SIRIUS

Advanced Wilderness First Aid for MBT enthusiasts

Learner's manual

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Canada - English

SIRIUSMED

MEDICINE
BEYOND LIMITS

1. Introduction

1.1 About SIRIUSMEDx

1.1.1 Curriculum Development

SIRIUSMEDx has established a board of advisors that meets regularly to review curriculum and develop teaching methodology and standards. The membership of this board reflects a broad spectrum of experience and specialization in the fields of emergency medicine, EMS, search and rescue, first aid, experiential education and international adventure travel. Board members are also active instructors.

Sirius curriculum guidelines and teaching methodology conform to established standards and practices in a variety of fields to ensure our programs deliver material that is closely aligned to the interests, needs and capacities of our clients.

These standards and practices reflect the guidelines of the following fields and organizations:

- Wilderness emergency care organizations, including the Wilderness Medical Society.
- Standard urban-based first aid programs, including the Heart and Stroke Foundation of Canada, Canadian Ski Patrol System, Life Saving Society of Canada.
- Current search and rescue standards and practices.
- Emergency medicine protocols.
- Nursing care protocols.
- Outdoor recreation and adventure education programming.
- Experiential-based educational programs.
- National and regional standards in occupational health and safety.

1.1.2 Certification

Participants successfully completing each course will receive Sirius Wilderness Medicine certification, which is recognized by outdoor programs, companies, associations and government departments across Canada and the United States. Sirius course certification is valid for a period of three years. Some companies and organizations, however, may require more frequent recertification. Course participants are urged to review skills and knowledge by following regular training.

Sirius programs are recognized, among other organizations, by the Prospectors and Developers' Association of Canada, McGill University Environmental Health and Safety Office, Canadian Outward Bound Wilderness School, Association des camps du Québec, Youth Challenge International, National Outdoor Leadership School (NOLS), Laurentian University Outdoor Adventure Leadership program, Université Laval, Université du Québec à Chicoutimi, Memorial University of Newfoundland and Labrador, Cégep de la Gaspésie et des Îles, Collège Merici, Capilano University and numerous federal, provincial and territorial government departments. Sirius Wilderness Medicine course content also conforms to the guidelines established by the Wilderness Medical Society.

1.1.3 Evaluation

All SIRIUSMEDx programs utilize competency-based learning objectives. Practical skills are assessed on an ongoing basis throughout the program. Realistic application of first-aid skills is achieved through practical sessions and outdoor simulations using stage blood and make-up. In addition to frequent quizzes, all courses are followed by a written examination. The passing grade is 70 percent.

Course graduates may recertify their training, within a period of three years, by completing the one of the following programs:

- **Wilderness First Aid 20h** : requalified through a 20h, advanced 40h or 80h course.
- **Wilderness First Aid 40h** : requalified through a 20h, 40h or advanced 80h course. It is also possible to access the 50h Bridge for participants who have completed their 40h during the past 12 months.
- **Wilderness first responder: 80h requalifie**d through a 50h or 80h course.

1.1.4 Course Manual

This manual has been prepared as a study guide to complement SIRIUSMEDx courses and as a reference for further reading. It is not a substitute for training and practice. Professionals working in remote settings are urged to refresh their skills and knowledge on a regular basis through continued reading and professional training. We have included a list of recommended reading material at the back of this manual.

2. Wilderness First Aid

2.1 First Aid

2.1.1 Emergency Services

In most populated regions of Canada and the United States, EMS is activated by calling 9-1-1. 9-1-1 services are essentially around the clock emergency call centres designed to alert and dispatch the relevant agencies required in an emergency. These include:

- EMS ground level – first responders and ambulance.
- EMS Airborne (public or private)
- Fire department.
- Police.
- Search and Rescue.
- Electricity provider.
- Natural gas or propane provider.

2.1.2 Lay Rescuers and Healthcare Providers

Responsibilities of a First Aider

- Ensuring that the safety and well-being of all those on the scene are not compromised.
- Preventing further injury to the rescuers, bystanders and patients.
- Carrying out the essential procedures to save lives.
- Transferring responsibility of care for the patient over to qualified pre-hospital care personnel as soon as possible.

In effect the goal is to provide **the best care possible as quickly as possible**.

- It is provided outdoors. Rescuers must deal with extreme and variable weather conditions, which may affect the safety of patients and rescuers.
- Definitive medical care may be hours or days away from the accident site, due to evacuation complications, inclement weather or lack of transportation and communication. This delay may require the rescuer to apply advanced first aid techniques such as administering medications, reducing dislocations and cleaning wounds.
- First aid equipment and supplies are generally limited and must often be improvised from the materials at hand.
- Some injuries and illnesses are more common in wilderness areas. Examples of these include deep frostbite, severe hypothermia and contact with poisonous plants.
- Working and travelling in remote settings generally involves situations in which participants are required to perform physically demanding exercise for prolonged periods of time. This may have a significant impact on the individuals' general health and physical condition aside from any accident or illness that may occur.
- Wilderness first aid almost always involves long-term care of patients and rescuers prior to and during evacuation. This includes providing the necessities of food and water and rest, stabilizing body temperature and offering psychological support for patients and all group members.

2.1.3 Leadership Considerations

Leaders

- Leaders must possess a level of fitness, experience and training that is commensurate with the activity.
- Leaders must be aware of risk management and hazard evaluation systems and be trained in appropriate emergency procedures.
- The leader-to-participant ratio must be appropriate. Group size must be consistent with recommended guidelines for the activity, environmental conditions, the kind of clientele and participant experience.
- Leaders should have appropriate training in group management, crisis intervention and other skills related to emergency response.

Participants and remote area workers

Proper care for participants includes the provision of:

- Adequate nutrition.
- Adequate hydration.
- A level of physical activity that is commensurate with participants' fitness capacity.
- An appropriate quantity and quality of rest and sleep.
- Proper equipment and clothing.
- Adequate shelter from the elements.
- A source of heat.
- Appropriate contingency planning in the event of an emergency.

Appropriate leadership in remote settings involves several steps. Good leadership starts well before the trip and continues through the program. In the case of foreign excursions care may also extend for a period of time after the trip is completed.

2.2 Responsibility and Liability

Participation in wilderness pursuits, work and travel in the backcountry all contain an element of risk and potential for injury. Many accidents can be prevented, however, with responsible leadership. Guides, expedition leaders, camp managers and company employees all have a contractual and therefore legal arrangement with the organization hiring them to provide a reasonable standard of care in the performance of their duties. It is therefore important to understand the legal considerations associated with working and travelling in remote settings.

Canada's Legal Systems

In Canada there are two legal systems in place. The province of Québec uses the Civil Law system and the rest of Canada uses the **common law** system. Although there are fundamental differences in the way the two legal systems are administered, both are based on the same basic premise: everyone must behave in a reasonable manner.

Litigation

Litigation or lawsuits occur when a person or group of people is of the opinion they were not provided reasonable care and some form of damage ensued. These damages may occur in the form of physical injury, monetary loss, loss of enjoyment of life or emotional and psychological trauma. A lawsuit is successful when the courts deem that the plaintiff (the party initiating the lawsuit) did indeed incur damages and that the defendant (the party accused of causing damages) was responsible.

Joint or Multiple Liability

In some situations, a court may determine that more than one party is responsible for the damage or injury. This is called joint or multiple liability. In effect, every party deemed to have contributed to the situation resulting in the damages could be held legally and financially responsible. This could include the company contracted to run an expedition or organization sending employees into a remote setting, the guide or leader, the manufacturer of equipment used, even the clients or employees themselves.

As litigation awards can easily climb up into millions of dollars, the financial implications are no less serious than the legal ones.

First Aid in the Workplace

In the workplace, the employee is protected by occupational health and safety codes. These codes outline practices for the workplace that the employer must provide to ensure a safe environment for the employee to exercise his or her craft. Employers must make provisions for the training of safety officers and first aid attendants and ensure that first aid is available in the workplace.

Each province and territory has its own occupational health and safety regulations act and department to oversee the application of these rules. Workers who operate in remote and wilderness regions require training that goes beyond the courses that are designed for the urban workplace.

In 2004, the Canadian government amended the Criminal Code (Bill C – 45, Law C-21 in Quebec) to broaden the responsibility of employers when providing adequate safety and protection from harm for their employees or anyone who is in their charge. The bill, created after the 1992 Westray (Nova-Scotia) coal mine disaster where 26 diggers were killed by a methane gas explosion, imposes potential criminal liability to an employer, in the event of a conviction of an occupational and health and safety infraction resulting in harm.

Federal Occupational Health and Safety regulations dictate that employers must provide specific wilderness first aid training if an employee's workplace is in a wilderness area.

Canada Occupational Health and Safety Regulations Part XVI – First Aid, Section 16.3, 4 (c)

If the work place is in a wilderness area, [the employer shall ensure that the first aid attendant at the workplace is qualified by having at least] a standard first aid certificate and wilderness first aid training that is specifically designed to meet the first aid needs of persons who work, live or travel in such areas.

In most cases an employee who provides first aid or emergency care at the request of an employer, however, is immune from liability in the performance of his or her duties as a first aid attendant.

Canada Labour Code (R.S.C., 1985, c. L-2, 126 [3])

No employee is personally liable for anything done or omitted to be done in good faith by the employee when the employee is assisting the employer, as requested by the employer, in providing first-aid or in carrying out any other emergency measures.

Duty to Care

Liability or duty to care refers to a legal responsibility. Leaders are charged with the responsibility of providing adequate leadership and care to group members. A leader's level of responsibility towards group members will depend on the degree to which these members rely upon the leader's judgment, experience and ability to foresee problems as well as on the participants' own level of autonomy and experience.

Most contractual arrangements between parties will include some form of liability or duty to care. An agreement may come in the form of a signed contract, as for instance between a company and a physician who is paid to accompany the remote-site workers and provide medical assistance if required. Or it may simply be between a group of students at a college outing club and the trip leader. While the level of responsibility may vary in these cases, the agreement to provide care remains.

In the province of Québec, for example, the right to assistance is written into the Charter of Human Rights and Freedoms.

Québec Charter of Human Rights and Freedoms

2. Every human being whose life is in peril has the right to assistance.

Every person must come to the aid of anyone whose life is in peril, either personally or by calling for aid, or by giving him the necessary and immediate physical assistance, unless it involves danger to himself or a third person, or he has another valid reason. (1975, c. 6, s. 2)

Standard of Care

The standard to which an individual should be able to perform at all times is known as the standard of care. In a court of law, this standard is established by peers and professional witnesses. In many cases the standard of care may be established prior to participation in an activity through a variety of sources, including written industry standards, sports association guidelines, unwritten standards, previous cases, experience and common sense. It is generally expected that rescuers should apply only as much emergency aid as they are competent to perform.

Good Samaritan Laws

Good Samaritan laws protect those who come to the aid of others in distress. The laws ensure there is no liability for damages if the rescuer has provided a reasonable standard of care. The standard of care imposed upon an individual who stops at the scene of an automobile accident, for example, is minimal, as the rescuer did not have a duty to care for the patient prior to his or her arrival at the scene.

Good Samaritan laws vary from jurisdiction to jurisdiction, but the principle remains the same. There is no liability for emergency aid given unless gross negligence is proven.
Civil Code of Québec 1471.
Where a person comes to the assistance of another person or, for an unselfish motive, disposes, free of charge, of property for the benefit of another person, he is exempt from all liability for injury that may result from it, unless the injury is due to his intentional or gross fault. (1991, c. 64, a. 1471)
Good Samaritan Act, British Columbia (RSBC, 1996, Chapter 172)

> 1. A person who renders emergency medical services or aid to an ill, injured or unconscious person at the immediate scene of an accident or emergency that has caused the illness, injury or unconsciousness is not liable for damages for injury or death of that person caused by his act or omission in rendering the medical services or aid unless he is grossly negligent.
>
> **Exceptions**
>
> 2. Section 1 does not apply where the person rendering the medical services or aid:

A. a) is employed expressly for that purpose; or
B. b) does so with a view to gain.

Good Samaritan laws may not apply when the person providing care is engaged expressly for that reason (e.g. medical person) or is under contractual agreement to provide care (e.g. trip leader). In either case, those providing care may be held liable for damages, injury or death caused by their actions or lack of actions.

Foreseeability

Foreseeability is the reasonable anticipation that harm or injury is a likely result of acts of commission or omission. Expedition leaders are expected to anticipate and manage potential hazards that may be inherent in their activity. Negligence may be proven if adequate preparation for and care during the expedition was not evident or the leader mismanaged an incident once it occurred.

Negligence

Negligence is a condition in which a party (individual or group of individuals) neglected to provide an appropriate standard of care. The following factors are required to prove negligence in a court of law.

- **A duty to care existed** It must be established that the defendant had a duty to care.
- **There was neglect of duty** The person who has a duty must have neglected that duty either by an act of commission (acting unwisely) or omission (failing to act). One cannot absolve oneself of responsibility by doing nothing when some action is needed. Similarly, a person who acts unwisely may be deemed no less guilty than one who fails to act.
- **A tort or wrong was committed.** A tort is a civil wrong resulting in injury or harm, whether physical, psychological or emotional.
- **There was an unbroken chain of events**
- The act of omission or commission must be directly related to the injury.

Defences against negligence include cases in which:

- The injury or circumstances resulting in the injury were not foreseeable. This is also known as an Act of God in some cases.
- The injured participant signed a disclosure form confirming he or she understood the nature of the activity and accepted the associated risks and consequences of those risks.
- The participant in question disregarded rules or procedures for an activity and this disregard contributed in a significant way to the cause of the accident.

Particular care must be exercised when working with special populations and children who are more likely to ignore rules or to be distracted during an activity.

Informed Consent

Informed consent is a legal term. It indicates that consent has been given on the basis of an appreciation and understanding of the facts and implications of a situation or action. Before providing care to a patient, the rescuer must ensure that the patient is aware of the plan of care as well as the benefits and any risks that may be involved.

Right to Refuse Treatment

Any person of legal age has the right to refuse treatment. If a patient or patients refuse your care or treatment ensure that they understand their condition and the consequences of not receiving treatment. Complete a detailed report and have the patient read it and sign it. If possible, have a witness read and sign the report as well.

Implied Consent

Implied consent is the legal term describing consent that cannot be explicitly expressed through writing or speech. In an emergency setting, a person found unconscious is deemed to give consent to appropriate treatment. Implied consent might also be assumed in the case of a person whose level of consciousness is altered by the effects of medication, alcohol, altitude, hypothermia, shock or other disability that would interfere with the capacity to make reasonable decisions regarding his or her well-being.

Non-Competency

In the case of a person who for one reason or another is incapable of giving or refusing consent to care, another person who has been legally granted the mandate to do so may make the decision in his or her place. The representative must act solely in the interests of the patient represented regardless of the representative's own beliefs and opinions.

Consent to Care for Minors

When approaching a child in need of first aid or emergency care introduce yourself to any adults on the scene to determine who may be responsible for the child. In the case of children, the parent or legal guardian holds the authority to provide consent to care unless the emergency is serious or life threatening

The age at which a person is solely responsible for giving consent to care varies from jurisdiction to jurisdiction. In the province of Québec, for example, once a child reaches the age of 14 he or she can give or refuse consent to care.

Civil Code of Québec

14. Consent to care required by the state of health of a minor is given by the person having parental authority or by his tutor.

A minor 14 years of age or over, however, may give his consent alone to such care. If his state requires that he remain in a health or social services establishment for over 12 hours, the person having parental authority or tutor shall be informed of that fact. (1991, c. 64, a. 14)

In Loco Parentis

The Latin expression **In loco parentis** means "in place of a parent". It is assumed by the courts that anyone charged with the responsibility of a minor will act as any "reasonable parent" would. It should be stressed, however, that the actions of expedition leaders, camp managers and outdoor professionals are not measured against those of a "reasonable parent" but rather against those of a "reasonable leader" with adequate training.

Confidentiality

Every person has the right to non-disclosure of confidential information. Sharing information about a patient's condition or medical history is done only with appropriate authorities and those involved in the follow-up care of the patient, or if a medical clearance authorization has been given or filed by the victim.

Abandonment

Abandonment refers to the termination of care before the responsibility has been passed on to someone who is equally or more qualified. A rescuer who stops providing aid to a patient before passing on responsibility to another can be held liable for the abandonment of the patient under his or her care.

Accident Reports

Comprehensive accident reports have several important functions. They provide an accurate record of the patient's condition and other information that together help to form the basis of a plan of care. They act as a reminder to rescuers of the procedures to follow and thus minimize the chance that important information is neglected during an emergency situation. Detailed reports can also be used to establish accident trends over a period of time, which may help an organization or institution develop important changes in policies and activity procedures.

Finally, an accident report form or patient assessment record represents a legal document in a court of law. It provides clear evidence about the care provided, helping to determine whether it was appropriate to the situation and lending support to any decisions made by the leader or caregivers.

Rescuers should carry several copies of the accident report form in their first aid kit along with a pencil that can be sharpened with a knife. (Pens do not work well in the cold and may dry out or leak, rendering them useless in an emergency). Once it is filled in by the rescuer in the field, the form should be kept as an official record. The rescuer should also write up clean copies with any additional information when the expedition is over.

Information to be recorded includes:

- Patent's name, address, phone number, age and gender.
- Date and time of the accident and date the report was completed.
- Weather and environmental conditions.
- Findings and observations. Assessment and treatment administered (including instructions and information given to the patient).
- Evacuation procedures and assistance required.
- Any events or conditions relating to the incident.
- Condition of others in the party.
- Name and address of healthcare professional who assumed care for the patient.
- Name and address of person in charge when accident occurred.
- Name and address of the person who completed the form.

2.3 Preventing Disease Transmission

2.3.1 Disease and Disease Transmission

Direct Contact

Indirect Contact

Airborne Transmission

Vector Transmission

2.3.2 Universal Health Precautions

- Wear protective gloves.
- Use masks with a one-way valve for rescue breathing or CPR.
- Wear face shields, protective glasses and clothing for spraying fluids.

- Use a face mask in case of airborne infection transmission risk (respiratory virus, flu, tuberculosis, etc.).
- Clean up fluid spills and reusable equipment.
- Safely dispose of used medical supplies, soiled bandages and garments.
- Wash your hands thoroughly after providing first aid.

Protective Gloves

Safe Glove Use

- Always carry gloves in a sealed container, to prevent damage or puncture from sharp objects in a first aid kit.
- Remove any jewelry that could tear the gloves.
- Inspect the gloves before putting them on and as you are working.
- Always use a fresh pair of gloves for each patient. Ensure they are the right size (neither too small nor too big).
- A thin pair of outer gloves will protect the disposable gloves from damage and protect the wearer's hands from cold and sharp objects that may damage the inner gloves.
- Avoid patient contact if you have any broken skin, even if wearing gloves.

Glove Removal

Masks (respirator) or Shields

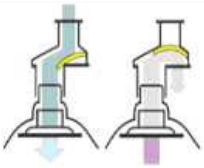
A barrier device helps a rescuer deliver breaths to a patient while minimizing contact with the patient's mouth, saliva, vomit and exhaled air. There are many types of devices available for different requirements (size and ease of transportation) and situations (capacity to be cleaned and re-used).

The use of a mask is recommended to protect the rescuer's eyes, nose or mouth from splashes or sprayed or aerosolized particles (in the context of respiratory infections, coughing, etc.). Several mask models are available, from the simplest ones to models equipped with visors. In certain infectious contexts, such as Canada's northern areas or in developing countries, where tuberculosis is prevalent, the use of high-level protection masks (N95 compliant) is recommended. A fit test is required, prior to use, in order to ensure proper airtightness.

Face Shields

A face shield is the simplest form of barrier device available. It is intended for single use only but is very portable. Some models pack away into a small pouch, suitable to put onto a key chain or into a wallet.

Most face shields are made of plastic and have a hole located at the opening of the mouth. Within the hole is a biological filter that prevents the transmission of germs through exhaled air. Some models have a stem that inserts into the patient's mouth and incorporates a one-way valve which provides added protection.



Pocket Masks

Pocket masks are made of clear plastic and come in two sizes – adult and pediatric. The single-use mask has a built-in one-way valve to prevent exhaled air and fluids from coming into contact with the rescuer. Some models have detachable and disposable valve filters making them suitable for re-use. Some masks come as well with an inlet for supplemental oxygen and face straps to hold the mask in place.

Protective Eyewear and Clothing

Whenever possible, protective eyewear, face shields and clothing should be worn if rescuers think they risk being splashed by blood or body fluids. In remote areas, ski goggles, work glasses or sunglasses can double as protective eye covering, and rain gear can serve as protective clothing.

Cleaning Up

When possible use detergents to clean up blood and fluid spills. Always wear gloves. Remove or bury bloodied snow or earth. All reusable equipment such as pocket masks and goggles can be cleaned by scrubbing with hot soapy water and soaking in a 1:10 solution of household bleach for 10 minutes or scrubbed with alcohol and left to dry. Bloodied clothes and shoes should be sealed in double plastic bags and evacuated with the patient.

Disposing of Used Supplies and Bloodied Objects

Always place sharp objects such as needles, syringes and scalpel blades in a puncture-resistant container such as a Nalgene-type bottle and ensure the container is properly disposed of. Needles should never be recapped, bent or broken by hand. Used gloves and soiled bandages should be hermetically sealed in double plastic bags and marked as biohazard waste.

Washing Hands

Hand washing is the most effective way to prevent the transmission of many communicable diseases. Hands should always be washed after providing first aid.

How to Wash Hands

- Wet hands with warm water. Add regular soap and rub your hands together, lathering all surfaces for at least 15 seconds. (Since anti-bacterial soaps destroy good bacteria as well as bad and thus can contribute to antibiotic resistance, it is better to use regular soap.)
- Wash the front, back and sides of your hands, as well as between your fingers and under your finger nails.
- Rinse your hands well under warm running water, using a rubbing motion.
- Wipe and dry your hands gently with a paper towel or a clean towel.
- Use the paper towel to turn off the tap so that you do not re-contaminate your hands.
- If hot water and soap are not available, remove any debris with cold water, and then use alcohol-based sanitizers to clean hands. Hands should always be washed after gloves are removed whether or not the gloves remain intact.

2.3.3 Exposure Incident Management

A rescuer may discover during an emergency situation that he or she has been inadvertently exposed to a patient's body fluids. For instance, a sharp object, such as a bone fragment, may pierce the rescuer's glove and skin. The risk in this situation is bi-directional. The rescuer becomes exposed to the patient's blood. The patient is also now exposed to the rescuer's blood.

Blood-Borne Pathogen Exposure and Management

- Continue patient care until someone else can take over.
- Thoroughly scrub the affected area with soap and water and let your own wound bleed for five minutes.
- Disinfect your injury with a disinfectant (alcohol or other).
- Inform the patient of the situation and document contact information and any history you or they have of communicable diseases.
- In the event of a suspected confirmed exposure to a disease transmissible through blood or body fluids (Hepatitis B, Hepatitis C, HIV, Zika, etc.), seek prompt medical attention.

- Several treatments can be used in order to decrease the risk of transmission, such as immunoglobulin administration (immunity *Booster*) against hepatitis B or HIV drug prophylaxis. The latter should ideally be started within the first few hours after contact.
- In other cases, there is not specific treatment available, but it is important to get a basic medical check and establish a follow-up plan.

