that can treat emergencies related to high-altitude illness, cold exposure, trauma, geographically specific infectious diseases, and avalanches.
    - In contrast, a one-day river trip near a highway where weight is less of an issue and evacuation may be aided by a nearby vehicle would be entirely different. You would want items to treat emergencies related to water sports, cold exposure, and trauma.

Pre-Made Medical Kits

Premade medical kits are filled with items to cover general cuts and scrapes. They are not specific enough to cover a broad array of injuries. First aid kits should emphasize improvisation and multiple uses. For example, duct tape can be used for numerous issues rather than one specific issue. Take the time to become knowledgeable of the medical conditions of the participants in your group and recognize endemic or common diseases in the area. This will you can take the appropriate medicines, equipment, and most importantly, knowledge with you.

Containers

Containers for first aid kits will vary along with the contents. For example, a six-day trek over mountainous terrain far from cities will require a medical kit that is lightweight and contains items that can treat emergencies related to high-altitude illness, cold exposure, trauma, and geographically specific infectious diseases. A three-day river trip with four young, healthy people can be in a metal container, and can be more substantial.

Many commercial kits are available and carry essential supplies and equipment but do not contain prescription medications. Making your own kit is an option and can save money. Either way, you will need to adjust and bring items that pertain to the specific activities, participants, and location.

PAWS

While it's not practical to list each item that should go in every type of medical kit, some general items are helpful to have. The acronym PAWS is an excellent way to remember the category of items to include in a first aid kit.

P	Prevention / Procedures
A	Analgesics / Antibacterials / Antiseptics
W	Wound care
S	Survival

Prevention/Procedures

Prevention

These are items for the prevention of illness and potential problems:

- Water filter and water purification tablets
- Gloves
- Sunscreen/lip balm
- Sunglasses
- Blister prevention and treatment
- Insect repellant and barriers (netting / treated clothes)

Procedures

There are specific tools of your trade that may be used in a variety of situations:

- Wound care material: steri-strips, tape, gauze, Medi-honey, sutures, etc.
- Scissors
- Dental repair material: Cavit, eugenol, etc.
- Blood pressure cuff and stethoscope
- Flashlight
- Syringe
- Flexible splints
- Safety pins
- Needles
- Tweezers

Analgesics, Antibiotics, Anaphylaxis

There should be medicine available in each kit to cover both pain and potential infections. You should know what diseases are common in the area you're headed. As well, you should know the diseases and chronic conditions of the people traveling in your group.

Analgesics

Tylenol (also called Paracemetol and Acetaminophen) belongs to a class of drugs that relieves pain and lowers fevers. It does not prevent the clotting of blood, so it is safe to use in head injuries.

Aspirin prevents blood from clotting, which promotes bleeding. Therefore, it should not be used in any kind of head injury. It can be used to treat pain, fever, and inflammation. It should be given to any individual with signs and symptoms of angina.

Ibuprofen is used to relieve pain from various conditions such as headache, dental pain, menstrual cramps, muscle aches, or arthritis. It is also used to reduce fever and to relieve minor aches and pain due to the common cold or flu. Ibuprofen is a nonsteroidal anti-inflammatory drug (NSAID). It works by blocking your body's production of certain natural substances that cause inflammation. This effect helps to decrease swelling, pain, or fever.

Antibiotics

Topical antibiotics such as Bacitracin should be used in cases of superficial skin wounds. Application of topical antibiotics not only minimizes risk of infection but also allows the wound to remain moist, expediting the healing process.

Anaphylaxis

Anaphylaxis is one of the true medical emergencies that one may see in the wilderness. You should always be prepared to treat an anaphylactic patient and know if any members of your group have had an anaphylactic reaction in the past.

- EpiPen®
- antihistamines
- albuterol inhaler
- oral steroids

Wound Care

Regardless of the activity, abrasions and lacerations are among the most commonly experienced injuries. As a result, appropriate and adequate supplies for wound care are one of the essential parts of a medical kit. Having each person on the trip bring their own necessary wound supplies will help to ensure that enough wound care supplies are available. Below are different treatment options for primary wound care:

- Gloves
- Alcohol swabs, antiseptic wipes
- Irrigation supplies
- Antibiotic ointment
- Nonadherent gauze
- Steri-strips, benzoin
- Tape
- Ace bandages, tubular stretch bandages
- Band-aids
- Q-tips
- Scissors

Survival

The potential for the group members to be separated, and other worst-case scenarios need to be considered. Below is a list of items each group member should carry at all times.

- Map and compass
- Communication equipment: satellite phones
- Space blanket
- Knives

Expiration Dates

Check the medicines in your first aid kit often to see if their effectiveness has expired. The expiration date addresses medicine's highest effectiveness. It's a gauge of how close to its optimal efficiency a drug will function. That date is based on several factors, including how well the drug worked when it was tested and then sealed in its unopened container, and whether it was maintained at certain temperatures and moisture levels. Once the drug is opened, its expiration date isn't as useful to gauge its effectiveness. Typically, medicines will change into a brownish color when they lose effectiveness. However, EpiPens are airtight. Experts think the expiration date is a good gauge of the injectable drug's highest potency.

Cleaning a Wound

You don't need any special liquid to clean a wound. Water is very effective. Due to its ability to kill bacteria, people have used hydrogen peroxide, iodine, and alcohol in the past. However, plain water with vigorous irrigation works just as well. Using alcohol and full-strength hydrogen peroxide can damage vital tissues. If a wound is significantly contaminated, and a person is immune-compromised, diluted hydrogen peroxide can be used. Hibiclens is a gentle cleaner but has shown to be about the same as cleaning with plain water. Iodine, in the form of betadine, is an appropriate antimicrobial for possible use if a wound is highly contaminated. Betadine is an excellent choice for your kit.

Additional Items to Consider

Other items for potential inclusion depending on the nature of your trip and your group:

- Pocket medical reference on paper or electronic
- Finger and toenail clippers
- Alcohol-based hand sanitizer
- Digital thermometer (expanded range for hyper/hypothermia)
- Urine pregnancy test
- Stethoscope
- Pulse oximeter

Medications

- Oxymetazoline (nose spray for nose bleeds)
- Albuterol

Chapter 13: Biking Injuries

Biking is a popular sport in which people move at fast speeds. With high velocity comes an inherent risk for injury. But with the progression of technology of such sports, participants now feel more comfortable at higher speeds and maneuvering through more technical terrain. This trend in the progression of velocity and technicality pose a greater risk for injuries. The injuries which occur at higher speeds can often be more serious and laced with greater complications.

HOW TRAUMA HAPPENS

Bones are strong. The average healthy mid-shaft femur can support a force of around 12,000 pounds (53,000N) for fracturing. But even though they are so strong, bones will break because of the momentum involved. The mass, direction, and velocity of an object determines its momentum. For example, the bigger and faster an object is moving, the greater its momentum. A baseball flying through the air has a lot of momentum. When it hits a baseball bat, the force needed to change the baseball's direction (that is, its momentum) is huge and is done almost instantaneously. What this means is that the shorter the time of impact, the greater the force. In other words, what matters most is not so much how fast you are going when you stop, but how quickly, or abruptly, you stop.

To reduce the force of an impact, and thereby reduce the likelihood of a bone fracture, it is necessary to stop movement gradually. For the human body, a gradual stop is accomplished in a number of ways. When a person jumps, he or she instinctively creates a system of shock absorbers through the bending of toes, ankles, knees, and hips. This bending motion is essential as it increases the time it takes to stop, thus decreasing the overall force on the body. Crashing, while skiing or mountain biking, can have devastating consequences if that person stops quickly. Helmets are designed to deal with this problem.

The three ways in which bones can break are by forces of **tension**, **compression**, and **shearing**, with shearing and tension being the most common mechanisms through which the break occurs. Factures can often occur as a combination of the three force vectors. However, a shear fracture can be particularly dangerous because the fracture often results in a spiral break in which the bone is apt to puncturing through the skin, which can cause excessive bleeding along with the increased risk of infection. An example of a mechanism of injury that could cause such a spiral fracture is having one's foot locked into a specific position, then falling while twisting one's leg around the anchored foot.