2.3.4 Communicable Diseases

Bacteria

Bacteria are microscopic single-cell organisms that reproduce without the need for a host. They were among the first organisms to appear on earth and exist in every habitat. A gram of soil will typically contain up to 40 million bacterial cells. The ecosystem depends heavily on the activity of bacteria. Pathogenic bacteria can cause a variety of serious illnesses, such as cholera, tetanus, tuberculosis and streptococcus.

Viruses

Viruses are infectious organisms that can only replicate inside the living cells of other organisms. They are smaller than bacteria and cannot be seen with a light microscope. Existing in the millions, viruses can infect any living organism, including animal, plant and even bacteria.

Flu Viruses

Flu viruses include the various seasonal influenza strains. These viruses are generally respiratory illnesses of varying severity. They are transmitted by direct contact and through the air by the coughs and sneezes of those already infected. Annual immunization is an efficient way to protect oneself from the flu.

Hepatitis

Hepatitis is an inflammatory disease of the liver resulting in severe, sometimes life-threatening, damage. It is most frequently caused by viruses. So far, seven hepatic viruses have been identified: A, B, C, D, E, F and G, the most common being hepatitis A, B and C. Liver viruses can survive for a very long time outside the host.

Hepatitis A Virus

Hepatitis A virus lives in the bowel of an infected person and is transmitted by fecal-oral transmission only. Hepatitis A virus can be prevented through vaccination.

Hepatitis B Virus

Hepatitis B virus is transmitted through the blood, body fluids, sexual contact, mucous-membrane contact or non-intact skin contact with infected blood. It has a long incubation period (30 to 180 days) and can be carried by people who are asymptomatic and therefore unaware they have the disease. There is no treatment for Hepatitis B, but it can be prevented through vaccination.

Hepatitis C Virus

Hepatitis C virus is also transmitted through blood and sexual contact, but not by contact with saliva unless it is bloody. There is currently no immunization available for Hepatitis C Virus.

HIV

The human immunodeficiency virus (HIV) is a virus that causes acquired immunodeficiency syndrome or AIDS, which is a life-threatening degenerative illness. It is transmitted through blood or sexual contact. There is no evidence to date that HIV is transmitted through non-blood body fluids such as tears, saliva, vomit, stool or urine. There is currently no cure for HIV, although there are various treatment protocols available.

Parasites

Parasites are small plants or animals that live on or in another larger living organism benefiting from the host organism often at the latter's expense. Parasites include tapeworms, fleas, lice and protozoa. Human diseases caused by parasites include malaria, giardiasis, dysentery and sleeping sickness.

Fungi

Fungi, such as moulds and mushrooms, are micro- and macro-organisms found throughout the earth's environment, as well as in and on plants and animals. They perform an essential role in nature helping to decompose organic matter and recycle it into nutrients. Fungi have traditionally had a variety of applied uses, providing food (mushrooms) or drugs (penicillin and antibiotics) or used as leavening agents (yeast) or biological pesticides to control weeds, plant diseases and insect pests. Fungi also cause a number of plant and animal diseases. In humans, these include ringworm, athlete's foot and **candida albicans** .

2.3.5 Immunization

Providing emergency care to others usually includes the risk of transmitting a disease from the patient to the rescuer or from the rescuer to the patient. Obtaining immunization from common diseases is a critical defence for rescuers who regularly come into contact with people who may carry a communicable disease.

The following are the latest Public Health immunization (vaccination) recommendations for health workers:

- **Highly recommended basic immunization** : diphteria, pertussis, tetanos, polio, measles, rubella, mumps, chicken pox and meningococcal infections.
- **During your travels abroad**, you may be exposed to diseases that are preventable through vaccination. You should consult a health care provider or travel clinic, preferably six weeks before your departure, in order to check your immunization status and assess your needs, according to your destination and scheduled activities. **https://voyage.gc.ca/**
- **Flu immunization** – Flu vaccines are administered yearly because the circulating flu virus strains are constantly evolving and changing. The immunization decreases throughout the year, which is why vaccination campaigns are generally done in November and December, ahead of the winter months when the virus prevalence is at its highest.
- **Hepatitis B Immunization** – Hepatitis B is a viral disease. It is transmitted through direct exposure to blood or other biological liquids. The virus attacks liver cells, which leads to its inflammation. All persons potentially at risk of exposure to blood and other biological fluids or at risk of accidental needle sticks, (i.e. syringes, or accidental cuts) should be vaccinated against the Hepatitis B virus. The vaccine is generally administered in 3 doses spread over 6 months. It is important to complete the vaccination calendar in order to achieve the proper immunization. However, the non-response rate can vary between 5% and 15%. An antibody count can be performed in order to ensure an efficient vaccination.
- **Rabies vaccine** – Rabies is rare in North America and Europe, where strict control measures have been implemented. Vaccination is highly recommended to anyone facing a high risk of contact with animals potentially carrying the virus. Are considered at-risk: vets, animal control and wildlife protection agents, hunters and trappers in high risk areas, speleologists and tourists who visit endemic regions or countries where safe and adequate access to post-exposure prophylactic treatment is difficult. **Pre-exposure vaccination (3 doses) does not exclude the need for post-exposure vaccination.**

3. Anatomy and Physiology

The human body uses a number of physiological mechanisms to survive in, compensate for and adapt to the constantly varying conditions of life – including cold or hot environments, the stress of exercising for long periods of time and working in extreme environmental conditions. These different physiological mechanisms are performed by a complex network of structures and elements. A large part of wilderness medicine depends on a solid understanding of how all these elements contribute to making the body work. It is this understanding that allows a leader to prevent many problems or, if accidents occur, make appropriate decisions regarding care and management.

3.1 Homeostasis and the cell

3.1.1 The Body's Structures

The body is made up of trillions of cells, each composed of molecular and chemical substances and processes. As cells grow, some will group into specialized cells — known as tissues — that perform specific functions, such as connective tissue or muscle tissue. Tissues in turn can combine to form organs, such as the liver, brain, heart or kidneys. Together, organs and tissues are organized into body systems, such as the skeletal system, the respiratory system or the nervous system. The systems perform all of the body's major functions.

3.1.2 Homeostasis

The cells and tissues of the body function and survive within narrow limits of internal environmental conditions. The body's maintenance of this stable and constant environment is known as homeostasis. It is achieved through the healthy functioning and interconnectedness of all the body's organs and cells. For instance, the respiratory system provides oxygen to the cardiovascular system, which in turn transports it to the cells. The kidneys maintain constant ion concentrations in the body's fluids. The digestive system provides nutrients to the body's cells.

The Cell

The cell is the smallest and most basic unit of all living organisms. Each of the body's cells is specially designed to perform one particular function, and each cell contributes to the maintenance of homeostasis. While cells may differ in function, however, they all share certain basic characteristics. All living cells convert food to energy and heat through a complex process that requires a constant supply of oxygen and basic nutrients.

A cell's contents consist of intracellular fluid, intracellular structures (including the nucleus) and insoluble materials. Each cell is encased in a membrane, which separates the cell's contents from the extracellular space and fluid surrounding it. The cell membrane is made up of lipids, proteins and carbohydrates. These help the membrane control the entry of nutrients, the elimination of wastes and the release of other materials. Any alteration in the cell membrane could affect cellular activities.

3.1.3 7 Essential Elements

Among the many factors required for cell activity, seven can be said to be essential. The use of the term "elements" here refers to generic factors as opposed to the more specific "chemical elements" mentioned above.

- Water H_20
- Oxygen O_2
- Glucose $C_6H_{12}O_6$
- Electrolytes K^+, Na^+, Cl^-

- Blood Pressure BP
- Temperature °Celsius
- Acid-Base Balance pH

Water (H2O)

Water is the single most important constituent of the body, making up approximately 60 percent of total body weight (approximately 40 litres in a 70-kg adult). Water is essential to life and all of the body's functions. Without it, we cannot survive.

The human body can be seen as a series of compartments, all of which contain water — intracellular space, extracellular space, blood vessels, digestive tract, etc. The fluid balance within the body is maintained through the free movement of fluids through all of the body's membranes. A water deficiency in one part of the body may be filled by fluids from other parts. Since all physiological systems need water to function, any significant change in the body's water volume can have important consequences.

Water's Functions

Water has a variety of essential functions:

- **Metabolism** – Water is used in all cellular chemical reactions.
- **Transport** – Water is the main component of blood (plasma), providing nutrient transport to the cells.
- **Digestion** – large quantities of water are absorbed and secreted daily by the digestive tract. This allows food to pass through the gastrointestinal system and then to be absorbed into the blood.
- **Waste Removal** – The by-products of cell metabolism are removed and excreted from the body through the urinary and digestive systems.
- **Thermoregulation** – Circulating fluids in the body act as a heat transport system removing heat from the core and transporting it to the cooler areas of the body. Heat can also be dissipated from the body through the process of sweating.

Water-Related Problems

Water is lost from the body through:

- Urine and feces.
- Respiration.
- Perspiration.
- Bleeding.
- Vomiting.
- Diarrhea.
- Significant soft tissue injuries (e.g., burns).
- Diuretics, such as caffeine, nicotine, alcohol and some medications.
- Metabolic disturbances and diabetes.

Fluids enter the body through the foods we eat and the water we drink. The average daily requirement for water is between 1.5 and 2 litres a day, but can vary a great deal.

Most of the water that enters the digestive system is absorbed through the upper portion of the large intestine. Any medical condition that interferes with the action of the digestive tract will have an effect on the absorption of water. This includes gastrointestinal infections that cause vomiting or diarrhea. Large quantities of water (and with it large amounts of sodium and potassium) may be lost through vomiting and diarrhea.

Dehydration is a condition in which fluid loss is greater than fluid intake. This can result from high altitudes, extreme environmental conditions, such as very hot climates, or from emergency medical conditions, such as gastroenteritis or complications of diabetes. Dehydration requires immediate attention (for more information, see Environmental injuries and emergencies (p. 165)).

Oxygen (O2)

Oxygen is an atmospheric gas and is essential for cell metabolism.

Oxygen's Functions

For cells to function, grow and replicate, they require energy. That energy is obtained through a chemical reaction involving the intake of oxygen and the release of carbon dioxide. Oxygen is absorbed from the environment by the lungs, transported in the blood and consumed by cells throughout the body. Once in the cells, oxygen combines with carbohydrates, proteins and fats to release energy (and carbon dioxide), enabling cells to survive and perform their important functions.

Oxygen-Related Problems

Without oxygen, cells cannot survive. Some cells, such as muscle cells, can function for periods of time in the absence of oxygen. They incur an oxygen debt that can be paid after exercise. Other cells, such as those of the heart and nervous system, however, are extremely sensitive to oxygen levels. Cells of the higher centres of the brain and nervous system in particular may cease to function within seconds of a reduced oxygen supply and will be permanently damaged if denied oxygen for more than 4 to 6 minutes.

Any condition that interrupts or reduces the oxygen supply to the body is a medical emergency and must be attended to immediately. Management of the airway and respiratory system is always given priority over local injuries.

Principal Causes of Interrupted or Diminished Oxygen Supply

- **Insufficient Oxygen Availability** – With decreased barometric pressure, the air at high altitudes is less dense and there is less oxygen available for breathing. Oxygen is in even shorter supply in cases of avalanche burial and completely unavailable to the lungs in cases of water submersion.
- **Obstruction of the Upper Airway** – This can result from inhaling a foreign object, food, vomit, blood or from anaphylactic shock.Obstruction of the Upper Airway
- **Improper Lung Operation** – Lung operation is impaired when fluid (such as pus, blood, water) enters the alveoli.
- **Interference with the Integrity or Function of the Chest and Breathing Apparatus** – Trauma to the lung, chest wall, diaphragm or damage to the nerves and muscle tissue, can prevent proper oxygen supply.
- **Interference with the Central Nervous System** – Head injuries, stroke or meningitis could impair the nervous system's ability to communicate effectively with the respiratory system.
- **Abnormal Function of the Cardiovascular System** – Heart attacks, severe bleeding, head injuries, loss of vasomotor tone or peripheral resistance in the blood vessels can all diminish blood flow, which in turn reduces oxygen levels available to the body's cells

Glucose ($C_6H_{12}O_6$)

Glucose Function

Glucose is the body's most important metabolic nutrient and the preferred nutrient of most of the cells. It is a simple carbohydrate or monosaccharide (the simplest form of sugar) derived from the digestion and breakdown of complex carbohydrates such as disaccharides (table sugars) and polysaccharides (starches found in bread, rice, pasta, fruit, cereals).

Any excess glucose is generally stored by the liver in the form of glycogen for general use when supplies are low. When both glucose and glycogen levels are low, most cells can turn to the components of proteins and lipids for alternative sources of energy. On the other hand, brain cells depend exclusively on a constant supply of glucose for all their energy needs (except in the case of prolonged fasting, in which case ketones become the main substrate). Because glucose cannot easily be stored in the tissues of the nervous system, minimum sugar levels must be maintained at all times in the blood. Blood sugar levels are regulated by two hormones, insulin and glucagon. Levels rise after a meal and eventually fall again over several hours, being at their lowest in the morning before the first meal of the day.

Glucose-Related Problems

Glycogen stores in the body are not large and can be severely depleted in a number of hours during heavy exercise if carbohydrates are not consumed. Conversely, ingesting too many simple carbohydrates on a regular basis can elevate blood glucose levels beyond what the body can safely tolerate.

Common Causes of Interrupted Glucose Supply

- **Diabetes** is a hormonal disorder in which the body does not produce enough or no insulin to meet its needs, making it unable to use sugar (for more information, see Medical emergencies (p. 200)).
- **Gastrointestinal Illnesses**, such as bacterial or viral infections or seasickness that involve severe vomiting or diarrhea, can disrupt the absorption of glucose and other nutrients from the gastrointestinal system.
- **Insufficient Nutrition** for the amount of work being performed.

Electrolytes (K+, Na+, Cl-)

Electrolytes are inorganic ionic compounds They include potassium (K^+), sodium (NA^+) and chlorides ($Cl^{-)}$. They are called electrolytes because of their ability to conduct an electric current when in solution. They are found in the foods we eat and are essential to maintaining homeostatic balance within the body's extracellular fluid.

Electrolyte Function

Electrolytes are used in all parts of the body and are essential to the normal function of all cells. Sodium is the dominant electrolyte found in extracellular fluid. Potassium is the dominant electrolyte found in intracellular fluid. Among other activities, electrolytes are principally used to control body hydration, maintain pH balance and activate muscle and nerve tissue.

Body Hydration

Sodium is an essential element in body fluid homeostasis. Whenever the kidneys detect a change in sodium levels in the body, they will act to increase or decrease sodium output in the urine, as well as to induce greater urine production or conversely greater water retention to help regain electrolyte homeostasis.

Muscle and Nerve Activity

The brain, nervous tissue and muscle tissue all require electrical signals to function and communicate. The contraction of a muscle, for instance, requires a precise influx and output of calcium, sodium and potassium across muscle cell membranes. In the case of nerve transmission, opposing sodium and potassium ions are used to create an electrostatic charge on cell membranes. The dissipation of this charge is what allows nerve impulses to be transmitted from one cell to another.

Electrolyte-Related Problems

Any severe imbalance in electrolyte levels can result in grave cell malfunction and in extreme cases be fatal. Too much or too little potassium, for instance, can profoundly affect the nervous system and can cause irregular heart beats (arrhythmia). Furthermore, a rapid decrease in sodium levels in the blood (hyponatremia) can impair vital functions and even lead to coma or death due to cerebral oedema.

Common Causes of Electrolyte Imbalance

- **Prolonged Exercise** – Electrolytes are lost through sweating and must be replaced along with water during prolonged physical exercise.
- **Gastrointestinal Illnesses** – Along with water, large quantities of sodium, chloride and potassium are lost through vomiting and diarrhea.
- **Kidney Disease** – Since the kidneys are part of the body's system of regulating hydration, any malfunction in the kidneys will result in poor electrolyte balance.
- **Excessive hydration** (with water or low electrolytes concentration drinks) can lead to hyponatremia (a decrease in the sodium plasmatic level) through a dilution effect.

Blood Pressure (BP)

The body uses circulatory pressure to regulate fluid movement. Body fluids, including blood, flow from areas of high pressure toward areas of lower pressure.

Circulatory Pressure is often divided into three types.

- **Arterial or blood pressure** refers to the pressure found within the arteries.
- **Venous pressure** refers to the pressure found within the veins.
- **Capillary pressure** refers to the pressure found within the capillaries.

The pressure varies among the three types, with venous pressure being relatively low and arterial pressure being relatively high.

Blood Pressure Function

Blood pressure is the pressure exerted by circulating blood against the walls of the blood vessels. The level of pressure depends on both the volume of blood pumped from the heart (cardiac output) and the resistance exerted by the vessels against the blood (total peripheral resistance). The greater the volume and the greater the peripheral resistance, the greater the pressure. The greater the pressure, the faster the flow.

Pressure-Related Problems

Adequate blood pressure must be maintained at all times to supply all parts of the body with blood and the essential elements it transports. Any major disruption in blood supply or blood pressure is a medical emergency and is potentially fatal.

Common Causes of Blood Pressure Problems

- **Lack of sufficient Blood Volume** – Adequate fluid volume is required to maintain blood pressure. Severe bleeding or dehydration can lead to a substantial loss of fluid, and will jeopardize pressure.
- **Damage to the Heart** – Any damage to the heart or its functions can inhibit blood output into the arterial system. For example: myocardial infarction, arythmia, etc.
- **Blood Vessel Damage** – Certain types of illness or trauma could affect the blood vessels' ability to adapt to changing conditions. For example: anaphylaxis, sepsis and intoxication.
- **Nervous System Problems** – Any interference with the nervous system's ability to receive and send signals could jeopardize its proper control of blood vessels, such as in the case of spinal injury, for example.

Temperature (°C)

Heat is a by-product of all metabolic activity in the body, and an important regulator of enzyme activity in the cells.

Temperature Function

All living organisms are subject to vast changes in environmental temperatures. The enzymes that control metabolic activity function within very narrow limits above and below a core temperature of 37 degrees Celsius or 98.6 degrees Fahrenheit. As the body cools, metabolic activity diminishes, and once the temperature drops below the enzymes' thermal threshold the enzymes will stop functioning altogether. Higher body temperatures, on the other hand, will increase metabolic activity until a certain threshold beyond which enzyme activity is halted.

Different body tissues have different levels of tolerance to changes in temperature. Skin tissue at the extremities (fingers and toes) can tolerate and survive a fairly wide range of hot and cold. Heart tissue, on the other hand, must remain within a very narrow temperature range to function and survive. As a result, maintaining the core body temperature within its narrow range is a vital homeostatic activity for tissue no less than for enzymes.

Thermoregulation depends on a variety of functions, including adequate tissue hydration and blood volume, adequate food consumption and physical activity. Any significant drop in fluid levels can lead to a drop in temperature. Since heat is generated when cells assimilate nutrients, an inadequate food intake by the body can in turn lead to a drop in body temperature. Finally, physical activity is the body's principle source of heat production. Over-exertion in hot climates can increase core body temperature very quickly and lead to substantial fluid loss through increased perspiration.

Common Causes of Temperature Problems

- **Insufficient Nutrition** – Food is processed in the body to produce heat.
- **Insufficient Water** – Fluid is used for metabolic activity, to transport heat throughout the body and to remove it from the body.
- **Insufficient Protection from a Cold Environment** – In a cold environment the body can easily lose heat faster than it can produce it.
- **Illness or Injury** – Any problem that will reduce our ability to move will greatly reduce heat production.

Acid-Base Balance (pH)

Acids and bases are extremely important compounds used by the body for homeostatic regulation and for the effective functioning of cells. Acids are substances that release hydrogen ions (H^+) when put into solution. Fluids with a high concentration of hydrogen ions are therefore referred to as acidic. These include table vinegar and hydrochloric acid found in the stomach. Bases are substances that release hydroxide ions, which in turn r^{em}ove hydrogen ions from solution. Fluids with a low concentration of hydrogen ions are therefore considered base or alkaline. These include ammonia and lye. The dynamic relationship between acids and bases is known as an acid-base balance or pH.

pH Regulation

Because hydrogen ions are so reactive, in excessive numbers they can disrupt cell and tissue function by breaking chemical bonds and changing the shapes of complex molecules. As a result, the concentration of hydrogen ions in the body's fluids must be carefully regulated and remain within relatively narrow limits.

The hydrogen ion concentration of a solution is measured in terms of its pH value, which is a scale going from 0 to 14, 0 being the most acidic and 14 the most basic. A solution with a pH of 7 is called neutral. For enzymes to function effectively the pH of body fluids must remain within the relatively narrow window of 7.35 and 7.45. A person is considered to have acidosis whenever the pH value falls below this range.

pH-Related Problems

The regulation of hydrogen ions is one of the most important aspects of homeostasis. Slight changes in pH can cause a significant alteration in the rates of chemical reactions in the cells of the body. Most problems occur when the body overproduces hydrogen ions and the pH drops below 7. An acid-base equilibrium is maintained in the body primarily through the exchange of oxygen and carbon dioxide in the lungs and through the excretion of acids and bases by the kidneys.

Common Causes of Altered pH Values

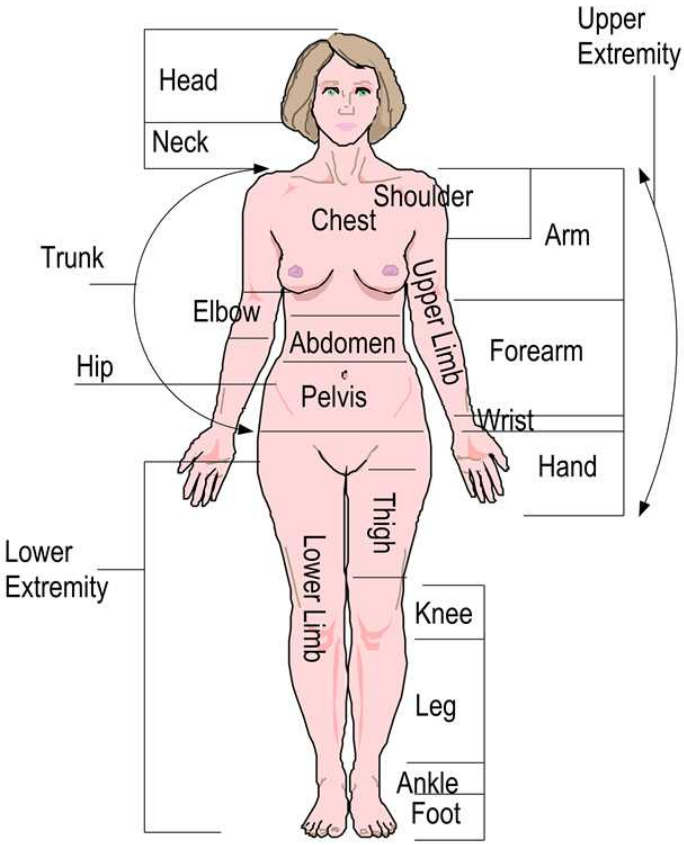
- Metabolic disturbances, i.e. diabetes and certain drug intoxications (for example: ASA, alcohols, etc.)
- Respiratory and cardiovascular system problems.
- Inadequate tissue hydration.
- High altitude.

3.2 Anatomical Terminology

To communicate effectively, medical professionals need a highly precise and detailed map of the human body. The universally accepted system uses prominent surface features of the anatomy as landmarks. Physical characteristics or injuries are identified and located in relation to these landmarks. Anatomical terminology therefore includes the body's external features and surface landmarks as well as anatomical postures and movement, direction and location.

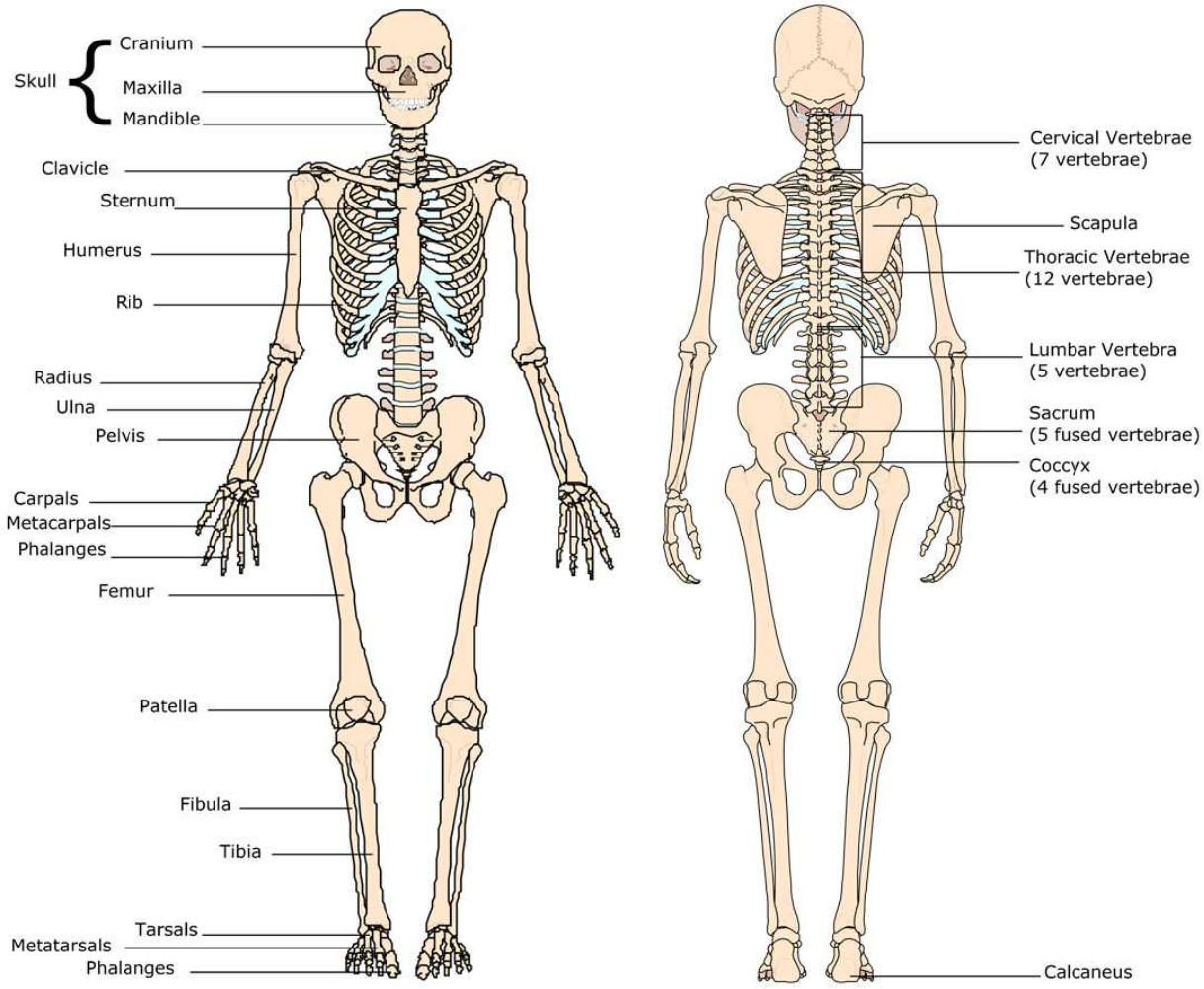
3.2.1 Surface Anatomy

The visible features or anatomical landmarks of the body are collectively referred to as surface anatomy.

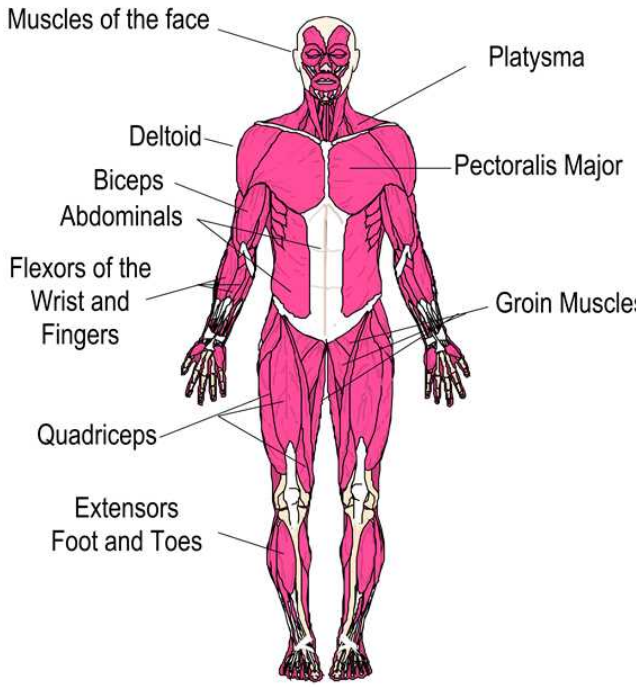


3.2.2 Axial and Appendicular Skeleton

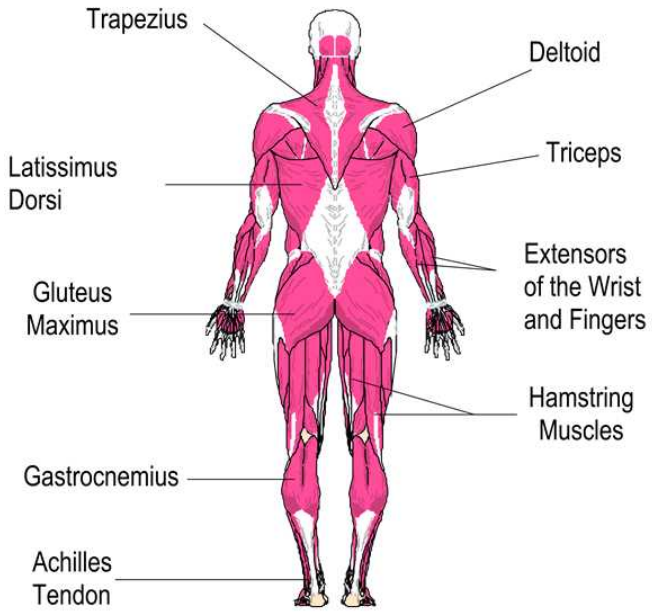
- The **axial skeleton** refers to the head and trunk of the body. It includes the skull, spinal column, sternum, ribs and sacrum.
- The **appendicular skeleton** relates to the appendages or limbs of the body. It includes the limbs (arms and legs) and the pectoral and pelvic girdles, which connect the limbs to the axial skeleton.



3.2.3 Major Muscles of the Body



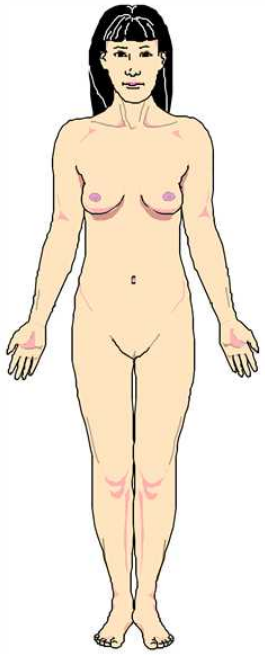
Anterior view of the muscles of the body



Posterior view of the muscles of the body

3.2.4 Anatomical Position

Anatomical terms are applied to the body in a specific position of reference. The anatomical position is the position in which the body is erect and facing the observer, with the arms at the sides and the palms facing forward, as shown here.



Positional Terms

The following terms are used to describe other body positions.

- **Supine position** – The patient is lying face up.
- **Prone position** – The patient is lying face down.
- **Lateral recumbent** – The patient is lying on the left or right side (e.g. right lateral recumbent).
- **Position of function** – Joints and limbs are in a normal and relaxed position.
- **Position of comfort** – The patient assumes a position that maximizes comfort.

3.2.5 Anatomical Planes and Sections

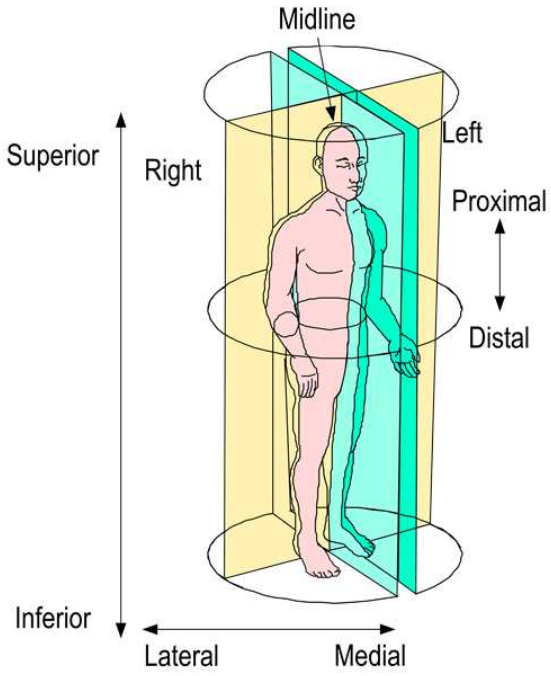
Anatomical planes are divisions of the body used to describe body parts in relation to each other.

- **Sagittal** – A division producing right and left sections.
- **Frontal** – A division producing anterior and posterior sections.
- **Transverse** – A division producing inferior and superior sections.

3.2.6 Anatomical Directions and Locations

The following terms are used to describe directions and locations. **Direction** refers to movement relative to the axes of the body. **Location** refers to a position that is relative to the position of another landmark or point.

- **Superior** – Towards the head.
- **Inferior** – Towards the feet.
- **Anterior** – Towards the front.
- **Posterior** – Towards the back.
- **Medial** – Towards the centre of the body.
- **Lateral** – Left or right of the midline of the body.
- **Proximal** – Towards the attachment of an extremity.
- **Distal** – Away from the attachment of an extremity.
- **Superficial** – Towards or on the surface of the body.
- **Deep** – Away from the surface of the body.



3.2.7 Anatomical Cavities

Many vital organs are suspended in internal chambers called body cavities. Cavities have two principal functions – to protect delicate organs like the brain from accidental shock or unexpected bumps and to allow visceral organs like the lungs, heart and intestines to expand and contract without distorting surrounding tissues or disrupting the functioning of nearby organs. There are two main classes of cavities – dorsal and ventral.

Dorsal Cavities

Dorsal cavities (from the Latin dorsum, back) include the head and spine.

- The **cranial cavity** encloses the brain.
- The **spinal cavity**The spinal cavity encloses the spinal cord.

Ventral Cavities

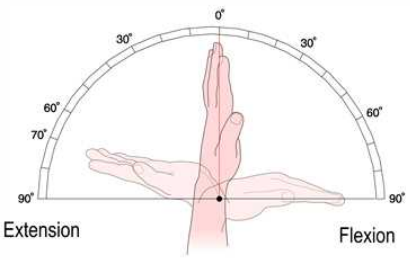
Ventral cavities (from the Latin ventralis, related to the belly) include all those cavities found within the body's torso and pelvis. It's divided into three:

- The **thoracic or chest cavity** includes the pericardial cavity surrounding the heart and a pleural cavity surrounding each lung.
- The **abdominal or peritoneal cavity** extends from the diaphragm at the base of the thoracic cavity down to the superior margin of the pelvic girdle.
- The **pelvic cavity** includes the area of the pelvis immediately inferior to the abdominal cavity.

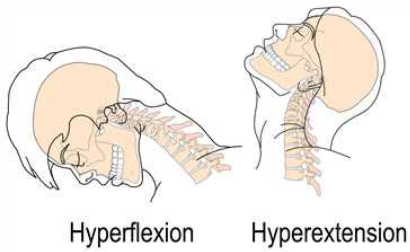
3.2.8 Joint Movements

A joint is the articulation between bones. The following terms describe the most common movements of a joint.

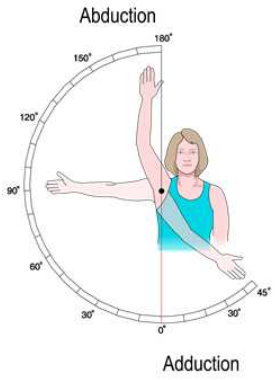
- **Flextion** refers to the act of bending a joint.
- **Extension** refers to the act of straightening a joint.



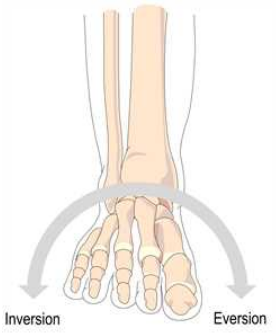
- **Hyperextension** refers to the extension of a joint beyond its normal range of motion.
- **Hyperflexion** refers to the flexion of joint beyond its normal range of motion.



- **Adduction** refers to movement of a limb towards the body.
- **Abduction** refers to movement of a limb away from the body.
- **Inversion** refers to the inward movement of the sole of the foot at the ankle joint.



- **Eversion** is the outward movement of the sole of the foot at the ankle joint.
- **Plantarflexion** refer**s to the extension** of the ankle joint The term describes the movement of the plantar surface (or sole) of the foot relative to the joint.

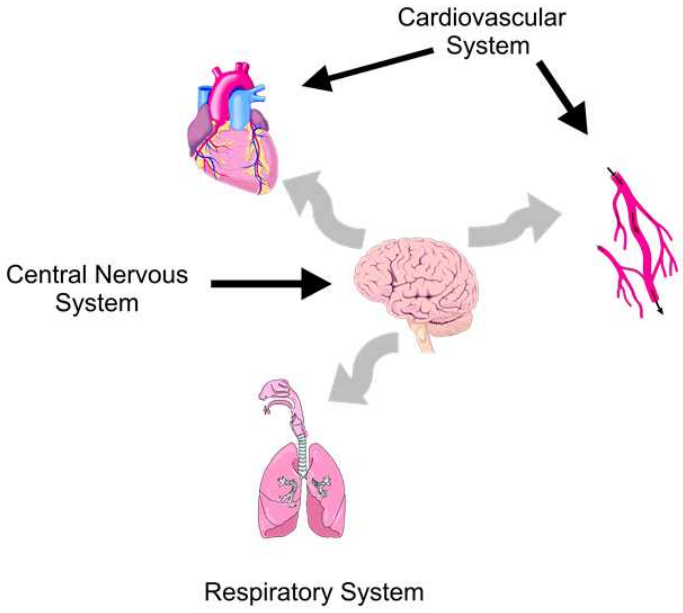


- **Dorsiflexion** refers to flexion of the ankle joint. The term describes the movement of the dorsum (top) of the foot relative to the joint. The term describes the movement of the dorsum (top) of the foot relative to the joint.
- **Rotation** refers to rotation of a bone around its long axis.
- **Pronation of the forearm** refers to the movement of the forearm around its long axis, with the palm of the hand rotated in a posterior or downward position.
- **Supination of the forearm** refers to the movement of the forearm around its long axis, with the palm of the hand rotated in an anterior or upward position.

4. Body Systems

There are eleven body systems – cardiovascular, respiratory, nervous, digestive, reproductive, urinary, muscular, skeletal, endocrine, lymphatic and the skin. The urinary and reproductive systems are often referred to collectively as the genitourinary system, the muscular and skeletal systems are often grouped together as the musculoskeletal system, and the cardiovascular and lymphatic systems are sometimes collectively known as the circulatory system.

All the different body systems are involved in the process of maintaining homeostasis. Our lungs (respiratory system) need to be intact and healthy to breathe in adequate amounts of air. Our heart (cardiovascular system) has to pump oxygenated blood efficiently to all parts of the body as well as non-oxygenated blood back to the lungs. Our blood vessels (cardiovascular system) have to have good muscular tone to be able to maintain blood pressure and control blood flow. The brain (nervous system) needs to be able to perceive any changes in internal and external temperature, atmospheric and blood pressure, internal pH levels, among other things, to make the appropriate adjustments.



Most of the body systems are explained in subsequent chapters. Because of their vital importance in maintaining basic cellular function, however, the nervous, cardiovascular and respiratory systems are categorized as primary organ systems and are explained in some detail here.

4.1 The Respiratory System

The primary function of the respiratory system is to supply oxygen (O_2) to the body and to remove excess carbon dioxide (CO_2) and other metabolic waste products. As this gas exchange occurs, the respiratory system also contributes to the homeostatic regulation of pH values in the blood.

The respiratory system is organized into several components: **the upper airway**, the **lower airway**, the **lungs**, the **pleura**, the**diaphragm**, and the thoracic **muscles** and **bones**. The airway is the passage through which air enters the body and descends to the lungs. In emergency care, the term “airway” usually refers to the upper airway.

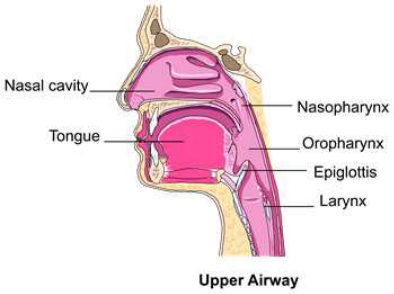
Upper Airway

The structures of the upper airway include the **mouth**, the **nose**, the **nasal cavity**, the **pharynx** and the**epiglottis**.

During inhalation air enters the nose and mouth and passes through the nasal cavity and throat where it is warmed to body temperature and humidified before it descends into the wind pipe and down to the lungs.

The Pharynx

The pharynx is a cavity that begins at the back of the nose and runs down behind the mouth to the epiglottis. It is shared by the digestive and respiratory systems.



Upper Airway

The pharynx is made up of two parts. The **nasopharynx** lies behind the nasal cavity. The **oropharynx** is located behind the mouth and extends down to the epiglottis.

The Epiglottis

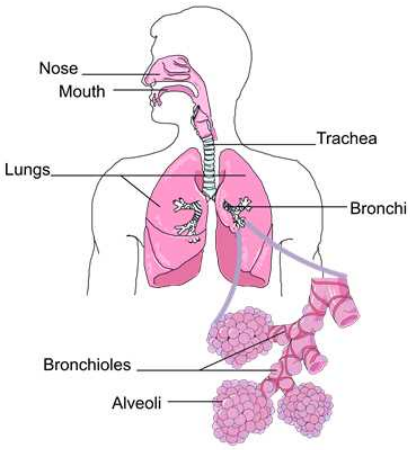
The epiglottis is an elastic cartilage located at the opening of the wind pipe or trachea. During regular breathing, the epiglottis must remain open for air to flow down the trachea into the lungs. When food is swallowed, the epiglottis naturally closes to prevent food from entering the trachea, which could cause an airway obstruction. This essential reflex is absent in the unconscious patient.

Lower Airway

The lower airway is made up of the **larynx**, **trachea** and **lungs**.

The Larynx

The larynx is a cartilaginous structure located at the top of the trachea and containing the vocal cords. The vocal cords are two folds of mucous membrane stretched horizontally across the larynx. They are open during inhalation. To produce sound, they are brought together and made to vibrate during exhalation.



The walls of the larynx also contain bands of smooth muscle that can constrict and close the trachea if there is an insult to the lungs such as when a person inhales toxic smoke or water.

The Trachea

The trachea or wind pipe is a flexible tube that runs parallel and anterior to the esophagus. It is made up of cartilaginous rings to give the trachea rigidity and prevent it from collapsing during breathing. The rings are open at the back, so as not to inhibit the passage of food through the esophagus.

The Lungs

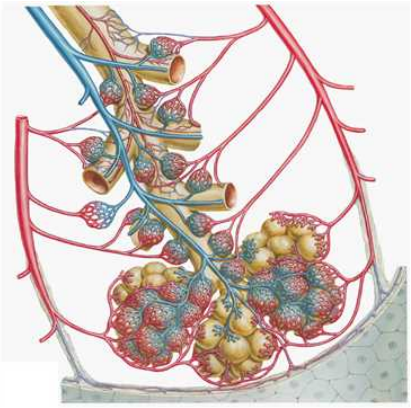
The lungs consist of the **bronchi**, the **bronchioles** and the **alveoli**.

The Bronchi

The primary bronchi are two cartilaginous tubes extending left and right from the base of the trachea into the lungs. They branch into secondary and tertiary bronchi, at each stage becoming increasingly smaller and eventually losing their cartilaginous structure. At this stage they become bronchioles.

The Bronchioles

The bronchioles help to control airflow resistance and air distribution to the lungs. The walls of the bronchioles contain smooth muscle and are lined with a mucus-secreting membrane. Constriction of these smooth muscles can almost entirely block the passage of air. In an asthma attack or an allergic reaction, for instance, an inhaled allergen or foreign substance will cause the bronchioles to narrow and produce excess mucus.



Like the bronchi, the bronchioles continue to branch into ever-smaller passageways. The finest of these deliver air to the respiratory surfaces of the lungs, the alveoli.

The Alveoli

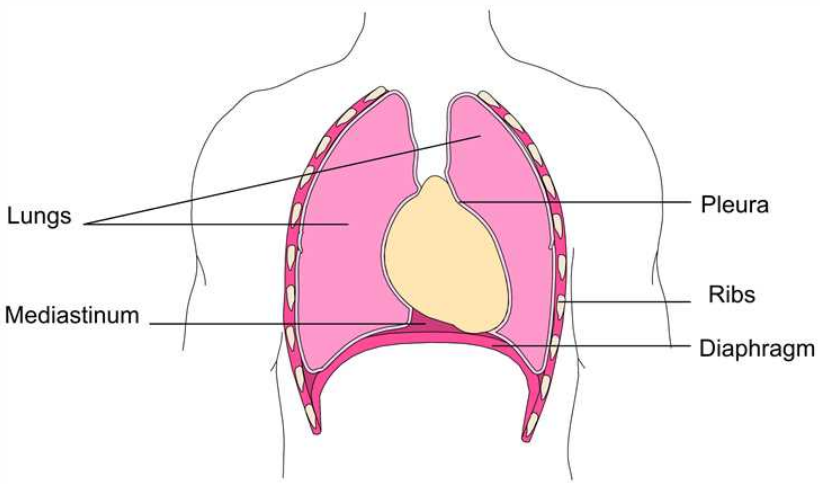
The alveoli are exchange surfaces, where oxygen is diffused from the lungs into the blood and where carbon dioxide is transported from the blood back into the lungs.

Thoracic Cavity

The thoracic or chest cavity is made up of the ribcage, the thoracic vertebrae and the diaphragm. The main part of the chest is the 12 pairs of ribs, which are attached to the vertebrae at the back. The ribs are also connected to the sternum (breast bone) in the front, except for the last 2 pairs of floating ribs. Between each pair of ribs are several layers of intercostal muscles. The thoracic cavity is separated from the abdominal cavity by the muscular diaphragm.