Mountain Biking Injuries

There are nearly Nine million mountain bikers in the United States, and about that many in Europe. With such a growth of the sport, the technology surrounding mountain biking has grown as well. With the inventions of geared and full suspension bikes, along with larger tires and improved traction, participants are tempted to test the edge of speed and ruggedness, leading to an increase in injuries.

When people think of mountain bike injuries, they first think of fractures and dislocations. However, those types of injuries are low on the list, accounting for just a few of the total injuries. Most fractures and dislocation occur while mountain biking happen in the upper extremity, where they can be subject to high compressive forces. Injuries involving the distal radius, clavicle, scaphoid, and hamate are among the most common biking fractures, while common dislocations involve the shoulder.

Type of Cycling Injury	Percentage
Wound	35%
Bruise	25%
Strain	15%
Tendinitis	7%
Fracture	4%
Dislocation	3%

Body Part Percentage			
Neck	50%	Thighs	8%
Knees	42%	Elbows	5%
Groin	35%	Head	4%
Hand	31%	Hips	4%
Shoulders	31%	Ankles	4%
Back	30%	Achilles	4%
Feet	30%		

Wounds and bruises are the most common types of injuries people tend to sustain when biking. The most common parts of the body that are injured for which bikers seek medical care are the neck, knees, buttocks/groin, and upper extremities. Head injuries are common and can be very serious. High speed, technical terrain, and proximity of other bikers in races all increase the likelihood of head injuries. Thus, bikers should ALWAYS wear a helmet. Mountain bikers should always check with the manufacturer's recommendation when determining which type of helmet is correct for their given style of riding. As well, any time a fall involves an impact to the head, the integrity of the helmet should be checked to make sure it is still suitable for continued use. Helmets also have an expiration date. It is essential to replace the helmet once that date has passed. If a date is not listed, it is recommended to replace the helmet after five years of use.

Head Injuries

Head injuries from biking can result in a concussion. Clinical findings of a concussion depend on the severity and location of the injury. Look for CSF leaking from the ears or nose, as this may be a sign of a skull fracture and would constitute a medical emergency. The treatment of a concussion (Traumatic Brain Injury, or TBI) varies with the severity.

One should use extreme caution when treating a concussion in a wilderness setting. A general rule is if symptoms worsen and last longer than 15 minutes evacuate the patient. Patient evacuation may also be required if other symptoms present. Head injuries are often accompanied with neck and spinal cord injury. Thus, caution and proper evacuation technique should be used when moving a patient that has suffered a head injury to ensure that no neck and spinal cord damage is caused.

Common Signs of a Concussion	
Headache	Vertigo
Slurred speech	Nausea
Vomiting	Vacant stare
Delayed speech	Delayed motor
Disorientation	Confusion
Memory deficits	Loss of consciousness
Intense emotions	Dizziness

With a mild concussion, there is no specific treatment, and patients are usually monitored for 24 hours. More severe concussions can require intensive monitoring, care, and even surgery, depending on the extent of the injury. Any patient that has experienced loss of consciousness for any period of time following a head injury warrants urgent evaluation at a hospital. A cranial CT scan is often used to help the care team with the assessment.

Other Biking Injuries

Not all biking injuries are the result of a hard crash. Some injuries come from small micro-injuries over an extended period of time. For example, **Micro-Whiplash** syndrome is the result of tail vibrations on the neck. We all recognize that the human head is heavy. Placing a helmet on it makes it heavier, and then it vibrates up and down while riding. Micro-Whiplash syndrome, along with generalized neck and back pain, can be avoided by ensuring the bike is properly fitted and adjusted for the rider. Massaging, ice, stretching, and non-sedating pain relievers can help in the management of such injuries.

Saddle associated symptoms are also common among bike riders. Proper saddle height and positioning can help avoid many of the saddle associated symptoms and injuries. If the saddle height is too low, patellar tendonitis and quadriceps tendonitis can occur, often presenting with patellar pain, swelling, and joint tenderness. Thus, correcting the saddle height can aid in the alleviation of the pain. Conversely, if the saddle is positioned too high, saddle sores and chafing are common and can present as localized skin irritation. Keeping the area clean and dry, and wearing

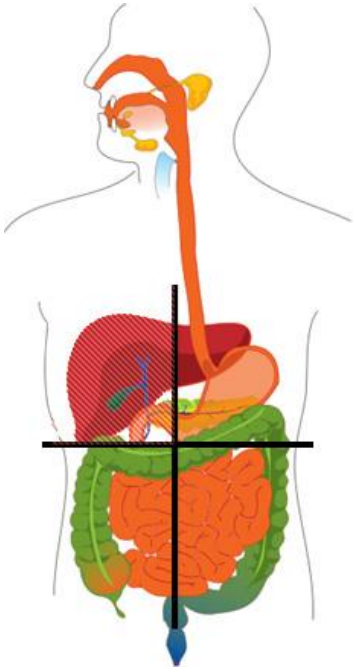
properly fitting shorts with chamois can help prevent and alleviate the symptoms associated with saddle sores and chaffing. Cycling shorts should always be thoroughly washed between uses.

Proper Bike Set Up to Reduce Medical Problems	
1. The rider should sit on the seat with their heel on the pedal. The height should then be adjusted so the leg on the pedal is straight. That is the proper seat height.	
2. When adjusting the seat angle for males, generally the level is slightly elevated in the back, and for women generally the seat angle is depressed in the back. Handlebar adjustments are usually necessary as well.	
3. The handlebar is generally positioned one to four inches below the level of the saddle, and the rider's nose should be directly over the handlebar. The proper adjustment should allow for about one third of the rider's body weight to be resting on the arms. However, the height and positioning of the handlebars can be adjusted during long rides to help with back and neck pain.	

Chapter 14: Abdominal and Chest Injuries

ABDOMINAL INJURIES

Most people experience abdominal discomfort or pain at some point in their lives. It is more common in the wilderness, in fact, it is one of the most reported back country problems. The pain can range in intensity from a mild ache to severe, disabling pain. While abdominal pain isn't normal, it isn't necessarily serious, and it often resolves itself. But certain forms of abdominal pain may indicate a serious health condition. To help evaluate abdominal pain, medicine divides the abdomen into four quadrants. Then you can know what organ is in that quadrant.



- The right upper quadrant contains the liver, right kidney, and the gall bladder.
- The left upper quadrant the spleen, stomach, and left kidney.
- The right lower quadrant contains the small intestine, the appendix, and the large intestine. In females the right lower quadrant also contains the right ovary.
- The left lower quadrant contains the small intestine, the large intestine, and in females, the left ovary.

Steps of an Abdominal Assessment

The first step in assessing abdominal pain is to see if there was trauma. If there was, determine the mechanism of injury (MOI). That will help to determine what kind of damage could have been done. Is the patient moving or staying still? If a patient is moving, then the sickness or illness is not as severe. Does the patient appear to be in a great deal of pain? Some injuries or illnesses cause more pain. Look at the patient's abdomen while they are lying down and look for symmetry as well normal shaping of the abdomen. Look for signs of trauma such as penetrating wounds and bruising. You should feel the abdomen by gently applying pressure in each of the four quadrants. Look for pain, tenderness, firmness, and rigid muscles. If these are present, the illness is more severe. Monitor vital signs to make sure there is no internal bleeding. If there is internal bleeding, the patient could go into shock. Always ask the patient if they have had blood in their urine, stool, or vomit as this can indicate internal bleeding.

Trauma

There are two types of abdominal trauma that need to be evaluated in an abdominal assessment; blunt and penetrating trauma.

Blunt trauma

This type of trauma usually occurs from a forceful blow to the abdomen. A skier, climber or biker could crash and land on the abdomen. First determine the mechanism of injury and events leading up to the injury. Ask the patient and/or bystanders to give you a description of the accident as this can give you an idea of what injury the patient could have sustained.