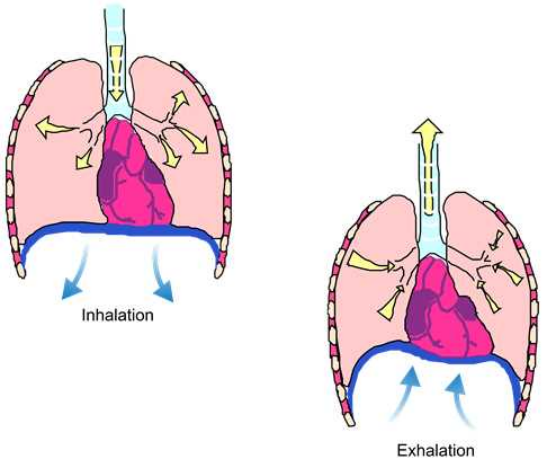
The Mediastinum and Pleural Cavities

The thoracic cavity is divided into two smaller cavities, the right and left pleural cavities. These are separated by the mediastinum, a central compartment containing the heart and its great vessels, the trachea and the esophagus.



The right pleural cavity contains the right lung and the left pleural cavity contains the left lung. Thin membranes called the pleura line the inside of each cavity (parietal pleura) and the outer surface of the lungs (visceral pleura) to form a closed sac. The two pleural linings are separated by a film of fluid known as surfactant, which lubricates the layers as the thoracic cage and the lungs expand and contract during breathing.

4.1.1 Breathing Process



Breathing results from changes in volume within the thoracic cavity. Because there is no air or space between the parietal and visceral pleural linings, the surfactant or fluid bond between them keeps the surface of each lung right up against the chest wall and superior surface of the diaphragm. Any movement of the chest wall or diaphragm will therefore have a direct impact on the volume of the lungs.

During **inhalation** , the diaphragm contracts and pulls downward while the outer intercostal muscles contract to raise the ribs and expand the chest wall. This increases the volume of the thoracic cavity, which in turn lowers the pressure, and air rushes through the airway and into the lungs to equalize the pressure.

During **exhalation** , the diaphragm relaxes. The decreased volume of the cavity causes the pressure to increase and forces the air from the lungs out through the airway. While at rest, exhalation is normally a passive process utilizing the elastic recoil of the lungs, chest wall and diaphragm to return the chest to its original size and shape.

Breathing measurement

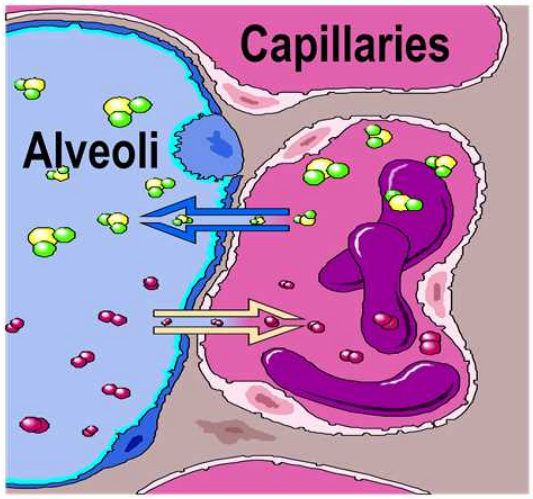
Breathing is measured as a function of **respiratory rate** (number of breaths per minute) and **tidal volume** (amount of air inhaled and exhaled with each breath). The respiratory rate for the average adult at rest ranges from 12 to 20 breaths per minute. The tidal volume during a normal quiet respiratory cycle averages approximately 500 ml.

Components Required for Breathing

- For normal breathing to take place several conditions must exist.
- The airway must be open and free of obstruction.
- The chest wall and thoracic cavity must be intact and have at least one lung functioning.
- The pleural space must be intact with negative pressure.
- The nervous system, which controls respiratory function, must be functioning normally, allowing the respiratory centre in the brain to react to changes in the carbon dioxide level in the blood.
- The cardiovascular system must be functioning normally.

Gas Exchange

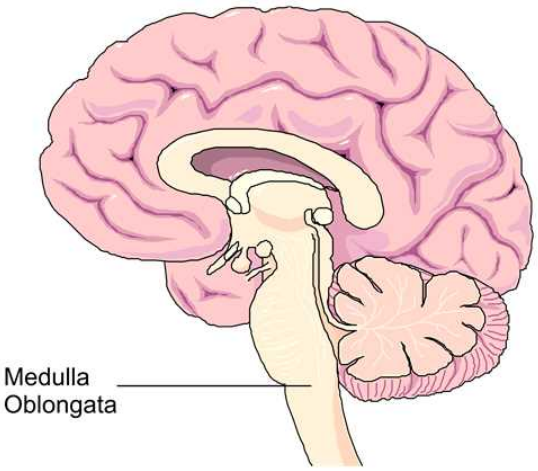
The major function of the respiratory system is gas exchange. The body's source of oxygen comes from air in the atmosphere. Atmospheric air is made up of nitrogen (78 percent), oxygen (21 percent), carbon dioxide (0.04 percent) and trace amounts of other gases.



During inhalation, air is taken into the respiratory system. Oxygen molecules are transferred by diffusion from the lungs to the blood and then transported to the cells and tissues of the body. Simultaneously, carbon dioxide molecules pass from the blood to the lungs to be moved out of the body through exhalation. Exhaled air contains all the same elements as atmospheric air but in different concentrations: nitrogen (78 percent), oxygen (17 percent), carbon dioxide (4 percent) and trace amounts of other gases.

Regulation of Breathing

The ultimate goal of respiration is to maintain proper concentrations of oxygen, carbon dioxide and hydrogen ions in body fluids and tissues. Breathing is regulated by the respiratory centre, which is located in the medulla oblongata at the base of the brain. Excess carbon dioxide or hydrogen ions in the blood will trigger a direct excitatory effect on the respiratory centre, which responds almost instantaneously to change respiration rates and restore homeostatic balance.



Respiratory disturbances can be caused by a variety of triggers. These include trauma to the head, neck and thoracic cavity, allergic reactions, poisoning, sleep apnea and other medical problems affecting the function of the respiratory organs. Other factors that stimulate the respiratory centre to act include changes in body temperature, ingested stimulants or depressants and emotions such as pain, fear and excitement.

4.2 The Circulatory System

Sometimes used interchangeably with the cardiovascular system, the term circulatory system in this manual includes the two principal systems of fluid transportation in the body – the cardiovascular and lymphatic systems.

4.2.1 The Cardiovascular System

Functions of the Cardiovascular System

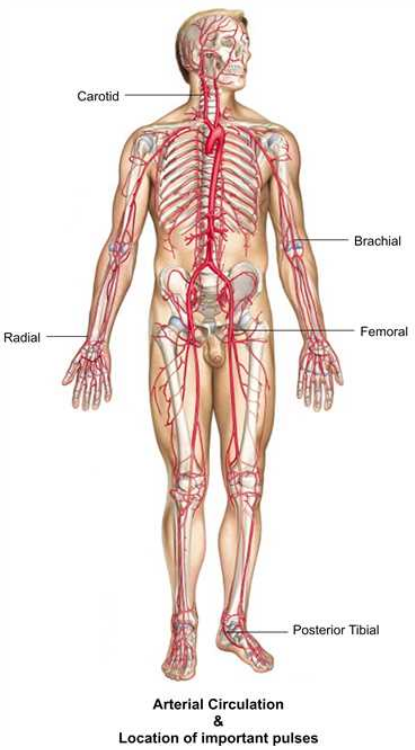
- Transports nutrients, gases and hormones.
- Transports wastes and carbon dioxide.
- Circulates and distributes fluids.

- Assists in temperature regulation.
- Protects against disease.

The cardiovascular system is made up of the **heart,** the **blood** and the **blood vessels**. The heart is a muscular fist-sized organ located between the two lungs and protected by the rib cage. It pumps nutrient- and oxygen-rich blood throughout the body and oxygen-poor blood back to the lungs. The blood vessels serve as the distribution system of blood to all of the body's cells.

Blood Vessels

Blood vessels are subdivided into two circuits. The **pulmonary circuit** carries blood back and forth between the heart and the alveoli of the lungs. The **systemic circuit** carries blood back and forth between the heart and the rest of the body. Both circuits have three types of blood vessels: arteries, veins and capillaries.



Arterial Circulation
&
Location of important pulses

The **Arteries**and the **arterioles** constitute a high-pressure distribution system that carries oxygen-poor blood from the heart to the lungs (pulmonary circuit) and oxygenated blood from the heart to all other regions of the body (systemic circuit). The walls of the arteries and arterioles contain smooth muscle fibres that assist in maintaining adequate pressure inside the vessels. They constrict or become smaller (vasoconstriction) to increase blood pressure or relax and become larger (vasodilation) to decrease blood pressure.

The aorta is the largest artery, originating at the heart and transmitting oxygenated blood into the arterial systemic circuit.

Veins and **venules** comprise a low-pressure system whose principal function is to return oxygenated blood to the heart from the lungs (pulmonary circuit) and oxygen-poor blood to the heart from all other parts of the body (systemic circuit). One-way valves located inside large veins promote the flow of blood toward the heart. The walls of veins are elastic and contain smooth muscle fibres that control the diameter of the vessels. The heart receives blood from the systemic circuit via two large veins, the superior vena cava (delivering blood from the upper half of the body), and the inferior vena cava (delivering blood from the lower half of the body).

Capillaries are the smallest blood vessels and connect arterioles to venules. Their thin walls allow for the diffusion of oxygen from the arterial system to surrounding tissues and the transport of carbon dioxide and waste materials from the tissues back to the venous system.

Distribution of blood within the capillaries is controlled by **pre-capillary sphincters** that are located at the junction of the arterioles and the capillaries. Contraction of a pre-capillary sphincter removes the capillary from active circulation, an action known as **shunting**. This can be observed by looking at your hands when they are cold. The skin here will generally be much paler than the skin of warmer areas of the body.

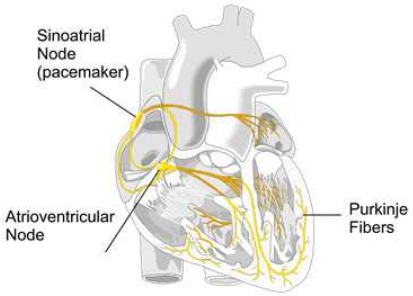
The Heart

The heart is divided into two pumps. The right pump sends oxygen-poor blood from the veins to the lungs and the left pump sends oxygen-rich blood from the heart to all parts of the body. Each pump is divided in turn into two chambers : **atrium** (upper) and the **ventricle** (lower). The right atrium receives blood from the systemic blood circuit and the right ventricle discharges blood into the pulmonary blood circuit in the lungs. The left atrium receives blood from the pulmonary circuit and the left ventricle discharges blood through the aorta to all the body's arteries.

Specially designed valves are located at the entrances and exits of each of these chambers to prevent backflow of the blood.

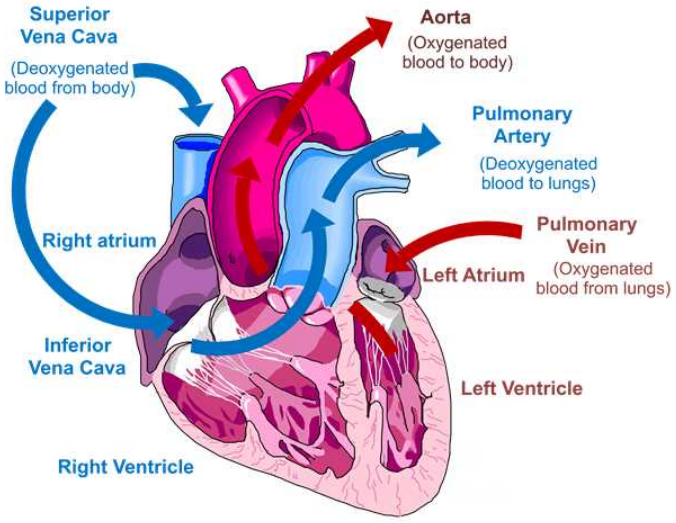
The Heart's Electrical System

The heart is made up primarily of muscle tissue. A network of nerve fibres coordinates the contraction and relaxation of the cardiac muscle tissue to obtain an efficient, wave-like pumping action. When the heart is working normally, an electrical impulse begins in the sinoatrial (SA) node or pacemaker of the heart. The impulse then travels to the atrioventricular (AV) node and moves through to the Purkinje fibres of the ventricles. This electrical flow is what produces a coordinated pumping contraction.



4.2.2 Cardiac Cycle

Each heartbeat is a complex and precise sequence of contractions and releases of the atrial and ventricular heart muscles. A single cardiac cycle includes a contraction or **systole** phase and a relaxation or **diastole** phase. During the contraction phase, the atrial or ventricular chamber pushes blood into an adjacent chamber or into an artery. During the relaxation phase, the chamber fills with blood and prepares for the next cardiac cycle. In a healthy heart, atrial contraction and relaxation are slightly out of phase with ventricular contraction and relaxation. If the atria and ventricles contracted at the same time, the valves between them would be closed and blood could not flow from one to the other.



The double thumping sound of a heartbeat heard through a stethoscope is the sound of the heart's valves as they close. The first thump represents the closing of the valves between the atria and ventricles. Following immediately afterward, the second thump represents the closing of the valves leading from the ventricles into the pulmonary and systemic circuits.

Cardiac Output

When necessary, the heart can adjust both the rate at which it pumps blood (heart rate) and the volume of blood expelled with each beat (stroke volume). Cardiac output is calculated by multiplying the stroke volume by the heart rate.

Pulse

The pumping action of the heart creates a palpable pulse in the arteries. The pulse is an effective way of measuring heart rate at those sites in the body where the arteries come close to the body's surface. A heart rate measurement is

based on the number of times the heart beats per minute. The normal range of heart rate in an adult at rest is between 60 and 100 beats per minute. The most common locations for measuring the arterial pulse are the radial artery on the inside of the wrist and the carotid artery on the side of the neck.

Blood Pressure

The push exerted by cardiac contraction creates a force or pressure of the blood against the vessel walls. This pressure is necessary to supply all parts of the body with blood and the essential elements it transports. The level of blood pressure is determined by both the volume of blood pumped from the heart (cardiac output) and the pressure exerted by the vessels against the blood within them (total peripheral resistance). The measure of this pressure is the blood pressure.

Blood pressure measurement

Blood pressure is most often measured indirectly by listening to the body's internal sounds with the help of a sphygmomanometer, commonly referred to as a blood pressure cuff.

Systolic blood pressure

Is the pressure that is exerted against the walls of the arteries during the contraction of the heart or its systolic phase.

Diastolic blood pressure

Is the residual pressure remaining in the arteries while the heart is at rest, the diastolic phase.

Mean arterial pressure

Three elements are involved in maintaining blood pressure:

- Adequate function of the heart.
- Sufficient blood vessel or vascular tone.
- Sufficient blood volume.

The interaction of these three elements is reflected in the mean arterial pressure of the body. is the average blood pressure in the cardiovascular system measured during a single cardiac cycle. The relationship between mean arterial pressure, cardiac output and total peripheral resistance is represented by the equation:

Mean Arterial Pressure = Cardiac Output X Total Peripheral Resistance

Any condition that decreases either cardiac output or total peripheral resistance will cause a decrease in the mean arterial pressure. Problems causing loss of blood volume, injuries to the blood vessels or circulation difficulties will therefore all directly result in decreased mean arterial pressure.

4.3 The Nervous System

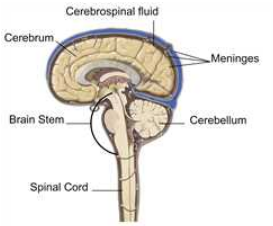
The nervous system plays a key role in maintaining homeostasis. It monitors internal and external environments, integrates sensory information and coordinates all the body systems, including voluntary and involuntary actions and responses. Working closely with all other body systems, the nervous system may be seen as the body's "trip leader."

The nervous system is made up of nerve cells called **neurons**. Neural information is transmitted from one neuron to another or to other cells across a junction known as a **synapse**. The information transfer occurs through the release of chemical messengers called **neurotransmitters.** More than any other body tissue, neural tissue has a very high metabolic rate and requires a constant supply of oxygen and nutrients.

4.3.1 Structural Division of the Nervous System

The nervous system is divided into two structural or anatomical subdivisions. The **central nervous system (CNS)** includes the brain and spinal cord. The **peripheral nervous system (PNS)** is the complex set of nerve pathways that links the central nervous system with all parts of the body.

Central Nervous System (CNS)



The CNS coordinates sensory information and motor commands, and is the seat of all higher functions, such as memory, thought and emotion. As its name suggests, the CNS is made up of the body's central nervous structures – **brain** and the **spinal cord**.

The Brain

The brain can store information, generate thought and determine reactions the body should perform in response to its environment. It is made up of the **cerebrum**, the **cerebellum** and the **brain stem**.

The **cerebrum** is the largest part of the brain. It controls emotion, thought, sight, speech and movement and interprets sensation. Divided in two, each hemisphere of the cerebrum controls activities on the opposite side of the body.

The **cerebellum** lies below the cerebrum and is involved in the control of muscle and body coordination.

The **brain stem** begins at the base of the cerebrum and extends down anterior to the cerebellum into the spinal cord. It is divided from top to bottom into three sections: the **mid-brain**, the **pons** and the **medulla oblongata**. The brain stem (particularly the medulla oblongata) controls our most basic autonomic functions, including breathing, swallowing and blood pressure.

The Spinal Cord

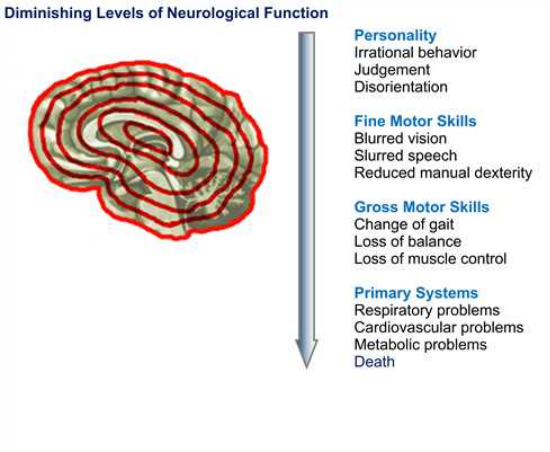
The spinal cord is made up of thin, tubular bundles of nerve cells that are enclosed in and protected by the bony vertebral column. The spinal cord is an extension of the brain down into the body, facilitating the transmission of neural signals between the brain and the periphery.

The Meninges, Cerebrospinal Fluid and Intracranial Pressure

The brain is extremely delicate and is protected from the hard bony structures of the skull by a triple-layered membrane called the **meninges**. The middle layer of the meninges is filled with a clear fluid called **cerebrospinal fluid (CSF)**, which cushions the brain and helps to maintain a constant **intracranial pressure (ICP)**.

CNS Hierarchy

The central nervous system functions according to a strict hierarchy. The most complex functions emanate from the cerebrum while the least complex emanate from lower down the spinal cord. The cells responsible for the most complex tasks are also the most sensitive to any changes in the body's internal environment, such as diminished oxygen or glucose levels. The first signs of nervous system damage will therefore manifest as impaired function of the most complex tasks. These include personality changes, irrational thought and inability to solve problems. Slurred speech and blurred vision might indicate more serious damage to the brain, and severe respiratory and cardiovascular problems could be signs of the most advanced neurological damage.



Peripheral Nervous System (PNS)

The **peripheral nervous system** is the set of nervous pathways linking the central nervous system with the rest of the body. It controls all sensory and motor functions in the body.

Nervous System Communication

The PNS includes two types of neurons, sensory and motor neurons.

Sensory Neurons

transmit sensory information from various parts of the body and from external stimuli to the central nervous system.

Sensory receptors

These stimuli are picked up by **sensory receptor**, which are specialized cells located in nerve endings throughout the body. and used to inform the brain about the state of the body and the surrounding environment. The body has many different kinds of sensory receptors.

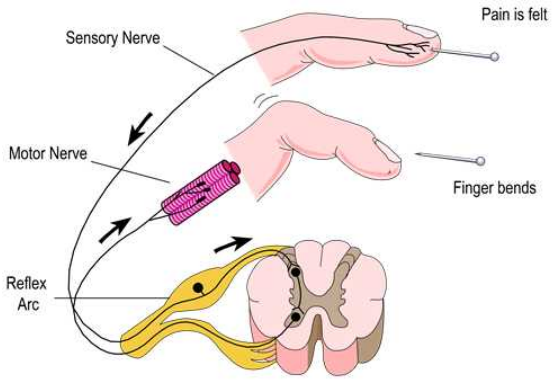
- **Tactile receptors** are found in the skin and provide information related to touch.
- **Nociceptors** are sensitive to pain.
- **Baroreceptors** measure pressure changes in the blood vessels and cranium.
- **Chemoreceptors**measure the chemical composition of the blood and other fluids, including concentrations of oxygen, hydrogen ions, carbon dioxide and glucose.
- **Thermoreceptors** measure temperature in various parts of the body.
- Other sensory receptors are found in the sensory organs, including the eyes, ears, taste buds and nose.

Motor Neurons

respond to information provided by the sensory system. They issue specific motor commands that activate and control **effectors,** or targets, such as muscles, organs and glands

Reflexes

are an automatic motor response that helps to preserve homeostasis in situations of immediate urgency. Triggered by a specific stimulus it allows the body to react to urgent sensory information before it is sent to the brain. Reflex perception and response occur through what is known as a reflex arc and uses both sensory and motor neurons. An outside stimulus, such as pain will activate a receptor, which in turns activates a sensory neuron. That information is processed by the CNS in the spine and will activate a motor neuron to respond with a muscle or gland adjustment.



The endocrine systems

The **endocrine system** is a system of glands that is responsible for regulating metabolism, tissue function, growth, development and mood. The endocrine system includes, among other glands, the **pancreas**, the **reproductive organs** and the **pituitary**, **thyroid** and **adrenal glands**. These glands secrete chemical messengers, called hormones, which travel through the body's circulatory system to reach their target.

The two systems complement one another. Endocrine system communication tends to be slower than the instantaneous signal transmission of the nervous system. And while the effects of nervous system communication are mostly short-lived, the effects of endocrine system communication tend to be longer lasting. As such, when a more sustained effect is required, the nervous system will stimulate the endocrine system to send the appropriate chemical signals.

4.3.2 Functional Division of the Nervous System

The nervous system is divided into two functional parts: the **somatic nervous system (SNS)**, often called the voluntary nervous system, and the **autonomic nervous system (ANS)**.

Voluntary Nervous System (VNS)

As the name implies the voluntary nervous system governs functions over which a person has control, such as the muscle contractions necessary to put on clothes or move to a warmer environment when feeling cold.

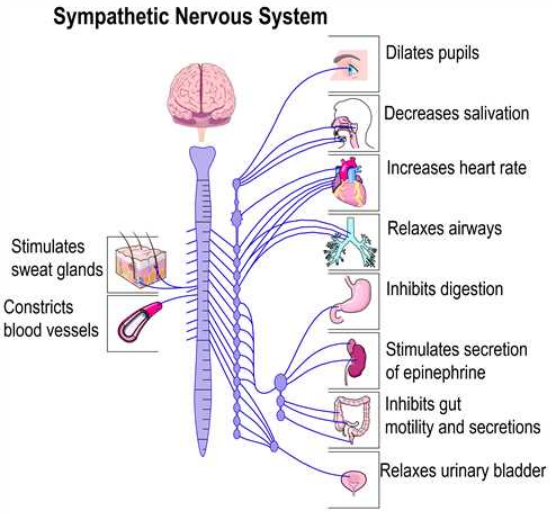
Autonomic Nervous System (ANS)

The autonomic nervous system operates at a subconscious level, controlling such events as the action of the heart and lungs, the diameter of blood vessels, the movements of the gastrointestinal tract and the secretions of the different endocrine glands. It controls body function through direct autonomic stimulation via motor neurons or else by activation of the endocrine system.

The autonomic nervous system also has two subdivisions: **sympathetic nervous system** and the **parasympathetic nervous system**. The sympathetic nervous system has a widespread effect on both autonomic and voluntary structures throughout the body. The parasympathetic nervous system stimulates only autonomic structures. The two systems work in close cooperation. They also exert an opposite influence on some organs, such as the heart, lungs and gastrointestinal tract, in response to different external triggers.

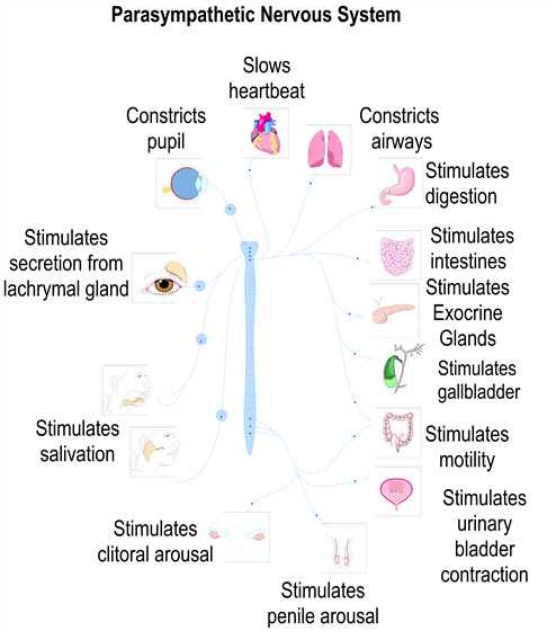
Sympathetic Nervous System

The sympathetic nervous system is often called the “fight or flight” system. It has the important role of increasing alertness, stimulating tissue metabolism and exciting the cardiovascular system, in short, preparing the body for increased activity in response to various forms of physical or psychological stress.



Parasympathetic Nervous System

The parasympathetic nervous system’s primary function is to help conserve energy, lower metabolic rate and promote basic bodily activities, such as digestion, in times of no stress. The parasympathetic response is less widespread than the sympathetic response. The parasympathetic nervous system nevertheless has the profound effect of slowing down the cardiovascular system and reducing tissue metabolism.

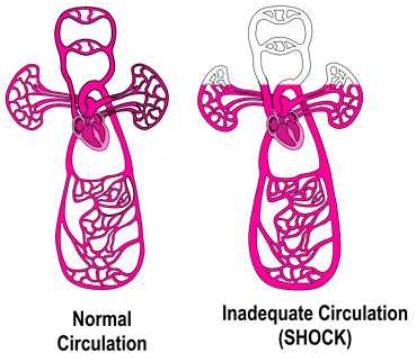


Overview of autonomous effects on various systems, tissues and functions

Organ	Sympathetic stimulation	Parasympathetic stimulation
Respiratory system	Increasing the frequency. Dilation of the airways. Decrease in mucous secretions.	Decreasing frequency. Airway constriction. Increased mucous secretions.
Heart	Increased frequency and contractility.	Decreasing frequency and contractility.
Blood Vessels	Vasoconstriction and vasodilation.	None.
Gastrointestinal tract	Reduced motility and blood supply.	Increased motility and blood supply.
Pupils	Dilation.	Constriction.
Sweat gland	Increased sweating.	None.
Blood coagulation	Increased.	None.
Blood glucose level	Increased.	None.

5. Shock

The primary function of the respiratory system is to provide oxygen to the blood—a process known as oxygenation. The primary function of the cardiovascular system is to circulate oxygenated blood to the tissues and cells of the body—a process known as perfusion. Oxygenation and perfusion are essential to homeostasis and life. When perfusion is diminished body tissues are deprived of oxygen and essential nutrients, while carbon dioxide and other waste products accumulate. Perfusion tolerance varies throughout the body. Skin tissue can survive with relatively little perfusion, while the vital organs and especially the brain need a constant supply of oxygen and nutrients to survive.



Shock occurs when the body's tissues and cells are not adequately perfused and therefore do not receive an adequate supply of oxygenated blood.

Maintaining Circulation and Perfusion

Four physiological factors are required for oxygen to circulate throughout the body and perfuse its cells:

- Adequate blood volume to fill the vessels.
- A heart capable of circulating the blood.
- Blood vessels that can adjust the muscle tone in their walls and control the flow of blood.
- A respiratory system able to transfer sufficient quantities of oxygen to the blood.

Shock can result from the diminished capacity or arrest of any one of these four factors.

Shock is a progressive condition, which if left unchecked leads to circulatory failure, tissue and organ hypoxia (oxygen deprivation) and ultimately death. The onset of shock may be immediate or delayed. Common causes of shock in the backcountry include dehydration, trauma resulting in excessive bleeding and poor acclimatization at high altitude.

5.0.1 Types of Shock

Shock can be classed into four general categories, each corresponding to one of the four physiological factors required for adequate cell perfusion listed above.

- Hypovolemic shock
- Cardiogenic Shock
- Distributive or vasodilatory shock
- Obstructive or respiratory shock

Hypovolemic Shock

Hypovolemic shock results from any significant decrease in circulating blood volume. The more blood is lost the greater is the effect on the body. There are four classes of hypovolemic shock.

	Volume Loss
Class 1	Up to 15 percent of total blood volume can be lost with no significant effect on arterial pressure or respiratory rate.

	Volume Loss
Class 2	Blood volume loss of between 15 and 30 percent will result in increased diastolic pressure, heart rate and respiratory rate.
Class 3	Blood volume loss of between 30 and 40 percent will cause a decrease in systolic pressure, a more marked increase in heart rate, confusion and anxiety.
Class 4	Blood volume loss of more than 40 percent will cause a significant decrease in systolic pressure, very low pulse and very marked increase in heart rate, negligible urine output and lethargy or unconsciousness. This amount of blood loss is immediately life-threatening.

Causes of Hypovolemic Shock

- Bleeding (internal or external).
- Dehydration (perspiration, vomiting, diarrhea, diuretics).
- Fluid loss from diabetic hyperglycemia (diuretic effect of high blood sugar).
- Fluid loss from burns (through tissue edema and evaporation).

Cardiogenic Shock

Cardiogenic shock occurs when the heart fails to pump adequate quantities of blood to all parts of the body.

Causes of Cardiogenic Shock

- Weakness of the heart muscle (e.g. caused by heart attack).
- Blockage of blood flowing from the heart (e.g. due to blood clots).
- Trauma to heart tissue (e.g. caused by vehicle accident or gunshot wound).
- Ineffective contractions of the heart (e.g. due to loss of neurological control).

Distributive or vasodilatory shock

Distributive or vasodilatory shock, results from the inability of blood vessels to maintain adequate resistance for blood flow. With any systemic vasodilation (dilation or expansion of the blood vessels), the normal blood volume is incapable of filling the system and blood pressure will drop.

The causes of the distributional shock

Vasodilation is the body's response to a variety of triggers, including the release of histamine or toxins into the bloodstream, inhibited nervous control of vasomotor tone and acute emotional stress. All these triggers represent different kinds of shock in their own right, but because of their direct effects on vasodilation they are classed under the broad heading of vasogenic shock.

Anaphylactic Shock

Anaphylactic shock is a severe allergic reaction (for instance, to insect stings, certain foods or drugs). The body's reaction involves the immediate release of histamine throughout the system, which causes systemic vasodilation and a drop in blood pressure (see Anaphylaxis (p. 217)).

Neurogenic Shock

Neurogenic shock occurs when there has been severe trauma or damage to the central nervous system, such as an injury to the spinal cord. This could inhibit the brain's signals to the vessels to constrict and result in systemic vasodilatation thus reducing blood pressure.

Psychogenic or vasovagal shock

This is an acute stress reaction resulting in decreased sympathetic tone and sudden dilation of the peripheral blood vessels. The drop in blood pressure temporarily deprives the brain of oxygen, causing a loss of consciousness or fainting. It is generally of short duration contrary to the other types of shocks.

Septic Shock

Septic shock occurs when a severe infection releases large quantities of toxins into the blood stream, damaging blood vessels and their muscle tone, which in turn causes vasodilation.

Toxin shock

Toxin shock induces metabolic acidosis. It is caused by the ingestion of poison or toxic substances, such as antifreeze or certain medications in excessive doses. Metabolic acidosis also occurs in people with renal failure or diabetic ketoacidosis. The ingested toxic substance or organ failure overwhelms the body's ability to maintain its pH or acid-base balance, lowering the fluids' pH values and causing acidosis. Subsequently, the acidosis damages the blood vessels and results in vasodilation and shock.

Obstructive or respiratory shock

Obstructive shock is the inability of the respiratory system to transfer sufficient oxygen to the bloodstream. Although we have defined shock as inadequate tissue perfusion, we include obstructive shock here because of the vital role the respiratory system plays in delivering oxygen to the cardiovascular system.

Causes of obstructive shock

- Traumatic injury to the chest or lungs (e.g., in a motor vehicle accident).
- Upper airway obstruction (e.g. from a foreign body or as a result of immersion).
- Lower airway obstruction (e.g. from asthma or infection).
- Severe pain that prevents effective breathing (e.g., caused by trauma or illness).

5.0.2 Stages of Shock

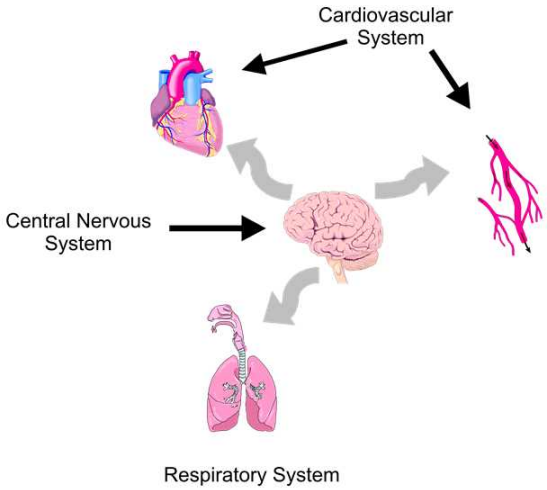
Compensated Shock

If the body's receptors detect a diminished supply of oxygen a number of mechanisms are put into play to compensate and ensure the flow of oxygenated blood to the brain and vital organs. This is known as compensated shock (or non-progressive or reversible shock). The effect of each of the following mechanisms may be measured objectively by closely monitoring the patient's vital signs and behaviour.

- The respiration rate increases in an attempt to increase oxygen saturation of the circulating blood. The volume of air inhaled with each breath (tidal volume) may diminish.
- The heart rate increases in an attempt to increase circulation. The amount of blood pumped with each contraction of the heart (stroke volume) will be reduced.
- Blood is shunted away from the periphery to increase the volume and blood pressure in the core. This results in the characteristic pale, cool, moist skin and increased capillary refill time.
- Gastrointestinal activity and blood flow to the digestive system are reduced, increasing the blood available to the brain and vital organs. This often leads to a feeling of nausea and may cause vomiting.
- The patient's behaviour may change. A patient experiencing these compensatory mechanisms may become restless, agitated or even combative.

Decompensated Shock

The longer a person remains in shock, the longer the vital organs and brain are deprived of oxygen and nutrients. After a certain period, the structures of the cardiovascular system (heart, lungs and blood vessels) begin to deteriorate, undermining the body's compensatory mechanisms and causing a vicious cycle of progressive deterioration. When arterial pressure falls low enough, for instance, blood flow to the heart is insufficient to supply the heart with its essential nutrients, which in turn further decreases cardiac output.



Once this cascade of events begins, it becomes increasingly difficult to re-establish effective circulation of oxygen to the brain and vital organs. Decompensated shock (also known as progressive shock) occurs therefore when the shock itself begins to cause yet more shock. Serious trauma and illness requires medical care that is not available in remote wilderness settings. Rescuers must make every effort to evacuate the patient as soon as possible.

Irreversible Shock

With prolonged oxygen deprivation the cells of the brain and heart die. Widespread cell death leads to irreversible multiple-system organ failure. Even the best treatment started at this point will not save a person's life.

Factors Influencing the Severity of Shock

Reactions to shock can vary from individual to individual. As well, different factors can influence the severity of shock and the speed of its progression.

Physical Condition

The physical condition of a patient will have an impact on his or her ability to respond to shock. Fatigue, exhaustion, hypo/hyperthermia, malnutrition or dehydration will all make a person more susceptible to shock. The elderly or the chronically ill have weakened systems, which will impair their ability to compensate for shock.

Pain

The body's response to acute or severe pain can at times cause adverse physiological effects. Acute pain can impede the return of normal pulmonary function, modify certain aspects of the stress response to injury or alter cardiovascular function.

Shock in Infants and Children

Infants and children may not demonstrate the classic signs and symptoms in the early stages of shock. They have a remarkable ability to compensate for shock, which may mask the severity of their condition.

Children compensate for shock by preserving their central blood pressure much longer than adults. A child's blood pressure may be maintained until approximately 40 percent of the blood volume has been lost.

Children with an adequate systolic blood pressure may still be in a state of compensated shock. In these cases, while central perfusion to the brain and heart may be considered adequate, other vital organ systems may be hypoperfused and may sustain damage that, if not reversed, will progress to decompensated shock. After this point a child's reserves are limited and his or her condition will deteriorate very rapidly.

Children with gastroenteritis can lose between 10 and 20 percent of their circulating fluid within 1 to 2 hours from constant vomiting, causing hypovolemic shock.

5.0.3 Assessment of Shock

The signs and symptoms of shock are caused both by lack of perfusion of oxygenated blood to the tissues and by the body's attempt to compensate for the failing circulation.

n the early stages of shock, the compensatory changes may maintain perfusion to near-normal levels. Pulse and breathing rates may increase only slightly or not at all, and blood pressure may remain normal. Later as compensatory efforts become more profound, the classic signs and symptoms of shock develop.

Compensated Shock (early stages)

Symptoms

- Restlessness, combativeness, anxiety.
- Thirst.
- Dizziness
- Weakness and trembling of the arms and legs.
- Nausea and vomiting.

Vital Signs

- Respiration is rapid and shallow.
- Pulse is rapid and weak.
- Blood pressure will decrease as shock progresses.
- Skin is cool and moist, with pale or ashen complexion.
- Pupils are equal, round and reactive to light.

Decompensated Shock (late stages)

Symptoms

- Altered level of consciousness, confusion, disorientation.
- Increased anxiety, restlessness and feelings of helplessness or depression.

Vital Signs

- Respiration is still rapid and shallow.
- Pulse is rapid and weak.
- Blood pressure is falling, with a weakening radial pulse.
- Skin is cold and clammy, with pale to cyanotic (blue) or mottled complexion.
- Pupils are sluggish to react.

Additional Considerations

- In cases of anaphylactic shock, histamine causes tissue to swell and generally leads to a swollen airway and respiratory distress. An obstructed airway is a medical emergency. Management of airway and breathing always takes precedence over other considerations.
- In cases of neurogenic shock, respiration may be slow and full rather than rapid and shallow, while the pulse may be slow and strong rather than rapid.
- In both neurogenic and septic shock, the skin may be flushed or red in colour.
- Cardiogenic shock may be accompanied by chest pain.
- Body temperatures may vary depending on the type of shock and the ambient conditions. In most cases of shock, the body's ability to maintain temperature is compromised and body temperature tends to decrease.

In cold environments, this is an important consideration. In cases of septic shock, on the other hand, body temperature is elevated due to systemic infection.

- Signs of advancing shock include a fall in blood pressure when the patient sits or stands up.
- Pregnant women are supplying blood to two organisms. Any diversion of blood away from the abdomen will place the fetus in jeopardy as well as the mother.

5.0.4 General Management of Shock

Anticipate

Make sure that everyone in a remote environment is adequately hydrated and rested at all times. This will provide a buffer in cases of injury and shock.

Always Assume Shock

Always assume shock in cases of serious illness and injury.

Treat the victim quickly

Whenever possible, treat for shock before signs and symptoms develop. In backcountry environments priority is given to stabilizing the patient's immediate environment.

- Treat the underlying cause.
- Insulate the patient from cold or heat to maintain body temperature.
- Reassure and keep the patient calm to prevent additional stress.
- Maintain the airway and watch for vomiting.
- Provide high concentration oxygen if it is available.
- Maintain patient in an appropriate position (such as the shock position, see below).
- Control any bleeding.
- Monitor a patient's vital signs frequently.
- Splint fractures and treat for pain.

> **NOTE**
> Do not give the patient food or liquids by mouth initially. This may provoke vomiting since gastrointestinal activity and blood flow have been reduced. In cases of long evacuations and delays, on the other hand, if the patient is conscious and alert, provide small amounts of water and food as tolerated to support hydration and nutrition.

Body Positions

The body's compensatory efforts can be supported by placing a shock patient in one of a number of positions. Different positions should be used for different types of shock or depending on the specific needs of a patient.

Supine Position

The general position for most shocks: the victim is lying on his back, legs extended.

Fowler's Position

This position is used to help relax abdominal muscles, to facilitate eating and drinking, and to support breathing in immobile patients. The patient is in a supine position with the upper body slightly elevated and the legs bent at the knees or stretched out. The angle of the upper body can vary from 15–25 degrees in the Low Fowler's Position to 30-45 degrees in the Semi-Fowler's position to as much as 80-90 degrees in the High Fowler's position.

Recovery Position

This position is used for unconscious patients and victims of drowning or poisoning to assure their own continued breathing. It is the position of choice for patients who must be left unattended when going to get help. The patient is made to lie on the side with upper elbow and knee forward and bent to prevent the body from rolling on the back. Having the patient on one side maintains an open airway, allows for drainage and reduces the chances of airway obstruction.

5.0.5 Acute Stress Reaction (ASR)

The body's reaction to injury or to a stressful situation may mimic the early signs of shock or the compensation mechanisms of shock and may make assessment more difficult. Known as acute stress reaction, this can influence the performance of rescuers as well as participants.

Sympathetic Reaction

This is the "fight or flight" response. Adrenaline is released into the body, speeds up pulse and respiratory rate, dilates pupils and generally prepares the body for action. It also stimulates the release of hormones that act in ways to mask pain. This reaction may occur in people who have sustained no physical injury or illness. It is usually self-limiting and lasts no more than a few minutes if managed properly. The effects of sympathetic ASR may make assessment of injuries difficult immediately after an accident.

Parasympathetic Reaction

A strong parasympathetic reaction in response to emotional or psychological stress may cause systemic vasodilation and a reduced heart rate. The subsequent drop in blood pressure may result in fainting. This is generally a self-limiting condition that resolves within minutes as there is no physiological damage to the body's major systems. Parasympathetic ASR can also complicate a complete assessment of injuries.

It is important to remember, however, that acute stress reaction can and often does accompany serious injury and true shock.

5.0.6 Evacuation Guidelines for Shock

Evacuation should be initiated immediately for any shock patients who do not improve or who show signs of progressive deterioration. Ensure that the patient is monitored regularly, and all ongoing assessment is recorded throughout the evacuation.

Patient Packaging

An immobilized patient is unable to generate significant amounts of heat and must be appropriately protected from the environment. The Hypothermia Wrap is a technique that utilizes simple equipment to provide a secure microclimate for the patient in a cold environment. Patients are considered adequately cared for only when they are "warm and comfy"!

Hypothermia Wrap Components

Ensure that the head is well covered.

- Impermeable wrap or groundsheet
- Insulating pad
- Sleeping bag or blankets for insulation
- Heat source placed in areas of high heat loss/gain (armpits, groin, neck)

Final wrap protects patient from the elements and retains heat.

Conscious patients may become anxious if their face is covered. Protect the head from elements and heat loss but keep the face and airway accessible.

6. Patient Assessment

Patient Assessment is a systematic procedure designed to provide the rescuer with information that helps determine a patient's condition in an emergency situation and how best to care for him or her. Patient assessment takes different forms depending upon whether the patient has an injury or an illness or is responsive or unresponsive. Not all components of the assessment will apply to every patient and the order of the assessment will vary depending on the nature of the problem. Rescuers must learn the techniques of patient assessment and practise them repeatedly so they can be performed accurately and in the appropriate sequences despite the likely distractions of a chaotic or even dangerous environment. The rescuer must also make every attempt to ensure that the reported findings are as objective as possible. Following all the steps of patient assessment will enable the rescuer to make appropriate decisions regarding the patient's treatment and care.

There are three main components of the patient assessment system:

- The Scene Survey reveals information about the potential hazards of the accident scene and the type of injury that may have occurred.
- The Primary Survey enables rescuers to obtain immediate information about the state of the patient and the presence of any life-threatening emergencies.
- The Secondary Survey yields more in-depth information about the patient's overall condition.

6.0.1 Important Definitions

Signs and Symptoms

In general, injuries and illnesses manifest as abnormal sensations, events and changes in the structure or function of the body.

Symptoms

Symptoms are subjective indications, such as pain, cold or dizziness, as described by the patient. An unresponsive patient will obviously be unable to provide the rescuer with information regarding symptoms.

Signs

Signs are objective indications discovered by physical examination and other methods of investigation. Signs include heart rate, respiration rate, skin colour, temperature and other indications that the rescuer can see, hear, smell, feel or otherwise evaluate.

Patient Age

As a person develops from infancy through to adulthood the body undergoes many physiological changes, the most obvious being changes in body weight and height and hormonal changes. Differences in size and weight can have an important impact on the kind of treatment a patient should receive. When dealing with first aid, the principal stages of development are:

- Infant – a person under one year old.
- Child – a person between one and puberty.
- Adult – a person at puberty and beyond.

Puberty is generally defined as breast development in females and underarm hair in males.

6.0.2 Accident Scene Management

Emergencies are generally times of great confusion and stress. Because chaos in itself can contribute to the possibility of further injury, emergency response in a remote setting involves managing the overall situation no less than responding to the immediate needs of the patient. Good accident scene management helps to restore order, minimize the impression of loss of control, and calm the patient, bystanders and other rescuers. It allows rescuers to give their full attention to the medical priorities of a patient without additional interruptions and is essential to ensuring that unnecessary complications and delays do not develop. Regardless of the specific situation or the sequence in which an assessment is performed, the rescuer should always adhere to the same general principles of accident scene management.

Remain Calm

The stance you take sets the tone for all those involved in the accident. Reassure the patient and other members of the group. Allay any fear, anxiety or sense of loss of control. Remain as objective as possible.

Take Charge

If you are not known to those involved in the accident, introduce yourself. Oversee all aspects of emergency response. You are in charge and should be the only one making decisions. Delegate tasks when necessary, but always supervise or follow up on any tasks performed by others.

Safety First

Survey the scene for possible hazards. Ensure your personal safety as well as the safety of other rescuers, other members of the group, bystanders and victims who may have to be moved. Continue to monitor safety issues throughout the patient assessment and continually assess for changes.