Perform a general abdominal assessment and be especially aware of bruising, as it is a sign of potentially significant injury. Be aware of the abdomen becoming firmer. This could be a sign of internal bleeding. See if the patient "guards" against pressure in any quadrant during the assessment. Guarding is when the patient has pain and does not want you to push on that area. This is not a good sign and raises concern for peritonitis. This is an inflammatory reaction within the abdomen due to bleeding, infection, or significant injury to the vital organs. The patient may assume the fetal position. These signs indicate that the patient needs to be taken to the hospital immediately.

Treatment of abdominal injuries

Follow the MARCH guidelines and if needed, began to evacuate the patient. Keep the patient still and warm and avoid giving the patient anything to eat or drink. If it is a long evacuation, patient may have small sips of a cool liquid. The reason for this is that they might need surgery and it is important to have an empty stomach during surgery. Do not give the patient alcohol

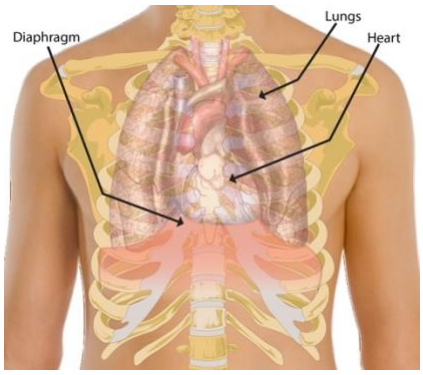
Penetrating Trauma

This very serious problem occurs when an object passes through or penetrates the abdomen. The Bleeding can be rapid and lethal. If your patient is in shock or going into shock, their only chance of survival depends on immediate evacuation. If patient is stable and does not go into shock, infection is a bigger concern. Treatment for this is supportive care as you do for blunt trauma. Evacuate the patient as soon as possible. Do NOT remove an impaled object as it may cause more damage if it is pulled out. Also, the object might be preventing bleeding from a damaged blood vessel that will start bleeding if the object is removed. Instead, place padding around the object so that it does not penetrate further or get accidently pulled out.

Chest Trauma

Anatomy of the Chest

The chest contains many vital organs including the heart and lungs, so an injury to the chest could be life threatening. The 12 ribs protect the chest. At the bottom or the chest is the all-important diaphragm muscle that is the main actor in breathing.



Common Chest Injuries

Chest injuries are common. The majority are not that serious. But this might be difficult to tell. When you examine someone for a chest injury there are several important points to remember. Here are some tips as you look at chest. Look for blood, bruising, or broken skin. Is it superficial or deep? Look at the rate and depth of breathing. If it is painful to breath, it might be more serious. Look at the ease of breathing - is the patient having more trouble breathing? Then this might make you want to evacuate sooner. A

patient that has point tenderness on the chest wall and is breathing much faster and is also having trouble breathing should make you aware of a more serious situation.

Fractured (broken) or injured rib

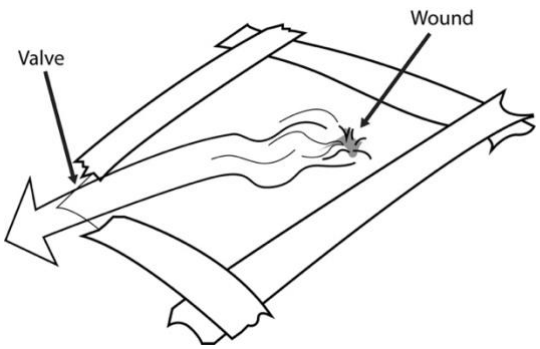
A broken rib is a very common chest injury in outdoor sports. It usually not life threatening. But a fractured rib can puncture a lung, so watch for this. Broken ribs are painful and will make breathing painful, but a punctured lung will make breathing very difficult.

Broken ribs are very painful and there is pain and tenderness at a very specific point over the injury site. We call this point tenderness. The patient's breathing is usually shallower because of the pain. Often, there will be bruising at the site of injury. Watch for signs of punctured lung. Patients with minor fractures need little done other than pain management. But more serious problems can ensue.

Pneumothorax

This injury happens when a lung is cut open or punctured and air moves in around the lungs, rather than in the lungs. The term literally this means "air in the chest." This can be very life threatening if air keeps leaking from the injured lung as it can collapse the lung completely. A patient will have sharp chest pain, great difficulty breathing, a rapid pulse, bruising at the site of injury, a rapid pulse and pale cool skin. The treatment for this is evacuation and get to help.

Sucking chest wound



This wound is associated with penetration of chest wall usually by some object. It makes hole in chest wall that makes a bubbling sound while breathing. Air moves in and sometimes out of hole. Air that moves into the hole collapses the lung. People with a sucking chest wound have difficulty breathing and you will hear a sucking sound or see a bubbling of air at the injury site. The treatment is to evacuate. You can make a one-way valve while in transport. Cover the hole with a glove or piece of plastic. Leave one corner free so that air can exit but not enter. It is important that air leave the chest, but that air does not enter the chest.

Hemothorax

Broken ribs can tear a vessel and cause blood to collect around the lung in the chest. This is called a hemothorax, 'blood in the chest.' This makes it difficult to breath and this condition required immediate evacuation. You can look for sharp chest pain, difficulty breathing, blood in the saliva and pale, cook skin.

Chapter 15: Lightning

Background

The power of lightning is immense. For every ten feet of ascension through the air, there is a 300-volt potential difference in electricity. This amounts to approximately 380,000 volts at the top of the atmosphere. This powerful "battery" tries to discharge through lightning strikes, striking the earth more than 100 times each second and 8 million times per day.

Worldwide, approximately 50,000 thunderstorms occur per day. The annual fatality count is not known, and estimates vary. The National Geographic estimates that about 2,000 people are killed worldwide by lightning.

TYPES OF ISSUES ENCOUNTERED WITH LIGHTNING

Thunderbolts often rain down with great fervor in tropical central Africa. The weather patterns in Africa bring in warm air from the Atlantic Ocean that collides with mountains, producing many thunderstorms and lightning year-round. The North and South Poles, however, rarely experience thunderstorms and, therefore, have almost no lightning. In the United States, lightning researchers estimate that 22 million lightning flashes strike the ground each year. The most lightning prone region is Florida.

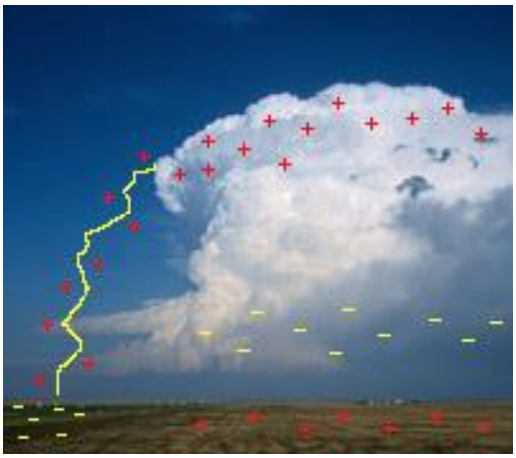
Location of Lightning Deaths	**Percentage**
Open fields, sport parks, in/on water	54%
Under trees	23%
On beaches	12%
Working on farm equipment	7%
Other	
Standing near open windows, riding a bike	4%

The Physics of Lightning

As lightning connects from the clouds to the ground, the second stroke of lightning will return from the ground to the clouds (upward streamer) following the same channel as the first strike. The heat from the electricity of this return stroke raises the temperature of the surrounding air to around 27,000 C° (48,632 F°). The heated air is compressed, raising the air from 10 to 100 times the normal atmospheric pressure. The compressed air explodes outward, forming a shock wave of compressed particles in every direction. Like an explosion, the rapidly expanding waves of compressed air create a loud, booming burst of noise that we call thunder. If a person is near this wave, significant trauma is likely.