Be Systematic

Minimize interruptions during the patient assessment. Ensure that only one person does the entire exam.

Communicate information

Inform the patient of your assessment and explain the plan of care. Tell the patient what you are doing before you do it. In the case of children, inform parents or guardians if they are accessible of your plan of care. For unconscious patients, act as if they were conscious in case they can hear you.

Record

Record all findings and complete a detailed assessment and plan as soon as possible.

Follow up

Re-evaluate your patient on a continuous basis to determine if your care is having any effect and to discover problems that might not have been evident during the initial assessment. Ongoing evaluation of a patient is a critical aspect of long-term care.

Prevent Further Injury

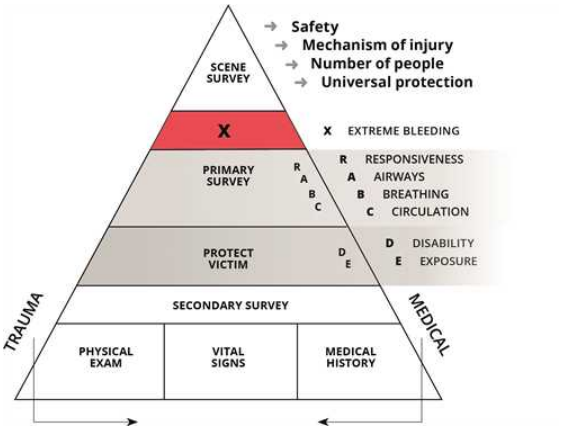
Prevention of further injury is a principle applied to all aspects of patient assessment and care.

Debriefing

After the patient has been transferred or evacuated, debriefing helps rescuers, other group members and bystanders understand and make sense of a potentially difficult or traumatic experience.

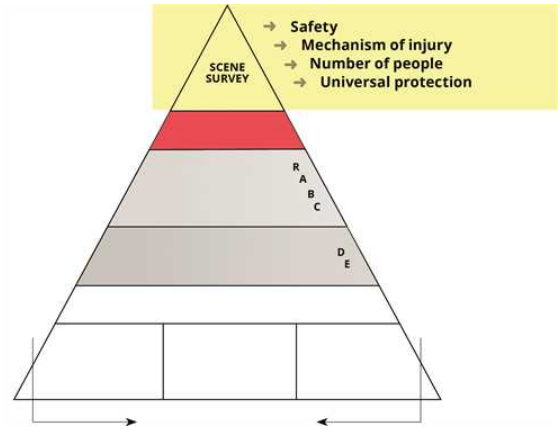
6.0.3 Introduction to PAS

Presentation of the patient assessment system



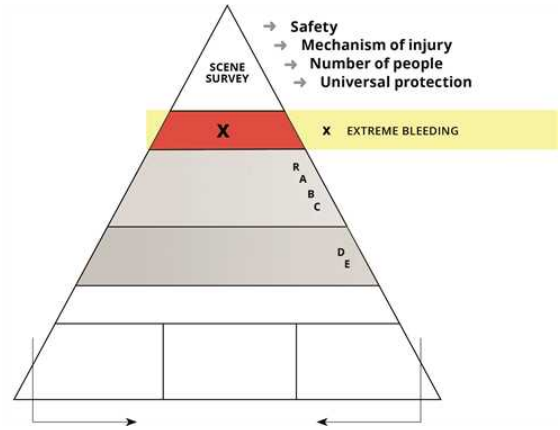
Scene Survey

Scene Survey : The scene survey enables the rescue workers to detect any potential danger, to identify valuable clues about the course of the situation and to establish the exact number of victims and persons present. A few minutes spent on this stage of the assessment increases the safety and efficiency of the process.



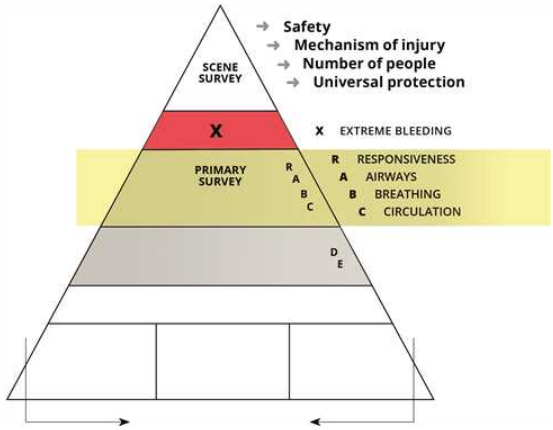
Extreme bleeding

In the trauma setting, the first phase of the primary survey is to rapidly assess the presence of major life-threatening bleeding. The rescuer performs a visual examination as well as a quick and systematic blood check with gloved hands. When a life-threatening bleed is identified, it should be referred and treated immediately.



Primary Survey

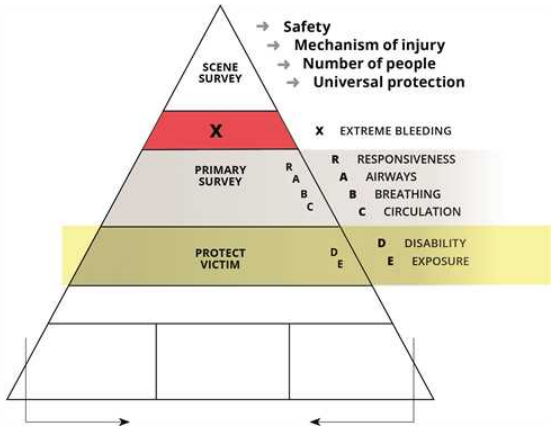
Primary Survey : The primary examination is the rapid and concise assessment of the respiratory and cardiovascular systems in order to detect and treat any life-threatening emergency. This means that only critical problems that affect the respiratory and cardiovascular systems are addressed. Lesser problems will be investigated in the secondary survey and addressed at that time.



Protecting the victim

Protecting the victim: This step between the primary and secondary examination is essential, especially in remote areas. It consists of identifying the conditions (disorders or dysfunctions) that need to be addressed quickly and implementing various measures to protect the victim such as

- Environmental protection measures (hypo-hyperthermia)
- Spinal protection measures
- Measures to address acute pain: Temporary and rapid immobilizations in case of limb instability.
- Treatment of major bleeding not initially referred
- Preparation for travel to a safer location to complete examination and treatment.



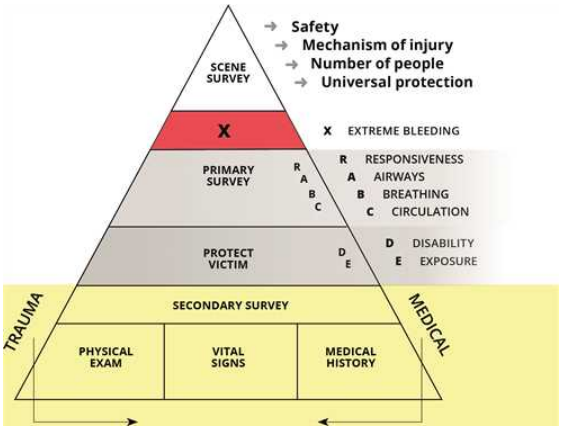
All of these measures will protect the victim, and expose the parties to be examined in an environment conducive to completing the secondary examination and quickly addressing the patient's shock.

Secondary Survey :

The secondary survey allows rescuers to assess the victim thoroughly and completely. This step helps to detect the presence of hidden injuries. The secondary survey consists of three sets of information :

- Physical Exam
- Vital Signs
- Medical History

In general, when the victim has suffered trauma, the first step is a physical survey, followed by vital signs and a medical history. When the victim has had a medical emergency, the medical history, then the vital signs and finally the physical survey should be prioritized. But the most important thing is to carefully complete each of these three evaluation blocks, even if you choose a different order.



6.1 Scene Survey

The scene survey is a critical element of wilderness emergency care. It allows the rescuer to determine any potential hazards, in other words, the scene safety. It provides valuable clues about the mechanism of injury. It establishes the exact number of patients and bystanders. A few moments spent at this stage of the assessment will save much time later on. If the patient is unable to respond, ask bystanders for details of the incident.

You will often begin the scene survey before you have even fully reached the scene or the patient. Always follow the general principles of accident scene management listed above.

6.1.1 Scene Safety

Assess the scene for safety to yourself, other rescuers, bystanders and patients.

Priorities for Safety

- Immediate danger to the leader/rescuer.
- Immediate danger to the group.
- Immediate danger to bystanders.
- Immediate danger to the patient.

Hazards

Do not approach or attempt to gain access to the patient until potential hazards have been removed or dealt with. Moving the patient may become necessary if the location is unsafe or if the patient is in a position that would impede further assessment and care. This may include immediate dangers from the surrounding environment in which the patient is found or menacing weather conditions that could cause further harm. Watch out for group members standing about in wet clothing or patients lying in the snow.

Hazards Include

- Contact with body fluids.
- Combative victims.
- Inclement weather conditions.
- Hazardous terrain, such as icy trails and rock fall.
- Bodies of water, such as rivers, lakes and oceans.

6.1.2 Universal Precautions

If there is a risk of contact with biological fluids, universal precautions should be followed. The rescuer must use the appropriate protective equipment.

6.1.3 Mechanism of Injury (MOI)

The mechanism of injury is an indication of what happened and how the injury or illness occurred. By surveying the scene, the rescuer may uncover important clues that help determine the mechanism of injury. This will assist the rescuer in establishing priorities before conducting a more thorough assessment. Bystanders can sometimes provide additional information.

To ascertain the mechanism of injury, the rescuer should determine the following:

- Is the patient moving?
- Is the patient injured or ill?
- Does the patient appear severely injured (angulated fractures, open wounds, obvious bleeding)?
- What are the possible causes and types of injury or illness?

Trauma Considerations

An injury involves some type of damage to the body caused by an external force or trauma. The injury may include fractures, wounds or damage to internal organs. In cases of trauma, the rescuer should attempt to determine the magnitude of the force involved since this will influence the type and severity of the injury.

- If the injury occurred during a fall, from what height did the patient fall?
- In what position did the patient land?
- On what did the patient land?
- How fast was the patient going?
- Why did the patient fall?
- Did something hit the patient?

Illness Considerations

An illness is an abnormal condition of the body that may cause discomfort, dysfunction or distress to the person afflicted. The illness may be caused by a variety of conditions such as a malfunction of one of the body's systems, stress caused by environmental conditions or an infectious agent. The precise cause of an illness can be very difficult to isolate. Determining it usually requires a thorough assessment of the individual and his or her medical history.

6.1.4 Number of Patients and Bystanders

Always take the time to determine the number of patients and bystanders involved before proceeding to the primary survey. In a wilderness setting it may be easy to miss an unconscious patient while those who are conscious and perhaps in pain demand your attention.

6.2 Primary Survey

The primary survey is a rapid check of the respiratory and cardiovascular systems focusing on identifying and treating any life-threatening emergencies. It must be performed separately on every patient involved in a given accident. During the primary survey, life-threatening medical problems are addressed in the order in which they are found. Only problems that affect vital functions are treated at this stage. Lesser problems will be investigated in the secondary survey and addressed at that time. In other words, it's used to identify whether our victim has an immediate threat to her life...

The primary examination consists of assessing the following functions and problems: (To remember the steps and priorities one can think of the acronym XRABCDE)

- X Extreme bleeding
- Responsiveness
- Airways
- Breathing
- Circulation

- Disability
- Exposure

The steps should be fast : 10 seconds under ideal conditions, we are not trying to measure, we are looking for a YES or NO answer, the time may be longer if there are obstacles to our evaluation or if the answer is NO and we have to make a quick maneuver to save our patient's life. If you get a YES, go to the next step.

6.2.1 X Extreme bleeding

This step is only applicable in a trauma setting.

It consists of a quick visual examination as well as a quick and systematic gloved scan of the entire body: back of the head, chest, back and extremities.

Is there a major life-threatening bleed that needs to be addressed immediately: NO or YES?

Examples of life-threatening bleeds: Arterial laceration with pulsatile bleeding, limb amputation with major bleeding, penetrating trauma with bleeding from a major blood vessel

Possible immediate interventions if YES

When you identify a major bleed you should quickly attempt to control it by :

- Wound packing and pressure dressing
- Application of a tourniquet
- As soon as the bleeding is under control, go to the next step
- If more than one rescuer is present, delegate the task and continue the assessment.

6.2.2 2 - Responsiveness

Is the person conscious: NO or YES?

Introduce yourself, announce that you are a rescue worker and ask if the victim needs help.

Immediate interventions possible if NOT conscious

When you find a victim who is not moving, speaking or reacting in any way is considered unconscious, then quickly check their state of consciousness:

- If she doesn't respond, speak up, tap her on the shoulder.
- You can check if she responds to pain by pinching her trapezius muscles (muscles between the shoulder and the base of the neck).
- If no reaction occurs, continue the primary assessment.

6.2.3 3 - Airways

Does the person have a clear airway: NO or YES?

If the victim is conscious, ask them to remove any object in their mouth, such as gum, consider asking them to remove their dentures if you are concerned that their state of consciousness will change quickly.

If the victim is unconscious, open his or her mouth to visually check for airway obstruction.

Immediate interventions possible if NOT cleared

To open the airway if spinal trauma is not suspected: Tip the victim's head back while lifting the chin to move the tongue forward, as in the figure below.

To open the airway if spinal trauma is suspected: perform a jaw subluxation, keep the head still and only lift the jaw by pushing the mandible (jaw bone upwards), as shown in the figure below.

Clean and free the mouth of vomit, blood or other fluids by leaning the victim on his or her side, possibly using a suction device or a gloved finger.

Monitor the airway of the victim lying on his or her back at all times, if this is not possible, place him or her in a lateral safety position to prevent the tongue from blocking the airway.

If spinal trauma is not suspected : tilt the victim's head backwards while lifting the chin with two fingers.

If you suspect cervical trauma: perform a jaw subluxation , keep your head still and only lift the jaw by pushing the mandible (jawbone upwards).

Lift jaw and tongue, and inspect oral cavity and airway for causes of obstruction

6.2.4 4 - Breathing

Does the person breathe without difficulty: NO or YES?

If the victim is conscious, can talk or moan, his or her airway is clear and breathing. Ask her if she has difficulty or pain when she takes a deep breath.

If the victim appears to be unconscious, check his or her breathing by opening the airways : lean over the victim so that you can listen, feel the breath on your skin and watch the movements of the chest.

A healthy person breathes effortlessly, quietly and regularly. In a normal adult, the chest rises and falls slightly during breathing. L'adulte normal prend de 12 à 20 respirations régulières à la minute.

A patient is not breathing adequately if any of the following is evident:

- Breathing rate of less than 8 breaths a minute or more than 24 breaths a minute.
- Shallow, irregular or laboured breathing.
- Gurgling sounds while breathing.
- Nasal flaring and/or pursed lips. Gasping for breath.

Do not mistake gasping for breath as normal breathing. If you are unsure, assume the patient is not breathing or is breathing inadequately.

Breathing may be difficult to determine in a patient who is wearing bulky clothing. In this case, bend over the patient and place your ear and cheek over the patient's mouth and nose to assess whether he or she is breathing adequately or at all.

Immediate interventions possible if NO

If the victim is not breathing or is breathing abnormally, begin CPR immediately (see Basic Life Support (p. 239)).

If respiratory distress is severe, consider investigating what causes it.

6.2.5 5 - Circulation

Does the person have intact circulation without major internal or external bleeding: NO or YES?

Internal - Carotid pulse examination

In 10 seconds or less, feel the victim's radial pulse. A strong radial pulse is a sign of good internal circulation.

Once you have checked the pulse, scan the patient for signs of inadequate circulation, such as:

- Pale or cyanotic skin.
- Blue lips not associated with cold.
- Cool and damp skin.

If you can't find a radial pulse, assess for the presence of a carotid pulse.

External - Rapid body survey for severe bleeding

Perform a quick body survey for any injuries and severe bleeding. This may require you to run your gloved hand under the patient and inside bulky clothing that might absorb blood. Blood loss may not be immediately apparent if it has soaked into the ground, sand or snow.

Immediate intervention possible if NO

At any time during the primary examination, if you discover major bleeding you must stop it immediately and treat any serious bleeding as a priority (see Soft tissue injuries (p. 88)).

Don't wait until you have checked your airway and breathing if you see a major bleed right away: There is no point in starting CPR on someone who is bleeding out, for example, because of amputation, if the bleeding is to be stopped, the bleeding must first be stopped before CPR can be useful.

6.2.6 6 - Disability

Is the body lost any integrity? there are no suspected fractures, spinal injuries or other major injuries: NO or YES?

Rely on your patient's mechanism of injury and pain. Spinal injuries and their management will be detailed in the chapter on Spinal Injuries (p. 126).

A responsive patient should be asked not to move. Where possible, another group member or bystander should be asked to hold the head and neck until a spinal injury can be ruled out.

In an unconscious victim, always suspect spinal injury. If necessary, the victim should be placed in a supine position to maintain an open airway and move the unconscious victim as carefully as possible (see below).

Immediate intervention if NO

If you suspect a spinal injury due to the mechanism of injury, act with caution.

Immobilize the victim's head and neck in a neutral position for assessment. This involves maintaining the alignment of the spine and head in a straight and natural position. Priority should be given to maintaining the alignment of the head, neck and shoulders. Management of potential spinal injuries, however, must never take precedence over management of the airway. If possible, continue to support the head and neck until cervical spine damage can be ruled out. It's also the time to splint fractured limbs and reassure your victim. Then move the victim only if necessary.

When the victim is unconscious, he or she should be placed supine to keep the airway open.

Move the unconscious victim as carefully as possible. However, moving a patient to ensure an open airway must not be delayed.

If the patient needs to be left alone while you activate EMS, place the patient in the recovery position.

6.2.7 7 - Environment

As a first aid measure, the E also includes the notion of the victim's exposure to allow for an optimal secondary examination. In the context of remote areas, it remains important to properly expose the body parts to be examined while ensuring that the victim is well protected from the outside elements.

Is the victim adequately protected from the outside elements: NO or YES?

Immediate intervention if NO

At all times, try your best to protect your victim from the elements. A person in shock, or even just feeling unwell, will have difficulty keeping body heat.

In the backcountry, this may involve insulating the patient from the ground and covering the patient with insulating layers to prevent heat loss (hypothermia wrap). A shelter may be required to protect the patient and rescuers from harsh weather conditions. A detailed assessment of even minor injuries takes time. Do not delay the management and prevention of shock. The airway must be maintained at all times.

- Treat for shock.
- Protect the patient and the others in the group from the cold and wet.
- Continue to monitor responsiveness, airway and breathing.

When your victim is stabilized, is as comfortable as possible, and you can no longer improve their condition immediately, it is time to take the next step, Secondary survey (p. 65).

6.3 Secondary survey

Once the primary survey is complete and the patient's most urgent needs are addressed, the rescuer can undertake the more in-depth secondary survey. This allows the rescuer to create a detailed and complete assessment, but also to discover any hidden injuries. The secondary survey consists of three blocks of information:

- Vital Signs
- Medical History
- Physical Exam

The mechanism of injury (MOI) is generally the best way to determine which block needs to be addressed first. Traumatic injuries often call for an immediate physical exam, for instance. If, on the other hand, traumatic injuries have been ruled out and the patient is alert and oriented but suffering from an illness, a rescuer would likely want to obtain a detailed medical history first and check the patient's vital signs before doing a physical exam. Regardless of sequence, all elements of the exam should be carefully assessed and documented.

Vital Signs	Medical History	Physical Exam
Level of Consciousness (LOC)	S Symptoms	Detailed Patient Exam
Respiration	A Allergies	
Pulse.	M Medications	
Skin signs.	P Past History	
Blood pressure.	L Last Meal	
Pupils.	E Events	
Temperature.		

6.3.1 Vital Signs

Vital signs are objective indicators of the main body systems (respiratory, cardiovascular and nervous). They provide the rescuer with essential information on the victim's condition, and on the evolution of the victim's condition over time. Vital signs include the patient's level of consciousness, breathing, pulse, skin characteristics, blood pressure, pupil activity and temperature.

Vital Signs Indicate:

- The patient's general condition.
- The urgency of evacuation.
- The effect of treatment.
- Whether the body's primary systems are affected.

Vital signs do not necessarily indicate what the specific injuries are. They are objective measures. Exact numbers are used when recording findings (i.e. respiration rate — 16/minute). Subjective descriptions may be added to objective findings if they help to describe the character of a particular function (i.e. raspy breathing sounds).

A single value for any vital sign is of limited use on its own. Establishing a baseline and recording vital signs over a period of time, on the other hand, will uncover a pattern that indicates if the patient's condition is improving or deteriorating. This recorded information is also valuable when the patient is turned over to definitive medical care. Establish a baseline of vital signs as soon as possible.

Some vital signs, such as respiration rate, heart rate and skin colour, will vary from individual to individual. Their values may be influenced by factors such as age, gender, race, physical condition, amount of physical exercise recently undertaken, stress and medications.

Level of Consciousness (LOC)

During the primary survey, a rescuer assesses the patient's general level of responsiveness. During the secondary survey, this assessment is made in a more systematic way and recorded to create a baseline against which later assessments can be measured. The state of consciousness refers to the victim's ability to interact with his or her environment. Assessing the level of consciousness makes it possible to observe the victim's response to particular stimuli.

AVPU Scale

The AVPU scale is a diminishing scale that assigns a value for a patient's level of responsiveness from alert and oriented to unresponsive. AVPU is an acronym for the key words Alert, Verbal, Pain and Unresponsive. The first level of the AVPU scale measures a patient's alertness to surrounding events and conditions. In the absence of coherent answers, the subsequent levels of the scale measure the patient's response or lack thereof to verbal and sensory stimuli. The responses to these stimuli are indicators of the patient's neurological or brain function.

A = Alert

Patients are considered alert and oriented if they are clearly aware of their identity, their environment and the events that took place. They should be able to provide coherent answers to the following questions:

- What is your name?
- Where are you from? Where are you now?
- When did the accident happen? How long have you been here? Do you know what time it is?
- What happened?

Patients who are able to answer all of these questions are considered alert and oriented X 4. If they can answer only three of the four questions, they receive a score of Oriented X 3 and so on. A patient who cannot answer the questions correctly or is unusually slow to respond is considered disoriented.

V = Verbal

When patients are neither alert nor oriented but can react to sound and verbal communication in some meaningful way (by waking up or by using sounds or eye or body movement), they are considered to be responsive to verbal stimuli. Responses to verbal stimuli can be appropriate, indicating a patient's comprehension, or inappropriate, indicating a deeper level of confusion.

P = Pain

When patients are unable to respond to verbal stimuli or questions but do respond to a controlled painful stimulus (such as pinching the earlobe or the skin above the collar bone) they are considered to be responsive to pain.

U = Unresponsive

Patients are considered unresponsive if they react to neither a verbal nor a painful stimulus.

Ensure that the patient's specific response or lack of response is recorded. In time a patient's response may change to indicate an improving or a worsening condition.

Respiration

During the primary survey, a rescuer quickly assesses whether the patient is breathing or not. During the secondary survey, this assessment is made in a more systematic way and recorded to create a baseline against which later assessments can be measured.

Assess the quality, rhythm, depth (tidal volume) and sound of a patient's breathing. Count the number of breaths a patient takes in one minute. It is generally difficult to accurately assess respiration rate on conscious patients if they know you are measuring it. In these cases, you can pretend to take the patient's radial pulse and observe the chest for signs of breathing.