Most experts define ***four*** primary types of lightning:

Not all lightning forms in the negatively charged (the lower area) of the thunderstorm cloud. Some lightning originates at the top of the thunderstorm, the area carrying a large positive charge. Lightning from this area is called positive lightning. Positive lightning is particularly dangerous because it frequently strikes away from the rain core, usually ahead of the thunderstorm. It can strike as far as 5 or 10 miles (8 or 16 kilometers) from the storm in areas that most people do not consider to be a lightning-risk area. Therefore, most lightning strikes happen prior to a storm. So, get to shelter before a storm strikes.



Types of Injuries from Lightning

Injury from lightning can occur by several mechanisms:

***Ground current**:* When a lightning strike hits the ground, the electricity does not disappear into the earth. It spreads out in the ground as a potentially deadly current with voltages decreasing from the point of the strike. If a person happens to be standing in a place affected by a ground current, it can travel up one leg, through the body (and potentially stopping the heart and breathing), and then down the other leg.

***Side splash**:* This refers to lightning that jumps from an object to a person, or even from one person to another. Side splash occurs because lightning follows the path with the least electrical current resistance to the ground.

***Upward streamer**:* The third most common cause of lightning deaths and injuries are the upward leaders, also called "streamers," that rise from high objects and the ground just prior to lightning strikes.

***Direct strike**:* Lightning that hits someone directly from the sky is called a direct strike. This rarely happens.

***Contact**:* It is well known that lightning when it strikes a building can get into the wiring or the water pipes and kill someone talking on a phone with a cord or someone taking a shower. This does happen, but such "contact strikes" are as rare as direct strikes.

***Blunt Trauma**:* This occurs from the impact of the concussive force of the strike itself or from being thrown due to the extreme nature of the muscular contraction from the electrical charge. Blunt Trauma is responsible for most of the lightning injuries.

Deaths Due to Lightning by Type	
Ground current	50-55%
Side splash	30-35%
Upward streamer	10-15%
Contact	3-5%
Direct strike	3-5%

Treatment for Lightning Strikes

The most common cause of death in lightning strikes is a cardiopulmonary arrest. Persons who have been hit by lightning and are in respiratory arrest may need only artificial respiration to prevent the secondary hypoxic arrest. Almost all persons hit by lightning who do not have cardiac and/or respiratory arrest at the scene survive, even though they may be seriously injured. Resuscitation for persons struck by lightning must be initiated immediately.

Pathophysiology Effects from a Lightning Strike

In addition to flowing on the outside of the body (flashover), the electrical current may also enter the body through the cranial orifices (eyes, ears, nose, and mouth) and flow through the body. This may explain why some patients have certain injuries such as ocular and/or ear, and others do not. Although the current flow occurs over a very short period, the amount of current is huge with an amazing amount of energy.

The identification of a victim of a lightning strike is easy if the strike was witnessed. However, there may be situations where it is unclear. Lightning injuries must be suspected when in the outdoors and in weather conditions conducive to lightning. Always follow the MARCH protocol. Call for evacuation to the closest medical facility. Any patient who is a victim of a lightning strike should be evacuated as soon as possible.

Reduce Risk

"When thunder roars go indoors." If you hear thunder, then you should seek shelter. There is no safe place outdoors. There is little you can do to substantially reduce your risk if you are outside in a thunderstorm. The only completely safe action is to get inside a safe building or vehicle. If you absolutely cannot get to safety, you can *slightly* lessen the threat of being struck with the following tips. But, don't be deceived--you are **NOT** safe outside. If you are outside, and thunderstorm develops, these tips can ***slightly*** lessen the threat of being struck by lightning:

- Avoid open fields, the top of a hill, or a ridge top.
- Crouched positions offer little protection.
- Stay away from tall, isolated trees or other tall objects.
- If you are in a forest, stay near a lower stand of trees.
- If you are in a group, spread out to avoid the current traveling between group members.
- If you are camping in an open area, set up camp in a valley, ravine, or other low areas.
- Remember, a tent offers NO protection from lightning.
- Stay away from water, wet items such as ropes, and metal objects such as fences and poles. Water and metal do not attract lightning, but they are excellent conductors of electricity. The current from a lightning flash will easily travel for long distances.

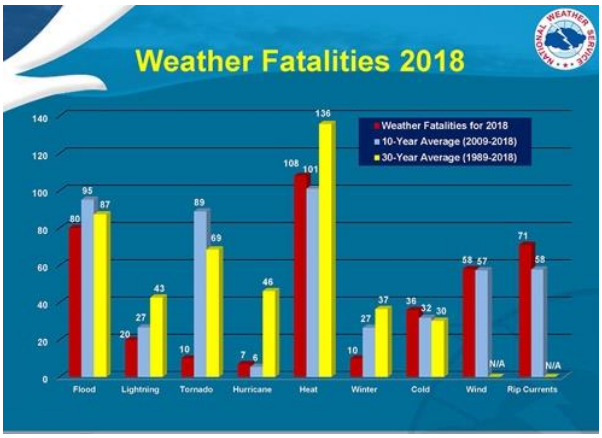
A house or other substantial building offers the best protection from lightning. However, people should stay away from windows and doors, and avoid contact with anything that conducts electricity, such as landline telephones.

Cars provide good protection. Lightning flows around the outside of a car, and the majority of the current flows from the car's metal cage into the ground below. It is not the rubber tires that protect you.

The best rule is that if you see lightning or hear thunder go indoors. The threat of lightning continues for a much longer period than most people realize. Wait at least 30 minutes after the last clap of thunder before leaving shelter. And remember, don't be fooled by sunshine or blue sky.

Chapter 16: Heat Related Illnesses

Heat-Related illnesses are the most common cause of weather-related deaths in outdoor medicine. The 30-year average is well above all other outdoor-related weather deaths.



To understand heat illnesses, it is essential to understand what heat is and how the body handles heat. The normal human body temperature is averaged around 98.6°F (37°C). This fact is critical in understanding heat-related illnesses.

Another important fact to know is that the body is only approximately 10-25% efficient in processing the food that we eat into energy. All the unused energy is given off as heat. If the body can't divest that excess heat, the human core temperature could rise above the average temperature of 98.6oF (37oC). That rise is known as hyperthermia.

THE SCIENCE BEHIND BODY HEAT LOSS

Body heat is given off three ways:

1. Radiation occurs whenever the air temperature surrounding the body is less than 20°C (68°F). Heat loss by radiation is constantly occurring during the winter months when temperatures fall significantly below this threshold.
2. Conduction occurs when the body is in contact with any object that is cooler than the body. Heat loss by conduction can be a significant issue when in contact with snow, ice, or cold water.
3. Convection occurs when the heat is transferred away from the body through circulating air currents. This is like sitting in front of a fan, and it's why we feel cooler when the wind is blowing. Heat loss by convection can be significant during winter storms with exposure to the wind.

Evaporation is the process that occurs when you sweat. It utilizes all three methods of heat transfer and is not a separate method. This same process can occur when wearing wet clothes.

It is crucial to keep in mind the different ways that heat is lost from the body to prevent heat-related illness. Heat moves from hot temperatures to cool temperatures. No heat can be transferred when two objects are at the same temperature. When air temperatures rise, radiation no longer works, and the body relies on convection and conduction. Water (sweat) is poured onto the skin to facilitate heat loss by wind and conduction. When the air temperature is the same as the body temperature, then no heat can be lost from the body and the body temperature will start to

rise dramatically. **Hyperthermia** is the name of the illness that happens when the body cannot transfer heat, or at least not transfer heat fast enough.

Medical Conditions

Anything that prevents heat from being transferred from the body will increase the risk of developing hyperthermia. Some medical conditions prevent heat from leaving the body. Diseases that cause water loss, such as dehydration, vomiting, and diarrhea, will promote heat retention. Obesity is an excellent insulator and will cause the body to hold onto heat.

Environmental Factors

There are environmental factors that will increase the risk of developing hyperthermia. Anything that will raise the body temperature or raise the temperature of the environment around the body will to this. These would include exercising in a hot climate, lack of air conditioning or proper ventilation, inappropriate clothing, a decreased fluid intake being inside a hot tent, or being inside an auto in the sun or sitting in a hot tub.

Physiological Response to Heat Stress

The first, and most apparent, response to heat is a person's skin will turn red. This is because veins dilate to increase blood flow that causes the body to lose heat faster. Simultaneously, the core vessels will constrict to shunt heat away from the core to the skin. The heart responds by increasing heart rate and cardiac output. The net effect is increased blood flow to the skin, which facilitates heat transfer to the environment. Sweat glands are activated to increase the amount of evaporative heat loss.

Clinical Manifestation

There are important clinical manifestations of heat injury that occur on a spectrum of severity, ranging from minor to life-threatening:

Heat Cramps

Heat cramps are caused by a loss of salt in the body. This happens when the lost fluid is replaced by a fluid solution without enough salt. Cramps typically involve only one muscle group (usually the calves) but can occur in any muscle. Cramps are brief, intermittent, and involuntary contractions of the muscle. They hurt. This happens after a lot of activity in a hot environment and drinking a liquid without salt.

The key to treatment is to replace the lost salt. This is done by eating salty snacks and electrolyte drinks. If needed, you can place ¼ to ½ teaspoon of salt in a quart of water. If the person does not respond to this treatment, then evacuation might be required. Drinking plain water will worsen the situation and stretching the muscles will not address the underlying cause of cramps due to low salt. There is a misconception that a lack of potassium causes heat cramps. This is not the case. It is sodium (salt is sodium chloride) that is involved in skeletal muscle contraction.

Heat Syncope (fainting)

Heat syncope results from dehydration, dilation of blood vessels in a hot environment, and pooling of blood in the legs while standing. Patients are typically not profoundly dehydrated or hyperthermic. Heat syncope usually affects two populations: the **non-acclimatized** and the **geriatric** demographic.

Heat syncope usually afflicts standing, stationary individuals. Blood vessels are dilated to facilitate heat transfer to the environment. The combined effect of these factors leads to less blood coming from the heart and therefore less blood going to the brain. That can cause fainting.

People will usually have lightheadedness, dizziness, restlessness, nausea, and will experience yawning. There may be some jerking of the muscles associated with this.

For initial treatment, lie the patient flat and elevate their feet. People will get better once the patient lies down. And blood back to the brain. Those who maintain proper hydration are less likely to experience heat syncope.

Heat Exhaustion

Heat Exhaustion is a form of heat illness that represents significant water and salt loss. Symptoms of heat exhaustion include weakness**,** fatigue, nausea with or without vomiting, headache, and thirst.

Headache is a common symptom of heat exhaustion and is often accompanied by dehydration. Headache is the first sign of dehydration. Although heat exhaustion isn't as severe as heatstroke, it isn't something to be taken lightly. Without proper intervention, heat exhaustion can progress to heat stroke, which can damage the brain and other vital organs and even cause death. Other signs of heat exhaustion include fast heart and fast breathing rate, profuse sweating, orthostatic hypotension, elevated body temperature. and an altered mental status.

Treatment for heat exhaustion is give the patient water and electrolytes. Also:

- Stop all immediate activities.
- Move the patient from direct sunlight to a cool, shaded area.
- Loosen tight clothing.
- Give them water as quickly as possible without causing them to vomit.
- Increase heat loss by using the three methods of heat transfer: convection, conduction, and radiation.

- Make the patient “sopping wet” with comfortable room temperature water and fan the patient with anything that increases air movement and thus the evaporation of the water.
- Get them out of the sun and ‘fan’ them to increase convective heat loss.

Heat Stroke

Heatstroke is a true medical emergency and is classically defined as severe hyperthermia, with a temperature > 40° C [104° F], neurological problems, and a loss of sweating.

Neurological abnormalities are the best indicators of significant heat injury. These include:

- Stumbling gait
- Irritability, confusion, combativeness, bizarre behavior, seizures, hallucinations, and fainting

- The victim may lapse into a coma.

Treatment includes active cooling. Remove all restrictive clothing and utilizes cold-water immersion. This has been shown to reduce the body temperature twice as fast as evaporative cooling and has been shown to be safe in young, healthy heatstroke victims. This cooling could include a lake, pool, river, or stream. If you can't immerse them, pour cool/cold water on them. The victim's skin should be kept "sopping wet" and continuously fanned to promote evaporation. If available, ice packs and cold compresses may be placed in an area where large arteries run, such as the groin, arm pit, and neck. The initial treatment goal is to drop the body temperature as rapidly as possible.

Evacuation Guidelines

Any patient with a loss of consciousness, more than one episode of syncope, or signs of heatstroke, should be evacuated. A patient with severe heat cramps that do not respond to salt solutions, or someone who has multiple cramps, should also be considered for evacuation depending on the situation. Patients showing signs of heatstroke should be evacuated. Patients with heat exhaustion do not need to be evacuated as long as they can be treated in the field, they respond well to treatment, and they do not develop signs of heatstroke.

1		Good
2		Good
3		Fair
4		Dehydrated
5		Dehydrated
6		Very dehydrated
7		Severe dehydration

Prevention

The most significant risk of developing heat-related injuries is dehydration. Most of the risk factors involve dehydration. Previous episodes of heat exhaustion or heat stroke are also risk factors for developing a heat-related illness. High humidity inhibits the body's ability to lose heat through sweating and evaporation. Increased physical exertion, wearing heavy clothing that does not 'breathe,' lack of acclimatization, and not drinking enough water will all increase the risk of heat illness.

Rehydration should include a combination of water and electrolytes to maintain proper balance in the body. Too much water in the absence of electrolytes can lead to dangerously low levels of sodium, causing neurological damage and dysfunction.

Consistently clear urine is a reliable way to gauge hydration status. It is, best to assess one's hydration status based on the color of the urine. The onset of a headache is often the beginning of heat illness, and the goal of hydration is to avoid heat illness altogether. It is best to catch signs of dehydration well before the onset of a headache and heat illness.

Preventative measures for heat-related illness include wearing loose-fitting clothing, which helps to dissipate heat by promoting airflow over the body and facilitates evaporative cooling. This is the most efficient way to cool the body. Dark-colored clothing absorbs light and increases body temperature and should be avoided. Tight-fitting clothing is restrictive and prevents efficient airflow that is needed to create evaporation. Dousing often in cooling fluids or misting sprays can be another effective method of cooling.

Acclimatization also decreases the incidence of heat injuries and improves performance in hot environments. Heat acclimation or acclimatization plays a large part in the body's physical responses and overall ability to cope with heat exposure. Adults should gradually increase the time and intensity of activity in a hot environment over 7-10 days. Children and the elderly require 10-14 days to maximize acclimatization. Acclimatization can be done using saunas and steam rooms 7-10 days in advance of a trip.

Chapter 17: Cold-Related Illnesses

Hypothermia (cold illness) is most often associated with prolonged exposure to cold winter activities such as skiing, snowshoeing, and mountaineering or sports activities in the rain or cold temperature. It can also result from immersion accidents. But hypothermia can also be a danger during the hot summer months. Both the elderly and young babies have a challenging time with thermoregulation and are susceptible to becoming hypothermic due to elevated levels of air conditioning indoors. As well, windy days and wet, cold weather in the summer are risk factors for hypothermia, as is cold water even on a hot day. It is crucial to be mindful of this and to be aware of the signs and symptoms of hypothermia year-round.

It is important first to understand how the body loses heat. Heat is lost from the body through radiation, conduction and convection, and evaporation. It is important to remember there is no such thing as "cold." If something feels cold, it just has less heat. Heat moves or is transferred, from a warmer object to a colder object. The human body is continuously transferring a significant amount of heat to the cooler environment around it. Our body temperature is about 37° C (98.6° F), and we are rarely in temperatures that are hotter than we are.