Measure breaths for 30 seconds and multiply this number by 2 to get the rate per minute.

Rhythm - Is the breathing rhythm regular or irregular?

Effort - Is breathing difficult or painful? Does it require the use of secondary respiratory muscles?

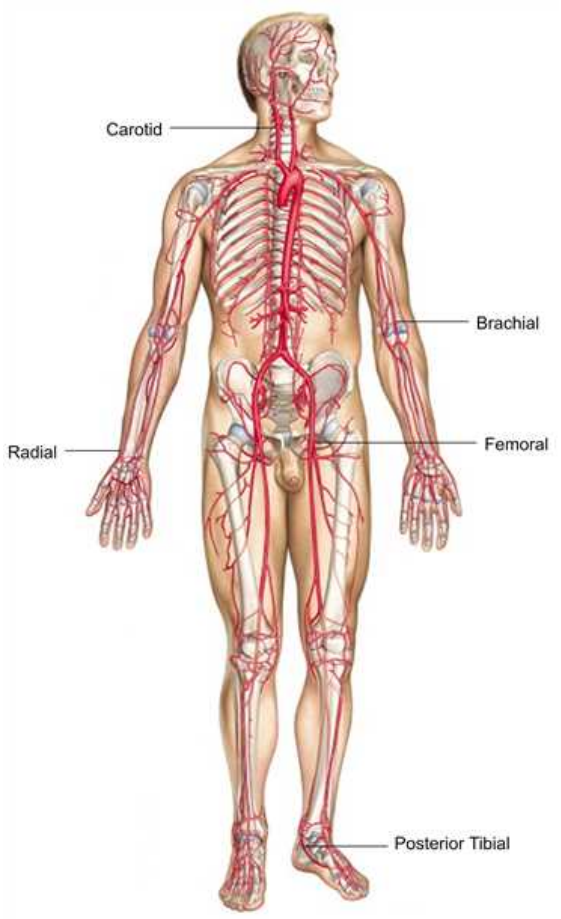
Sound - Can any breathing sounds be heard, like wheezing or gurgling?

Pulse

The pulse can be measured at various points throughout the body. During an assessment of vital signs, the radial pulse is the most easily measured. The radial pulse is measured by placing the pads of the first 2 fingers over the radial artery, located on the thumb side of the inside wrist. In unresponsive patients or in cases where the radial pulse cannot be measured, check the carotid pulse.

If there is a weak radial pulse or no pulse in one arm, make sure to check the other arm. An injury to the arm or shoulder would inhibit circulation in that limb, but not necessarily elsewhere in the body. Assess the pulse for rate (beats per minute), quality (strong or weak) and rhythm (regular or irregular). The pulse of a healthy person will generally be between 60 and 100 beats per minute. A very fit person may have a pulse of 50 beats per minute or less. As with all vital signs, the most significant information is how a pulse might change over time.

There are many locations on the body where the arterial pulse can be palpated with differing levels of ease.



Arterial Circulation & Location of important pulses

Most Common Locations to Take a Pulse

Radial pulse.

Carotid pulse.

Measure pulse for 15 seconds and multiply by 4 to get the rate in beats per minute.

Note the quality of the pulse – is it weak, strong, regular, irregular?

Skin Signs

The condition of the skin provides an indication of the patient's peripheral circulation, blood oxygen levels and body temperature. Cool, pale and moist skin on a particular segment of the body indicates diminished circulation in that area. Red, flushed and warm skin indicates increased blood flow in that area. In deeply pigmented people changes in skin colour may not be apparent. In such cases, evaluate peripheral circulation in areas that are not pigmented, such as the palms of the hands, nail beds and lining of the mouth. Colour and moisture can be perceived visually. Assessing temperature will usually require the gloved rescuer to partially slip the glove down from the wrist and feel the patient's skin (generally on the forehead) with the back of the hand.

When assessing the condition of the skin, evaluate all three of the following:

- Skin ColourObserve the face but also assess areas that are not exposed to cold.
- Temperature Touch the skin - Is it hot, very hot or cold?
- Moisture Touch the skin - Is it moist or dry?

Blood Pressure

Blood pressure (BP) is a measure of the health of the heart and blood vessels. It also indicates whether the fluid volume is adequate. Low blood pressure could indicate loss of blood or fluid, loss of vascular tone or a cardiac problem. Decreased blood pressure is a late sign of shock and indicates the patient has entered a state of decompensated shock.

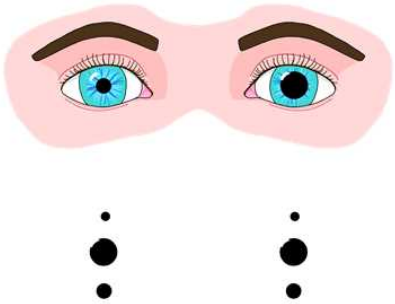
Normal blood pressure for an average adult is in the range of 120 / 80 mmHg. The normal range for a child is lower than for an adult, and in the case of an infant lower still. Older people, on the other hand, tend to have higher blood pressures.

Blood pressure cannot be accurately measured without specialized equipment. These include a blood pressure cuff (or sphygmomanometer) and a stethoscope. When there is no equipment available – often the case in wilderness emergency care – the patient's vital signs may be used to estimate the general state of cardiovascular function. As a

general rule, if a radial pulse is present, the systolic blood pressure is at or above 80 mmHg. Adequate distal capillary refill indicates that blood is circulating to the extremities. Overall, a patient who is alert and oriented, has a strong radial pulse and normal skin colour and temperature is considered to have adequate blood pressure.

Continue to assess vital signs and blood pressure regularly to detect any changes over time.

Pupils



The pupil is the dark centre of the eye through which light enters. In the majority of healthy people, both pupils are round and of the same size. They also react to changes in light. Normally, the pupils will dilate (become larger) in dimmer light and will constrict (become smaller) in brighter light. The eyes should also move together when following a moving object.

Differences in eye movement or unequal sized pupils could indicate a serious injury or medical condition. Note, however, that some medications can also influence eye movement and pupil response.

Checking Pupils PERRLA

Pupil assessment is summarized by the acronym PERRLA – Pupils that are Equal, Round and Reactive to Light and Accommodation. Accommodation refers to the pupils' ability to follow a moving object.

Ask/check to see if patient is wearing contact lenses. Are the pupils the same size?

Are they both round?

Do they react together to changes in light intensity?

Do both eyes move together when following an object?

Temperature

Assessment of body temperature may alert you to a systemic infection or changes in core body temperature.

The patient's temperature may be measured orally (in the mouth), axially (under the armpit) or rectally (in the rectum). The most common and readily accessible of the three is the mouth.

Types of thermometers

Digital Thermometers

Digital thermometers are ideal for short trips in the backcountry. They are made from plastic and have a flexible and durable tip. They are widely available, easy to use and rapidly provide a reading. However, they do have limitations because they are battery operated. Batteries are sometimes inefficient in the cold and they eventually run down completely.

Glass Bulb Thermometers

Glass bulb thermometers are more fragile than digital thermometers and their accuracy can be affected by extreme temperatures. They need to be shaken before use to bring the mercury reading down below 98.6 degrees Farhenheit or 37 degrees Celsius. Glass thermometers come in different formats for different uses: oral, rectal and oral/rectal. A glass oral thermometer is one with a long glass bulb that registers a temperature quickly due to its increased surface

area. The elongated bulb is fragile and should not be used for rectal readings. The shorter stubby bulb of the rectal thermometer is less prone to breakage but requires a longer time to register a temperature. Specially designed oral / rectal thermometers can be used for either the mouth or the rectum, but should not be used interchangeably.

Low-Reading Thermometer

A low-reading thermometer can register a temperature as low a 25 degrees Celsius, while a regular thermometer reads only as low as 35 degrees Celsius. A low-reading thermometer is a good option for backcountry use in colder environments where an assessment of a hypothermic patient may be required.

Taking a Temperature

The temperature reading will vary slightly depending upon where the reading was taken.

Temperature Readings		
Area	**Normal Temperature Range**	**Time Required for Glass Thermometers**
	° Celsius ° Fahrenheit	Minutes
Oral	36.1 - 37.2 97 – 99	3 - 4
Rectal	36.7 – 37.8 98 – 100	5
Axillary	35.6 – 36.7 96 – 98	10

How to Take an Oral Temperature

To measure an oral temperature, place the thermometer under the patient's tongue and leave in place until the digital thermometer beeps or for 3 to 4 minutes for a glass thermometer. Ensure that the person's lips remain closed to prevent a temperature change in the mouth. Remove the thermometer carefully and read the temperature immediately. Do not use an oral thermometer on an unconscious patient or if the patient has had a hot or cold beverage, eaten, smoked or chewed gum within the previous 10–15 minutes.

How to Take a Rectal Temperature

To measure a rectal temperature position the patient on the side with knees flexed. Lubricate a rectal thermometer with KY jelly or equivalent before inserting it approximately 4 cm into the rectum. Hold the glass thermometer in place for 5 minutes, or until the digital thermometer beeps. Take it off and read the temperature. A rectal temperature will be approximately one half degree Celsius higher than an oral temperature (or 1 full degree Farhenheit). Before disinfecting, wipe the thermometer with a tissue using a twisting motion to remove any lubricant.

Ensure that any thermometer used is sterilized with alcohol after each use. Some first aid kits are supplied with thermometer covers. These thin plastic covers prevent direct patient contact with the thermometer and are discarded after each use.

Vital Signs

Vital Signs			
	Adult	**Child**	**Infant**
LOC	Alert and Oriented x 4	Alert and Oriented x 4	Alert and Oriented x 4
Respiration	12 – 20 breaths per minute and effortless	15 – 30 breaths per minute and effortless	25 – 50 breaths per minute and effortless

Vital Signs			
	Adult	**Child**	**Infant**
Pulse	50 – 100 beats per minute and easily palpable	80 – 120 beats per minute and easily palpable	100 – 140 beats per minute; easily noticeable. Take the brachial pulse.
Skin Signs	Colour/temp /moisture normal Capillary refill within 2 seconds	Colour/temp /moisture normal Capillary refill within 2 seconds	Colour/temp /moisture normal Capillary refill within 2 seconds
Blood Pressure	Systolic 100 to 140. Diastolic 65 to 90.	Systolic 90 to 130 Diastolic 55 to 85	Systolic 85 to 110 Diastolic 40 to 65
Pupils	Pupils are Equal, Round and Reactive to Light and Accommodation	Pupils are Equal, Round and Reactive to Light and Accommodation	Pupils are Equal, Round and Reactive to Light and Accommodation
Temperature	Oral: 37 ° Celsius	Oral: 37 ° Celsius	Oral: 37 ° Celsius

6.3.2 Medical History

A patient's medical history is gathered through conversation with the patient and/or bystanders. It includes the patient's previous medical conditions or illnesses and all events leading up to the accident. The medical history is important in determining if a previous condition may have precipitated the current situation or may further exacerbate it.

Questions addressed to the patient should be as objective as possible. In the case of unresponsive patients, information may be obtained from Medic Alert® bracelets or information cards located in a wallet or purse, and from family members or group members where relevant.

SAMPLE

A patient's medical history is generally gathered by asking a specific set of questions. These are often represented by the mnemonic SAMPLE.

- S Symptoms
- A Allergies
- M Medications
- P Past History
- L Last Meal
- E Events

S Symptoms

Ask the patient about symptoms. Have the patient explain his or her chief complaint. The chief complaint is the injury or symptom the patient is most concerned about. In many cases a patient will identify one issue that may be the most painful or perhaps the most apparent. The chief complaint is not always the most serious problem, however. Other injuries and illnesses may develop symptoms over a period of time. Address the concerns of your patient but continue your full assessment to ensure that there are no other injuries that require your immediate attention. Record the chief complaint in the patient's own words.

Description of Pain and Other Symptoms (PQRST)

The PQRST scale helps the rescuer obtain objective information from the patient about pain and other symptoms. Ask the patient to describe his or her symptoms by responding to the following questions and record the responses in the patient's own words.

P Provoke	What provokes or causes the pain? What alleviates it?
Q Quality	What does the victim's pain feel like? How does she feel?
R Region	Where is the pain? Has it moved or spread?
S Severity	On a scale of 1 to 10 how would you describe the pain?
T Time	When did the pain begin?

Allergies

Ask the patient about any allergies or reactions he or she may have.

Medications

Ask the patient what medication he or she is currently taking or may require in cases of emergency.

Past History

Ask the patient about medical conditions, previous illnesses or injuries that might be related to the current problem.

Last Meal

Ask the patient what he or she last had to eat or drink. Determine as well when food and fluids were last consumed.

Events

Have the patient describe in his or her own words the mechanism of injury or illness. Ask the patient to be as specific as possible. The more you can learn about a situation the more accurate your assessment will be.

- What happened?
- How did it happen?
- When did it start?
- What happened in the time leading up to the incident?
- What may have caused it?

6.3.3 Physical Exam

The physical exam (also referred to as head-to-toe exam or patient exam) is a complete physical assessment of the patient. It is used to locate unsuspected injuries and further assess those already identified. Injuries are investigated for severity as they are discovered, but should only be treated after the full physical exam is complete unless they warrant immediate attention.

Important Considerations

- One rescuer should do the entire exam to ensure consistency.
- Wear protective clothing and gloves while conducting the exam.
- Talk with the patient and explain what you are doing regardless of the patient's level of responsiveness.
- Observe the patient's face throughout the exam for a response to pain.
- Examine one limb at a time and avoid unnecessary movement.
- Avoid cutting clothing as it will be needed to keep the patient warm.
- Some signs and symptoms may only manifest minutes or hours after an injury.
- Check your gloved hands visually for blood, as it may not be easily felt through gloves.
- Look for a Medic Alert® bracelet or necklace that may contain information about a medical condition.
- Avoid stepping over the patient.
- Record your assessment observations as soon as possible (see Recording Information below).

Detailed Mechanism of Injury

In cases of traumatic injuries, attempt to determine the characteristics of the force involved:

- What was the direction or angle of the force?
- What was the magnitude of the force? How much force was applied?
- Was it a blunt or penetrating force? A hard blunt force can cause considerable damage that may not be initially apparent.
- Was it a direct or indirect force? Did something hit the patient or did the patient hit something?

Assessing Distal Circulation, Sensation and Motion (CSM)

The assessment of distal circulation, sensation and motion provides important information about the patient's circulatory and neurological function.

Distal Circulation (C)

Assess distal circulation by checking a distal pulse. The distal pulse is that found at the farthest distance from the heart. Capillary refill will also indicate the quality of distal circulation.

Capillary Refill

Hairbeds in fingers and toes usually contain a lot of blood. This is why capillary filling is a quick and effective test to evaluate the efficiency of blood circulation in the extremities. The capillary refill test is performed by squeezing the nail bed of a finger or toe for several seconds and then releasing the pressure. The area should blanch (become white) and then return to its normal colour within 2 seconds after pressure has been released. Capillary refill may take a little longer in extremities that are exposed to a cold environment. Note the number of seconds that is required for the colour to return to normal. If the pink colour does not return within seconds, this indicates poor circulation and a potentially serious injury.

Locations for Checking Capillary Refill

Capillary refill on fingers.

Capillary refill on toes.

Distal Sensation (S)

Assess sensation to touch and pain at the extremity of the feet and hands. Take note of any numbness, tingling or other sensations, like “pins and needles.”

Distal Motion (M)

The victim should be able to wiggle his fingers and toes. The victim should have bilateral strength and a normal range of motion in all extremities Check the grip strength of the hands by having the patient squeeze 2 of your fingers. Have the patient push against your hands with his or her feet to establish strength in the lower extremities.

Exam Techniques

At each stage of the exam, you will need to draw on different techniques to assess injuries.

Observation

Look for cuts, abrasions, burns, swelling, bleeding, discolouration or other deformities. It is necessary to expose any injury that is detected during a physical exam so that a full visual assessment may be undertaken.

Questioning

Ask the patient about pain and other sensations. Have the patient describe the pain using the PQRST scale.

- What kind of pain is it?
- Does it hurt all the time or only when touched?

Here are definitions of specific types of pain:

- Point Tenderness is pain that occurs only when an area is touched.
- Rebound Tenderness is pain that occurs when pressure is suddenly released.
- Referred Pain is pain felt in an area other than the one being palpated.

Palpation

Feel with the finger pads for swelling, instability, areas that are hard or soft, wetness due to blood or other fluids or areas that elicit pain when touched. Use firm pressure unless it aggravates an injury. Explain to the patient that the procedure may elicit some pain or discomfort. Palpate the entire body.

Percussion

Place your index and middle fingers over the area to be assessed. Tap these fingers with the index finger of the other hand. Internal organs that are injured are very sensitive to this type of stimulus.

Listening
Without a stethoscope, very little of the body's internal processes can be adequately heard. Sounds made by the lungs and digestive tract, however, may be heard by placing an ear against the chest and abdomen. Listen for changes in breathing sounds and any grating sounds (crepitus) made by broken bones or injured joints.

Flexing
Carefully flex the joints to establish the range of motion and note whether this provokes symptoms. If possible have patients move their own joints.

Comparing
Compare opposite body parts for symmetry.

Smelling
Check for breath odour and malodorous discharge from wounds.

Exam Procedure
Proceed systematically Beginning with the head, neck and face to detect possible spinal injuries or any serious injury to the trachea that may lead to airway obstruction. When serious injuries are suspected ask another group member or bystander to keep the head and neck immobilized to reduce the chance of aggravating the situation during the rest of the survey. As you proceed through the exam, carefully remove any headgear or other accessories, such as hats, glasses and gloves, which may prevent you from examining that part of the patient thoroughly.

Head – Check for discoloration, deformity, instability, fluid, signs of trauma.

Neck – Check alignment of the trachea, tenderness along the spine, jugular vein distension.

Face – Examine areas of the face carefully to avoid further damage to fragile bones in this area.

Ears – Look for blood, CSF, signs of trauma.

Eyes and Pupils – Assess PERRLA. Check for contact lenses, trauma, foreign bodies.

Mouth – Look for foreign bodies, food, damaged teeth, blood, vomit, dentures.

Back and Spine – Check for tenderness, deformity, blood, signs of trauma. It may be necessary to log roll the patient to further examine for any suspected injury.

Chest – Assess respiratory effort, bilateral movement, pain, signs of trauma or instability. Ask conscious patient to take a deep breath.

Abdomen – Examine each quadrant of the abdomen separately. Watch for guarding, tenderness, rigidity, bruises. Listen to the gastrointestinal sounds.

Pelvis – Check pelvis for stability or pain.

Legs – Assess for symmetry, angulation, bleeding and range of motion.

Feet – Footwear may need to be removed to assess feet and distal CSM.

Toes – Check distal CSM, capillary refill.

Arms – Check arms for symmetry, angulation, bleeding, range of motion.

Fingers – Check distal CSM, capillary refill.

Hands – Check for bilateral strength.

Medic Alert® – Check for evidence of medical conditions.

Spinal Injury – If spinal injury is suspected have someone support the head during the exam.

6.4 Recording Information

The subjective and objective information obtained by interviewing and examining the patient should be recorded on an accident report form. The basis of all patient assessment forms is known as the SAP card. While the forms vary, the outline remains the same. Most accident report forms will also include space to record the patient's name and address and information related to weather conditions.

Information gathered during the assessment should be written down as soon as possible. This record becomes a crucial baseline against which any further developments in the patient's condition can be measured. The recorded information is essential for follow-up care. As well, it may be helpful in preventing future accidents and provides a legal record of the care that was provided. If necessary, have an uninjured member of the group or bystander help with the recording.

6.4.1 PAS Card

Subjective data
Record subjective information obtained through the interview process with the patient: mechanism of injury, chief complaint, symptoms, patient's description of pain and injuries. Whenever possible use the patient's own words.

Objective data
Record objective information: vital signs, patient's age, gender and medical history, physical exam.

Analysis of collected data
List all injuries and potential problems.

Plan
Formulate a plan for each of the problems on the assessment list. Indicate the frequency at which you intend to reassess the patient.

6.5 Long-Term Patient Care

Long-term patient management in the backcountry requires close monitoring for any change in condition. Some signs and symptoms may not be immediately obvious after an injury. They may become more apparent only after the initial care has been carried out. If undertaking an evacuation, regular stops must be made to re-assess the patient.

The frequency of assessment will vary depending on the patient's condition and how stable the condition is. Initially, the patient should be monitored every 5 to 15 minutes. If the condition becomes stable or is not life-threatening this interval may be increased to 30 minutes. Assessment intervals will increase only as the patient becomes more stable or as the patient's condition improves.

Evacuation may not be possible immediately or may take several hours or even days. Therefore, long-term care for the victim and group management must also be planned. Here is a list of questions for you to ask :

- How's the victim doing? Is she warm, comfortable? Is she hungry or thirsty? Does she need to urinate?
- How is the group doing?
- Check all bandages and splints for circulation distal to the site of the injury.
- Re-evaluate all components of the patient assessment if necessary.
- Assign someone from the group to record all vital and physical signs.
- Note any new conditions or changes in the severity of the injuries.
- Re-evaluate priorities as required.
- Has the plan changed?
- In cases of evacuation, what is the rate and progress of the evacuation?

The back of your PAS card can be used for long-term care and planning.

6.6 Evacuation Considerations

Once the immediate needs of the patients and the group have been addressed, the rescuer must evaluate the necessity of an evacuation. Before making a decision, however, it must take into account certain variables. The condition of the victims is obviously part of it, but it is not the only factor to be considered.

Condition of the Patients

- Assess the severity of the injuries or illness. Are the injuries stabilized? Can the patients walk on their own? Can immobilized patients be moved/carried or will movement risk further injury? Will transporting the patients cause more harm than good?
- How often will you need to re-assess their condition?
- When packaging patients for evacuation, rescuers must ensure they can have regular access to injury sites and can take patient vitals without unduly exposing the patient to the elements.
- Special consideration must be made for the patient's basic needs for food, water and eliminating wastes.

Condition of the Group

- Will group members participate in the evacuation of the patient? Will group members be evacuated at all?
- Is the group capable of being evacuated? Will an evacuation put group members at risk?
- Do group members have the physical and psychological stamina and necessary skills to navigate potentially difficult terrain and manage the stress of an evacuation?
- If the leader must leave with some group members, who will be in charge of remaining members?

Location

- What is the distance to the nearest trailhead, base, facility, centre?
- What is the nature of the terrain in between? Is the path uneven and difficult? Is there a clear path? Does the terrain include snow, mud, river crossings, changes in elevation, thick bush?
- How long will it take to get to the nearest point for help? Estimate half a kilometre an hour or less for litter carriers.
- Is the area you are in accessible by motorized vehicle or helicopter?
- Is it preferable to self-evacuate or have rescuers come to the group?

Physical Resources

- What emergency equipment is available to ensure a safe and rapid evacuation? Are there splints, stretchers, etc.? ?
- What is available in terms of first aid supplies, food, clothes, camping equipment, shelter...? ?

Type of Assistance Required

- What type of assistance is required? A shoulder to lean on? Helicopter? Motorized vehicle? Medical supplies?
- How urgent is the situation?

Type of Assistance Available

- What mechanism is available for initiating an emergency response?
- Do you have radio or telephone equipment?
- Will you need to write out a message and send messengers?
- How long will it take?