HYPOTHERMIA AND HEAT LOSS

Three Methods for Heat Loss

1. Radiation occurs whenever the air temperature surrounding the body is less than 20°C (68°F). Heat loss by radiation is constantly occurring during the winter months when temperatures fall significantly below this threshold.
2. Conduction occurs when the body is in contact with any object that is cooler than we are. Heat loss by conduction can be a major issue when in contact with snow and ice.
3. Convection occurs when heat is transferred away from the body through circulating air currents. This is like sitting in front of a fan. This is why we feel cooler when the wind is blowing. Heat loss by convection can be significant during winter storms when exposed to the wind.

Evaporation is the process that occurs when you sweat. It utilizes all three methods of heat transfer and is not a separate method. This same process can occur when wearing wet clothes.

It is crucial to keep in mind the different ways that heat is lost from the body to prevent cold-related injuries, especially when out in the field. When searching for possible places for shelter, look for areas that are dry (conduction), insulated (radiation), out of the wind (convection), and no direct contact with ice and snow (conduction). This will limit the effects of evaporation, radiation, conduction, and convection.

The single most important aspect of hypothermia and other cold-related injuries prevention is adequate preparation. By being aware of changing weather conditions, bringing the proper gear, having a backup plan in case of an emergency, and being aware that cold-related injuries can occur in above-sub-zero temperatures, you are significantly lowering your chances of developing

hypothermia or other cold related injuries in the wilderness. Remember, cold-related injuries are much easier to ***prevent*** than they are to ***treat*** in the wilderness. Therefore, preparation and prevention are crucial.

Physiology of Hypothermia

The healthy body maintains a core temperature of 37°C +/- .5°C (98.6°). When the body begins to lose heat, shivering utilizes muscle activity to produce heat. Additionally, because most of the heat loss from the body occurs at the skin, the narrowing of blood vessels, also called vasoconstriction, prevents blood from reaching the skin. Therefore, the blood is not cooled as fast. As the body continues to lose heat, some organs, including the heart and lungs, begin to shut down. This is the body's last attempt to conserve heat and protect the brain.

A core body temperature of 35°C (95°F) or less defines hypothermia. The perception of temperature is closely linked to skin temperature rather than core temperature. For example, shivering may begin when the core temperature is 37 degrees Celsius (98.6°F). Hypothermia compromises heart function, leading to decreased output and fatal heart rhythms. The body must expend energy to shiver and to vasoconstrict the vessels. Ultimately, the depletion of energy stores leads to a loss of temperature equilibrium and the dilation of blood vessels. When this occurs, blood rushes back to the skin, and the individual feels warm. This may lead to the phenomenon known as "paradoxical undressing," whereby hypothermic individuals take off their clothes despite being cold.

Classifications of Hypothermia

Mild hypothermia is defined by a core temperature ranging from 32° to 35° C (89.6-95°F). The cold temperature defense mechanisms are still working and will cause the patient to start to turn blue and create a sensation of cold. The victim may start to shiver uncontrollably. Their mental status may become impaired with varying degrees of confusion and disorientation. Urinary frequency is common due to increased renal perfusion caused by elevated cardiac output and peripheral vasoconstriction, increasing blood flow to the kidneys. The victim may have an elevation in their vital signs.

Moderate hypothermia is defined by a core temperature ranging from 28° to 32°C (82.4-89°F). The victim's blood pressure, heart rate, and respiratory rate will decrease. As well, victims are more confused, their pupils will dilate, and their muscles will tighten. Thermoregulation is less effective (shivering), and rewarming is required. Shivering ceases at and below a core temperature of 30°C (86°F).

Severe hypothermia is defined as a core temperature between 24°C and 28°C (75.2-82.4°F). At this temperature, the victim will go into a deep coma with dilated pupils and muscular rigidity. Their blood pressure will be barely detectable, and their pulse may be as low as 10 to 20 beats per minute. Life-threatening heart beats are easily induced in these victims with even with the slightest of movements.

Profound hypothermia is when the core temperature falls below 24°C (75.2°F). There is little chance of survival at this point.

Modified Swiss Staging System

Stage	Clinical Symptoms	Typical Core Temperature
Mild	Conscious, shivering	32 to 35°C (92 to 95˚F)
Moderate	Impaired consciousness, not shivering	28 to 32°C (82 to 90˚F)
Severe	Unconscious, not shivering, vital signs present	240C to 28°C (77 to 82˚F)
Profound	No vital signs	< 24°C (75˚F)

Treatment of Hypothermia

The most important consideration in treating hypothermia in the field is preventing further heat loss. To accomplish this, remove the victim from the situation that caused him or her to become cold. Transport them to a shelter, removing wet clothing, and providing an insulating barrier around the patient. Keep them out of the wind.

Remember that the three methods of heat loss are from **radiation**, **conduction**, and **convection**. Prevent conductive heat loss with the use of insulating materials, including clothes, blankets, sleeping bags, and sleeping pads. Evaporative heat loss is addressed through the application of a vapor barrier, such as bubble wrap or a tarp. Anything that can be done to help rewarm the victim will be helpful, such as sitting by a fire, and carbohydrate-rich food or beverages. Importantly, avoid alcoholic beverages, which may exacerbate hypothermia by causing peripheral vasodilatation. Handle the patient gently, as excessive physical stimulation may precipitate fatal heart beats. In a rescue situation, it is important to remember the premise that "no one is dead until they are warm and dead."

For the treatment of <u>mild hypothermia,</u> you need to remove the victim from the elements and shelter them to avoid further heat loss. The individual should completely undress, then dress in dry clothes and be wrapped in blankets, taking special care to cover the head and neck to avoid heat loss from radiation. Carbohydrate-rich beverages, and foods may be helpful in both rewarming and meeting the increased caloric requirement for shivering, taking care to avoid alcohol. Limited exercise may generate some heat. However, this is not advised in moderate and severe hypothermia. Do not use baths or water immersion to treat even mild hypothermia. Body-to-body rewarming may improve the comfort of the mildly hypothermic patient because of decreased shivering but should not be done at the expense of delayed evacuation. Those suffering from mild hypothermia will have a favorable outcome as long as the cooling process is halted.

For the treatment of <u>moderate hypothermia</u>, the individual has exhausted their capacity to achieve rewarming by shivering, and active rewarming must be performed in order to get their body temperature to a near-normal level. You should attempt rewarming in the field with items such as large electric heat pads or blankets, and warm water bottles. The areas of the human body with the highest potential for conductive heat loss include the axillae, chest, and back.

For severe hypothermia**,** treatment is a true medical emergency that requires aggressive treatment and prompt medical management with evacuation for initiation of active core rewarming. These victims have no ability to reheat themselves at this stage. It is important to consider that victims suffering from this condition may exhibit altered mental status if they are still conscious. Care must be taken in handling victims suffering from this condition as extremely cold core temperatures can cause cardiac irritability. Even the slightest jolt may cause these individuals to degenerate into life-threatening dysrhythmia, such as ventricular fibrillation. This becomes extremely important in determining when CPR needs to be initiated. Victims with severe hypothermia may have faint pulses, severe bradycardia, and appear to be dead. So, it is important to assess vital signs over a minimum of 60 seconds.

If the patient has vital signs, even if very slow, CPR should NOT be performed. After determining that the patient has no vital signs, CPR (including breathing) should be initiated.

Evacuation Guidelines

Evacuation guidelines indicate that all victims with moderate to severe hypothermia must be evacuated from the wilderness. They have lost the capacity to rewarm themselves and it is extremely difficult to actively rewarm these victims in the wilderness setting. Victims with mild hypothermia may not require evacuation if they are able to warm themselves, and they do not develop any sequelae from the episode. When transporting hypothermic patients, handle the individual very gently to prevent degeneration into a fatal rhythm, and keep him or her horizontal to prevent exacerbating potential hypotension.

The single, most important aspect of hypothermia treatment is adequate **prevention** through preparation. Hypothermia is the "killer of the unprepared," but even experienced and prepared outdoors, people have succumbed to this ailment. You should be aware of weather conditions and bring appropriate gear. Have a contingency plan in case a bad situation happens.

Chapter 18: Bites and Stings

Overall, the general management of a bite or sting is the same as a typical wound. You should conduct a primary and secondary survey to ensure the scene is safe and the victim is stable Infection is common with animal bites. Bites are tetanus-prone wounds, so ensure that your tetanus immunization is up to date.

TYPES OF BITES AND STINGS

Bears

North American bears include the brown bear (Grizzly and Kodiak), American black bear, and polar bears. These bears are fast (running up to 40 mph), large (140 to 1,400 pounds), and have a keen sense of smell and hearing. A bear's sight is equal or less in acuity to that of a human. Bear attacks are more common in the summer months when wilderness visitors are more numerous, and bears are not hibernating.

There are many suggestions for preventing attacks. Bikers and explorers should make noise. There are hand clickers that can be used, but even talking will allow a bear to hear and move away from you. However, be extra cautious in environments where a bear may not be able to hear you, such as near loud streams and in uneven terrain. Bikers should avoid common bear areas, such as streams with spawning fish, berry groves, and carcasses. If spotted by a bear, allow it to see you as a human by stepping forward to allow the bear a full view of you.

Pepper spray can be useful if discharged directly at a charging bear's head when it is within thirty feet. Pepper spray is not to be used as a repellent. It is a specific aerosol bear deterrent. Its active ingredients are capsaicin. This is extremely irritating to the bear's lungs, and it will immediately retreat. Guns are ill advised as the bullet will often miss or injure the bear, which will only enrage it.

If you encounter a brown bear, it will likely think you are attacking it. Therefore, you should do the following:

- Do not look into the bear's eyes, as this is interpreted by the bear as a sign of aggression.
- Do not make any sudden movements and do not run.
- Do not act aggressively toward the bear. However, you should stand your ground, but be submissive.
- If attacked, quickly get into the fetal position with your neck protected, because attacking bears are "head oriented". If rolled onto your back, protect your face with your elbows.

If you encounter a black bear, it is likely attacking you for food. Take the following actions:

- Yell and throw things and act aggressively toward the bear. Black bears usually flee in response to aggression.

- If the black bear attacks, then you should continue to fight and kick against the bear as much as possible. The reason for this is that the bear is attacking you because he wants to eat you and has lost the fear of humans.

After a bear attack, the possibility of significant injury is high, so all bear attack victims should be considered blunt trauma victims and, therefore, candidates for immediate evacuation.

Mountain Lions

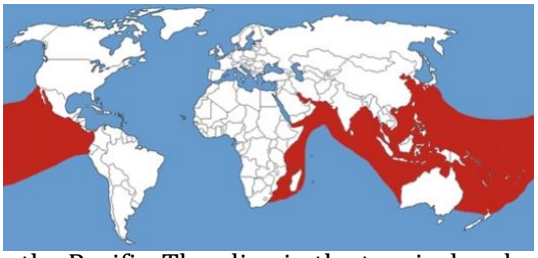
The mountain lion, also known as the cougar, puma, panther, or catamount, is a large cat species native to the Americas. The historic range of the mountain lion includes almost all North and South America. They are coming into contact with humans with increasing frequency. They hunt by stealth, then pounce and break the victim's neck. They can be scared off by using aggressive behavior toward the animal, although this is less likely in the case of a mountain lion with a cub or one that is wounded. When confronted, face it, talk very loudly, and make yourself appear as a threat. Do not turn and run away from a mountain lion; they can run much faster and will chase you. If you have small children with you, pick them up, as they preferentially attack children. If a mountain lions attacks, fight back using anything available, including rocks, sticks, and bare fists. Be aware that they are close to urban areas as well, and attacks happen on trails used by bikers and hikers.

Snakes

The easiest way to classify snakes for medicine is by three families: Vipers, Round Snakes, and Sea Snakes.

		
Viper (rattle snake)	Round Snake (coral snake)	Sea Snake

Family	Classification ?	Description	Types
Viper	Cortalidae	Triangular head	Cottonmouths, rattlesnakes, copperheads, puff adder, gaboon
Round snakes	Elapidae	Round head	Coral, mambas, kraits
Sea snakes	Sub class of Elapidae	Found in oceans	



Snakes are found everywhere on land except the North and South Poles, the islands of New Zealand, and the islands of Hawaii. They are found in fewer numbers in places like Europe and Scandinavia. Snakes can live near the tops of mountains (Timber rattlesnake) or in grassy fields. Sea snakes are found in warm coastal waters from the Indian Ocean to the Pacific. They live in the tropical and warm regions, but not in the Atlantic Ocean, or the North American coast above the Gulf of

California. All sea snakes are deadly. Knowing the location of snakes and whether or not they are venomous to humans is important medically.

All snakes have specialized salivary glands that produce saliva that dissolves animal and human tissue. This is how they digest and eat their prey. However, about 15% of snakes have taken it further and developed venomous saliva that will kill their prey.

North American Snakes

North America has two native types of poisonous snakes. These are the Pit Vipers and the Coral snakes. The overwhelming majority (over 99%) of envenomation are from pit vipers. Annually, there are approximately 9,000 snake bites reported to U.S.A. Poison Control Centers. This may be under the actual number as many victims do not present, and there is no mandatory reporting. Approximately 2,000 people are treated annually as envenomation victims. From 1991 to 2001, there were 57 deaths attributed to snake envenomation in the U.S.

Pit Vipers

In North America, pit vipers are found in 47 of the 48 contiguous states except for Maine. The pit viper includes multiple species of rattlesnake, copperhead, and the cottonmouth (water moccasin). Pit vipers have specific recognizable anatomy including a triangle-shaped head, catlike, elliptical pupils, and heat-sensing pits between eyes and nose. Venom is dispersed from ducts in the fangs. About 25% of pit viper bites are "dry" or without injection of venom. Pit viper venom dissolves tissue, blood and nerve tissues. Therefore, they are very painful bites. Each snake has a varying potency of its venom based on multiple factors:

- Age of the snake
- Location of bite
- Size, age, and health of victim
- Depth of the bite
- Amount of venom injected
- Emotional state of snake
- Time of year that the bite occurs

These are painful bites with patients reporting severe burning at the bite site within minutes. Soft tissue will swell outward from the bite, and blood oozing from the bite is common. Bruising occurs as blood cells 'dissolve' and patients will feel weak. It is common to have various tastes occur in the mouth. Tingling will happen in the mouth, face, and extremities as fasciculations occurs while nerve tissues are destroyed.

The treatment of viper bites is simple. Evacuate all victims of bites from venomous snakes. There is no other treatment.

Coral snake

Coral snakes in North America have a very distinct color banding pattern. The bite of the coral snake typically involves a finger, toe, or fold of skin, because the coral snake is unable to open its jaws wide. These are not painful bites. There is minimal or no local swelling. It may be difficult to see the bite(s). Fang marks may be difficult to identify. Symptoms will often progress rapidly once they appear. These are nausea and vomiting, headache, abdominal pain. The treatment of a Coral

snake bite is evacuation for definitive care. It is a venomous snake bite and needs to be treated urgently. Evacuate without any other treatment.

Snake bite treatment has been plagued over the years with poor suggestions and very bad information that has been adopted as fact. Here a list of things to avoid because they are either harmful to the victim or do not work:

- The Sawyer Extractor™ has been touted to remove venom if applied within two to three minutes of the bite. However, there is no evidence to support this at all. Therefore, the Extractor is NOT recommended.
- In North America, do NOT use pressure immobilization. Simple immobilization is fine, but it has no proven benefit.
- Electric shock therapy should NOT be used in any snakebite and can be harmful.
- Local application of ice is contraindicated, as it may worsen necrosis.
- Do NOT attempt to try to catch or kill the offending snake. Therapeutic recommendations for North American snake envenomation are the same for all species and attempts to capture a snake may result in additional envenomation and potentially another victim. Even a dead snake's jaw can clamp down and envenomate a human.
- Do NOT use aspirin, as it may worsen bleeding.
- Do NOT cut and suck on the wound, as this maneuver may infect the wound with oral bacteria and is ineffective at removing venom.
- Do NOT use a tight-fitting tourniquet that restricts arterial or venous flow.

Mosquitoes

No other insect carries more disease or is responsible for more deaths on the planet than the mosquito. According to the World Health Organization in 2015 about 3.2 billion people, nearly half of the world's population, are at risk of malaria.

A mosquito uses the sharp tip of its straw-like mouth (proboscis) to pierce a person's skin. It locates the blood vessel and draws blood up through its mouth. As it does this, it injects saliva that contains an anticoagulant. If the blood were to clot around the mosquito's mouth, it would stick in the skin. With the saliva comes the disease. Sometimes more than one disease will be injected into the human. So, every time an infected mosquito inserts its proboscis into the skin, that person is infected with the disease instantaneously, 100% of the time. Thus, the only way of being infected is to avoid being bitten.

Suggestions for avoiding a mosquito bite:

- Mosquitoes are most active at dusk, so staying indoors during that time will decrease contact.
- Choose a campsite that is above and away from standing water.
- Wear clothing with long sleeves and long socks with pants tucked into socks or boots.
- Wear clothing that is tightly woven, such as nylon, and is loose fitting so that a mosquito cannot bite through the clothing.
- Permethrin is a naturally occurring compound with insecticidal and some repellant properties that will remain on clothing for weeks when properly applied.

The United States Food and Drug Administration has approved three repellants for use in repelling insects and other insects. They are DEET, Picaridin, and Lemon Oil Eucalyptus. These are applied to uncovered skin.

DEET is the gold standard for insect repellents. It is sold in formulations of 5% to 35%. Use formulations of 10% or less in children and avoid use altogether in infants under six months of age. You should use formulations of 30% to 35% in malaria areas on adults.

Picaridin 20% concentration has been shown to have a similar efficacy as 20% DEET for up to eight hours. Picaridin 7% has similar efficacy to 10% DEET. Picaridin has notably less malodor and less staining of materials than DEET.

Oil of lemon eucalyptus is a naturally occurring chemical, unlike DEET and Picaridin, which are synthetic man-made substances. Oil of lemon eucalyptus is generally considered to be the most effective natural repellent on the market. In 2005, the Centers for Disease Control added this to its list of recommended insect repellents. They found repellents with concentrations of at least 30% generally provide about two hours of full protection from mosquitoes and up to six hours under certain conditions, which is roughly equivalent to repellents with 10% to 15% percent DEET. However, it provides significantly less duration of protection than higher concentrations (20% to 50%) of DEET and Picaridin, which completely repel mosquitoes for five hours or more.

Multiple other repellants have been studied extensively. Noteworthy among them is IR3535, which is marketed by Avon as "Skin-So-Soft Bug Guard Plus". Studies demonstrate a half-life of 20 min to 6 hrs. Overall, it's less effective than 12.5% DEET

Ticks

Ticks are not insects, although they are often mistaken for them. Ticks are actually classified as arachnids, or relatives of spiders, scorpions and mites. They require blood for sustenance. Ticks don't jump or fly. Instead, they crawl up low brush or grass to find a host. Then, they clasp on with their back legs and reach their front legs out to grab onto a passing animal or human. This process is called questing. Ticks find their hosts by detecting animals' breath and body odors, or by sensing body heat, moisture, and vibrations.

Almost all ticks belong to one of two major families, hard ticks, and soft ticks. Tick species are widely distributed around the world, but they tend to flourish more in countries with warm, humid climates because they require a certain amount of moisture in the air to undergo metamorphosis, and because low temperatures inhibit their development from eggs to larvae. A habitat preferred by ticks is the interface where a lawn meets the woods. They are ground dwellers.

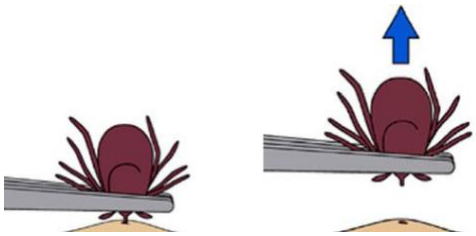
Ticks are second only to the mosquito for being prolific at transmission of diseases. But unlike the mosquito which transmits disease instantaneously, transmission from a tick bite can take up to 2-3 days. So, if you can remove a tick within 24 hours, your chances of getting a disease is fairly low. It's not unheard of for ticks to be carrying three different diseases at one time, making a diagnosis difficult.

Upward of 20 diseases are known to be transmitted from ticks to humans.

Prevention of ticks attaching, and frequent tick checks is the best way to prevent the transmission of disease. Know which ticks and which diseases are present in the area where you are hiking and camping.

Shirts should be tucked into pants and then pants into socks. Permethrin should be applied to clothes and DEET, should be applied on the skin. People can limit their exposure to tick bites by wearing light-colored clothing as well.

Tick removal is simple. Pull it off the skin. You can use your fingers if needed, but if you have tweezers or some other tool, use it to grab the tick as close to the skin surface as possible. Then, pull the tick straight upward with steady even pressure. Ticks don't have a 'head', so the head can't be left in the skin. It has a small 'poker' called a hypostome. If for some reason this remains in the skin, the clinical consequences are non-existent. Watch for local infection and symptoms of tick-borne illness (incubation period 3 to 30 days), especially headache, fever, and rash. If you suspect that the tick may have had a disease such as Lyme Disease, RMSF, tularemia, or ehrlichiosis, a tetracycline such as doxycycline can be initiated while in the wilderness. Treatment for other tick-borne illnesses is supportive.



Ticks will remain on clothing after a wilderness trip. Wash clothes in hot water and use high heat in the dryer for at least one hour to ensure that all ticks are removed from clothing.

The DO NOTS of tick removal:

- Do not use petroleum jelly
- Do not use fingernail polish
- Do not use rubbing alcohol
- Do not use a hot match
- Do not use gasoline
- Do not grab the rear end of the tick. This expels gastric contents and increases the chances of infection
- Do not twist or jerk the tick, as this will most likely cause incomplete removal of the tick

Hymenoptera

Hymenoptera is the order of insects that includes ants, bees, and wasps.

More people die in the U.S. from bee, hornet, and wasp stings than from any other animal bites or stings. A single sting to an allergic person can be fatal in minutes to hours. Non-allergic victims may experience fatal toxicity if they sustain multiple stings. But this takes many stings, upward of 500 to 1,400 simultaneous stings to cause death by toxicity in the non-allergic victim.

A local reaction is the most common reaction from a sting. It consists of a small red patch that burns and itches. The generalized reaction consists of diffuse red skin, hives, swelling of lips and tongue, wheezing, abdominal cramps and diarrhea. Victims of multiple stings often experience vomiting, diarrhea, dyspnea, hypotension, tachycardia, and syncope. People who have allergies to hymenoptera should see an allergist for desensitization, and they should wear medical tags and carry an EpiPen® or other epinephrine auto-injector.

The treatment of stings is straightforward. Scrape away the stinger in a horizontal fashion as soon as possible by any available means. Wash the site with soap and water. Place ice or a cold compress on the site. Give pain relief. Topical steroid cream can be helpful for swelling, as are oral antihistamines.

If hives occur with wheezing and respiratory difficulty, then epinephrine should be given immediately. This can be repeated 5 to 10 minutes after the initial injection. Beta agonist inhalers (e.g., albuterol) may help relieve the wheezing.

Scorpions

Scorpions are found in desert and semiarid climates between 50 degrees north and south latitude. Most scorpion stings result in only local pain and inflammation. In the United States, the most

medically important scorpion is the bark scorpion (genus Centruroides); found primarily Arizona and New Mexico.

The treatment of a scorpion sting is to clean the sting site with soap and water. Ice should be used if available. There are studies that suggest ice will help to neutralize the pain. For the vast majority of stings, this is enough. If the scorpion is identified as a bark scorpion evacuate as soon as possible, because the victim may decompensate rapidly. The need for evacuation is more significant in children and elders.