Weather Conditions

- Do current weather conditions permit an evacuation?
- Do you have the capacity to forecast local weather?

Time of Day

- How long will an evacuation likely take?
- How much time is available during daylight?
- Can an evacuation be conducted at night?
- Are your group members rested and able to start on a long evacuation or will you need to wait until morning to ensure you begin the evacuation with optimal conditions?
- Can the patients wait until morning?

Sending Messengers

- Always send at least two messengers and preferably four if you can spare that many from the group.
- Make sure each messenger has enough equipment to spend a night in the wilderness. Give each messenger a copy of the same written message (see below).

Written Messages

Written messages should include:

- One PAS card for each victim (including first aid already administered).
- Date, time and exact location of the incident.
- A list of any medical equipment or personnel requests you will need.
- A full list of names of group members remaining in the field.
- A list of your supplies and equipment and how long this will last you.
- Your plans for those in the field while waiting for the rescue team.
- Where the rescuers should meet with your group.
- The availability of a helicopter landing area or other options for access to mechanized travel.
- Any alternate evacuation plans.

6.7 Multiple-Patient Emergencies and Triage

When an accident involves many victims, the rescuer must assess and classify the condition of the victims according to the severity of their injuries before beginning to administer first aid. Priority is given to victims with the most serious conditions so that they are treated first. This process is known as triage.

Triage classifies the level of patient injury into different categories of urgency, from highest priority to lowest priority. Most first response systems around the world use a four-level colour-coded scale to identify the different levels of priority.

Patient conditions can change very quickly. It is important to continually re-evaluate patients and their priority levels, including “green” patients, to monitor for any change or deterioration in their condition.

6.8 Patient Assessment System Summary

1. SCENE SURVEY
   - Scene Safety – Priorities and Hazards.
   - Universal Precautions.
   - Mechanism of Injury (MOI).
   - Number of Patients and Bystanders.
2. PRIMARY SURVEY
   - Responsiveness.
   - Airways
   - Breathing
   - Circulation
   - Dysfunction
   - Environment

3. SECONDARY SURVEY

Vital Signs	Medical History	Physical Exam
Level of Consciousness.	SAMPLE	Detailed patient exam
Respiration.		
Pulse		
Skin signs.		
Blood Pressure		
Pupils		
Temperature.		

4. Assessment, Recording and Planning - PAS Card.
   - Subjective data - Mechanism of injury, main complaint, symptoms.
   - Objective data - Vital signs, medical history, physical examination.
   - Analysis - The list of injuries and problems.
   - Planning - The response plan for each of the problems.
5. ONGOING ASSESSMENT
   - Continue to monitor and re-assess the patient and group on a regular basis. Vital signs and patient condition should always be monitored by a single person.

THE PRIMARY SURVEY (RABCDE)

Responsiveness

Is the person responsive?

NO →

- ✓ If they do not respond, speak loudly and tap their shoulder.
- ✓ Check if they respond to pain by pinching their trapezius muscles.
- ✓ If no reaction occurs, continue the primary examination.

YES

Airways

Does the person have an open airway?

NO →

- ✓ Perform choking rescue maneuvers.
- ✓ Open the airways manually.
- ✓ Clean and free the mouth from vomit, blood, or other fluids.
- ✓ Constantly monitor the airway of a victim who is lying on their back. If this is not possible, place the victim in a lateral safety position.

YES

Breathing

Is the person breathing without difficulty?

NO →

- ✓ **If the victim is not breathing, initiate CPR immediately.**
- ✓ If respiratory distress is severe, consider investigating the cause.

YES

Circulation

Does the person have intact circulation without major internal or external bleeding?

NO →

- ✓ **At any point in the primary examination, if you discover major bleeding, you must stop it immediately with the following methods**:
  - Apply direct pressure to the bleed.
  - If this does not work, consider applying a tourniquet.

Tip! Don't wait until you have checked the airways and breathing if you notice a major bleed; stop bleeding right away.

YES

Disability

Is the body intact with no suspected fractures and spinal or other major injuries?

NO →

- ✓ If you suspect a spinal injury due to the mechanism of injury, act with care. Immobilize the victim's head and neck and move the victim en bloc and only if necessary.
- ✓ Take time to splint fractured limbs and reassure your victim.

YES

Exposure

Is the victim adequately protected from the elements?

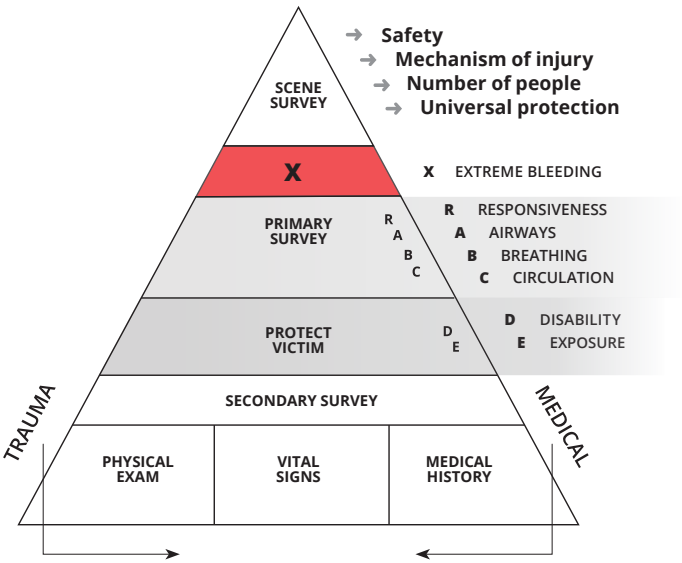
NO →

- ✓ At all times, try your best to protect the victim from the elements. A person who is in shock or even just unwell will have difficulty maintaining adequate body heat. Use a thermal burrito if possible.

YES

When the victim is stabilized and comfortable and you can no longer improve their condition immediately, it is time to move to the next step: the secondary survey.

PATIENT ASSESSMENT SYSTEM (PAS)



DATE :

TIME OF ARRIVAL ON SITE:

NAME :

AGE: | GENDER:

MECHANISM OF INJURY:

CHIEF COMPLAINT:

PHYSICAL EXAM

HEAD TO TOE

P – PROVOKE
Q – QUALITY
R – REGION
S – SEVERITY
T – TIME

C – CIRCULATION
S – SENSATION
M – MOVEMENT

MEDICAL HISTORY

S – SYMPTOMS

A – ALLERGIES

M – MEDICATION

P – PAST MEDICAL HISTORY

L – LAST IN / OUT

E – EVENT

+ VACCINE, MENSTRUATION...

VITAL SIGNS

	LEVEL OF CONSCIOUSNESS	PULSE	RESPIRATION	BLOOD PRESSURE	T°	SKIN SIGNS	PUPILS
	AVPU WHO, WHERE, WHEN, WHAT	FREQUENCY QUALITY	FREQUENCY QUALITY			**C** – COLORATION **T** – T° **M** – MOSTURE	**PERRLA**
TIME							
TIME							
TIME							

ACRONYMS

A – ALERT
V – VERBAL
P – PAIN
U – UNRESPONSIVE

P – PUPIL
E – EQUAL
R – ROUND
R – REACTIVE TO:
L – LIGHT
A – ACCOMMODATION

DATA ANALYSIS

PLAN

LONG TERM CARE

- Think of group **wellbeing**.
- Think of patient **comfort:** heat, hunger, thirst, need to urinate, menstruation, contact lenses.
- **Reevaluate:** 5 to 15 min originally, then extend the time lapse if patient is stable and is not in danger or if they get better

  + evaluate distal CSM in presence of bandages / splint / injury.
- **Note:** changes, new injury, treatment
- **Reevaluate: plan,** evacuation progression.

MEDICAL MONITORING

TIME	ACTION / OBSERVATION	LOC	PULSE	RESP	T°	BP	SKIN	PUPIL

ACCIDENT REPORT FORM

PERSONAL INFORMATION

Name of Patient

First _____

Last _____

Tel #_____

Cell #_____

Medicare number #_____

Address

Street _____

City _____

Province _____

Postal Code _____

Email address _____

ACCIDENT INFORMATION

Accident Date ____/____/____ Time ___:____ Location_____

Map #_____Grid reference #_____Latitude_____Longitude_____

Weather – Temperature_____Clouds_____Precipitation_____Winds_____Visibility_____

PATIENT INFORMATION

Age_____ Sex_____ Level of Consciousness: Alert & Oriented_____Verbal_____Pain_____Unresponsive_____

Airway (condition)_____**B**reathing (condition)_____**C**irculation (condition)_____

Position found in _____

Mechanism of injury _____

_____

Chief complaint _____

EVENTS LEADING UP TO THE ACCIDENT

Medical History

Allergies (Medic Alert®)_____ Patient Medications _____

History of Previous Injury/Illness_____ Last Meal_____

Contact Lenses yes ☐ no ☐ Tetanus Vaccine within Last 10 years yes ☐ no ☐

VITAL SIGNS RECORD

TIME	:	:	:	:	:	:	:
LEVEL OF CONSCIOUSNESS (AVPU)							
PULSE (Rate / Character)							
RESPIRATION (Rate / Character)							
SKIN (Colour, Temperature, Moisture)							
BLOOD PRESSURE (Systolic / Diastolic)							
PUPILS (PERRLA)							
TEMPERATURE (Oral ☐ Rectal ☐)							

Comments (Long Term Patient Care)

Time 1_____

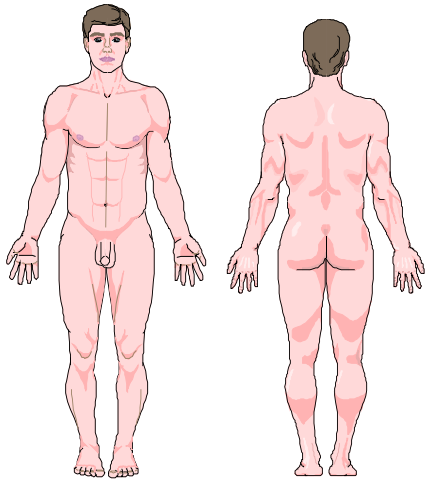
Time 2_____

Time 3_____

Time 4_____

Time 5_____

DESCRIPTION & LOCATION OF PAIN AND INJURIES



FRONT BACK

GENERAL CONDITION

TREATMENT PLAN

EVACUATION PLAN

ASSISTANCE REQUIRED

PATIENT CONSENT I have carefully read this report and agree that the information is accurate. I accept the prescribed treatment.

_____/_____/____
Signature Date
_____/_____/____
Witness Date

REFUSAL OF TREATMENT I have carefully read this report and understand its contents. I agree that the information is accurate. I hereby refuse the prescribed treatment.

_____/____/_____
Signature Date
_____/____/_____
Witness Date

Patient Released to (Medical Professional)

Name_____
Address_____
Telephone #_____
_____/_____/_____
Signature Date

Person Completing this Form

Name_____
Address_____
Telephone #_____
_____/____/____
Signature Date

7. Soft tissue injuries

The soft tissues of the body include layers of skin and fat, muscle tissue, connective tissue (such as tendons and ligaments), blood vessels, neural tissue and the body's internal organs.

Most soft tissue injuries or wounds from trauma will involve the skin. But injuries can occur at any level, superficial, deep or both. A blunt trauma can damage internal organs, causing internal bleeding, without necessarily causing any evident damage to the skin. A penetrating trauma necessarily involves the skin, but can penetrate right down to bone and organs, exposing the body to the possibility of infection.

7.1 Anatomy and Physiology of the Skin

The skin envelops the body in its entirety and is its largest organ. The only external areas of the body not covered by skin are the mouth, nose, anus and vagina. These openings are protected by mucus-producing membranes that function in much the same way as the skin.

7.1.1 The Skin's Functions

- It prevents harmful bacteria and foreign bodies and fluids from entering the body.
- It protects the body from solar radiation through its pigmentation.
- It maintains water balance by preventing fluid loss and controlling fluid intake.
- It helps to transmit stimuli from the environment to the nervous system through the numerous sensory organs located in the skin's middle layer.
- It regulates body temperature through blood flow control, either increasing blood flow to the surface to release heat from the body or constricting blood flow to preserve the body's heat.
- It also regulates body temperature through other processes, such as generating sweat to be evaporated on the surface to cool the body or initiating shivering or small muscular contractions to warm the body.
- Its subcutaneous layer insulates internal organs against the cold and helps to absorb shock in cases of trauma.

7.1.2 The Skin's Layers

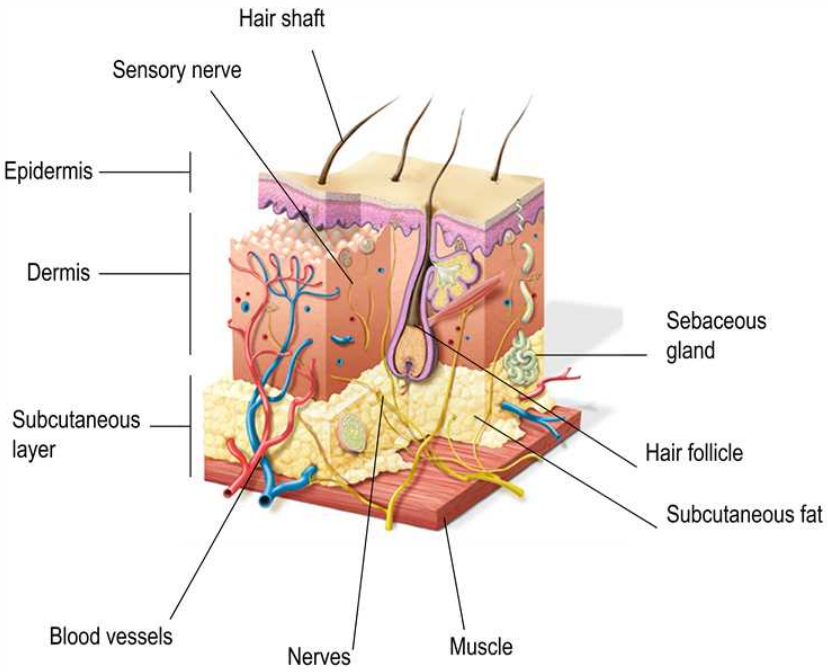
The skin is made up of three layers: the epidermis, the dermis and subcutaneous tissue.

Epidermis

The epidermis refers to the outermost layer of the skin. It is used to protect the underlying tissue layers. The epidermis's own top layer is comprised of dead cells that are constantly sloughed off and replaced. The inner layers of the epidermis contain pigment granules and active cells that are continually producing new skin cells. The epidermis contains no blood vessels or nerves.

Dermis

This is a much thicker layer protected by and located immediately below the epidermis. The dermis contains a rich blood supply and specialized structures including nerve endings, sweat glands, hair follicles and oil glands. Damage to the dermis can cause intense pain and profuse bleeding. If exposed to the environment the dermis is prone to drying and infection.



Subcutaneous Tissue

Comprised largely of fat and other soft tissue, the primary function of the subcutaneous layer is shock absorption and insulation for the body's internal organs. Damage to the subcutaneous tissue will result in bleeding, pain and potential infection.

Underlying Tissues

Beneath the layers of skin, lie the body's muscle tissue, connective tissue, neural tissue and internal organs. Muscles account for most of the soft tissue in the body and are discussed in more detail (see Musculoskeletal injuries (p. 147)).

7.2 The Body's Response to Injury

Stop the Bleeding

When the skin and underlying tissues are damaged, the body's immediate response is to initiate a series of mechanisms to stop the bleeding:

Vessel Retraction

The walls of severed blood vessels retract into the surrounding tissue.

Vasoconstriction

The damaged vessels constrict for up to ten minutes to inhibit blood loss.

Platelet Plug Formation

Platelets clump together to form a loose plug around the damaged vessels and further inhibit blood loss.

Inflammation

Local vessels become more permeable allowing plasma to seep through the capillary walls into the tissue, causing it to swell. The swelling serves to blockade the area, reduce bleeding and inhibit the absorption of foreign matter into the rest of the body.

Restoring Homeostasis

Before this initial response to stop the bleeding is complete, the body sets in motion two further processes to restore homeostasis: the Inflammatory Process and Tissue Regeneration.

Inflammatory Process

The inflammatory process isolates the wound site from neighbouring healthy tissue, while damaged cells, debris and any pathogens are cleaned up. The process includes several mechanisms, the first being local tissue swelling as described above. This is followed by vasodilation, in which the blood vessels now dilate to increase blood flow to the area (peaking at about 20 minutes after the injury), causing redness and heat. A blood clot is then formed from protein filaments. Called coagulation, this mechanism helps stabilize the existing platelet plug and begins to restore the integrity of the vessel. Finally, increased blood flow allows infection-fighting cells to accumulate in the area and initiate phagocytosis. Leukocytes (white blood cells), neutrophils and macrophages, generally arrive at the wound site within an hour after an injury. They are responsible for removing debris and dead cells and for destroying bacteria.

Tissue Regeneration

Once an initial tissue homeostasis is achieved, generally in the first hours after an injury, tissue regeneration can begin. This includes the growth of new blood vessel cells, connective tissue cells and skin cells. Skin cells migrate out from the wound margins to close over gaps. With clean, and especially sutured, wounds, the initial wound closure can occur in as little as 24 to 48 hours. Connective tissues begin to regenerate within about 2 to 3 days. However, the tissues do not immediately regain their elasticity and strength. The affected area remains vulnerable long after the wound has closed. Large open wounds may take a week or longer to heal because the inflammatory process is prolonged.

7.2.1 Factors Deterring Healing

Interrupted Blood Supply

Blood supply is an important factor in wound healing. Blood carries oxygen, nutrients and warmth to the area and is responsible for the removal of dead tissue and wastes. Slowing down blood flow in the first few minutes after injury, for example, affects the amount of heat available at the injury site. In a cold environment, this can predispose the affected area to frostbite. The body's blood supply to an injured site can also be affected by factors such as the patient's age, pressure caused by restrictive bandages and any severe damage to the vascular bed.

Mechanical Stress

Any stress that causes wounds to reopen inhibits the healing process. Wounds must be protected from excessive movement, pressure and re-opening.

Infection

Infection is the most common complication associated with wound healing. An infection is the invasion and colonization of body tissues by pathogenic microorganisms, such as viruses and bacteria. An infection interferes with the normal functioning of the affected organism and can lead to chronic and sometimes life-threatening wounds. Infections are classified as local or systemic. A local infection is limited to one area of the body, such a wounded digit. If the infection spreads throughout the entire body, it is called a systemic infection.

Abcess

An abscess is a localized collection of pus caused by a local infection.

Anerobic Infections

Anerobic infections are caused by the growth of bacteria in underlying tissues where there is an absence of oxygen. This may be the result of an infected lesion that has closed before being adequately disinfected. This type of infection is also found in deep wounds where there is a lack of oxygen. Anerobic infections can lead to life-threatening systemic infections such as tetanus and gangrene if not treated immediately.

- Tetanus is an infectious disease caused by the Clostridium tetani bacteria. It is characterized by spasms of the voluntary muscles, especially the jaw.
- Gangrene is tissue death of a body part. It is caused by the localized loss of blood circulation following an injury or infection.
- Gas gangrene is a life-threatening bacterial infection. Any injury that compromises circulation and thus deprives a tissue of oxygen is susceptible to developing this type of gangrene. Common signs and symptoms include swelling, red to brown skin discoloration and accompanying crepitus (crackling) of the skin caused by the formation of gas bubbles.

7.3 Varieties of Soft Tissue Injuries

Soft tissue injuries can be classed according to the type of force applied to the body during the injury, the type of wound and wound depth sustained in the injury and the type of bleeding involved.

7.3.1 Types of Force Applied

When assessing the mechanism of an injury, the rescuer must consider the force applied to the body at the time of injury. This includes a consideration of the kind of object with which the body came into contact and both the speed and direction of the moving force and/or body at the time of impact.

Penetrating Force

Penetrating force involves a force that cuts through tissue rather than bruising it. Penetrating force is a combination of two different mechanisms, the sharps wound and the firearm projectile wound.

Several objects have sharp and pungent characteristics: the ice axe, the arrow, the ski pole, the knife and pieces of glass or metal. Some natural objects can also take on penetrating characteristics such as ice or a split tree. These objects can cause puncture wounds, which are wounds with a very small point of entry and great depth.

Firearm projectile wounds can be classified according to the velocity of the projectile. Low velocity refers to pistol and revolver rounds while high velocity refers to rifle pellets.

- Low-velocity projectiles are generally associated with a smaller wound, but this does not mean that they are less significant injuries.
- With high-velocity projectiles, the wounds are larger and there are often associated fractures.

A rifle is considered to have low velocity projectiles. However, they are twice as deadly as other low- and high-velocity weapons and are associated with a higher infection rate. Firearm projectile wounds result from two different mechanisms. The first mechanism is the permanent cavity, which is the wound created by the missile permanently destroying tissue in its path. The second mechanism is the temporary wound that results from the shock wave created by the projectile. The shock wave stretches the tissue around the wound; the tissue then collapses.

Blunt Force

The blunt force results from the impact between a foam body (blunt object) and the human body. The blunt force injury has many different aspects. Erosion is the loss of the most superficial part of the skin. A laceration is the tearing of the skin or an internal organ. Contusion is a patch of color made up of blood that has seeped into the tissue as a result of ruptured blood vessels. Hematoma is a collection of blood between tissues; unlike contusion where the blood is in the tissue, the blood is between the tissues in the hematoma.

7.3.2 Wound Types

The two types of force described above result in two very different types of soft tissue injuries: open wounds and closed wounds.

Open Wounds

An open wound is an injury in which the integrity of the skin is broken and underlying tissues are exposed. These include abrasions, lacerations, avulsions, punctures, amputations, impaled objects and splinters. Open wounds are generally more prone to infection than are closed wounds.

Closed Wounds

A closed wound is an internal injury that has no opening to the external environment. Closed chest injuries are caused by blunt trauma. They include contusions, hematomas, twisting and compression injuries. While the skin itself is not broken there may be extensive damage to the tissues beneath that is not immediately visible. Closed wounds are generally less prone to infection than open wounds, but can be very dangerous because of the potential for severe blood loss.

7.3.3 Wound Depth

In addition to types of force and injury, wounds can be classified according to their depth.

Superficial wounds

They involve only the epidermis and sometimes the upper dermis. They include abrasions, minor cuts and first-degree burns, such as most sunburns.

Partial-thickness wounds

They can penetrate down to the lower dermis. They include blisters, second-degree burns, lacerations and punctures. They include blisters, second-degree burns, lacerations and punctures.

Full-thickness

Wounds involve the epidermis, dermis and subcutaneous tissue. They include third-degree burns, deep cuts and punctures.

Deep wounds

Deep wounds penetrate down into deep-lying tissues or organs in body cavities.

7.3.4 Types of Bleeding

Bleeding is likewise classified into several types to reflect different kinds of wounding.

External Bleeding

External bleeding results from an open wound. It is clearly visible to the eye and occurs when the skin has been penetrated, torn or removed. There are three types of external bleeding.

Capillary bleeding

It produces an oozing of blood through the skin common in scrapes and “road rash” injuries. This type of bleeding is usually short-lived and does not produce a significant amount of blood loss.

Venous bleeding

Is characterized by a slow flow of blood from the veins located in the subcutaneous tissues. Since venous pressure is relatively low, the body is able to kick in quickly to stem the blood flow. Depending on the extent of the damage, however, venous flow can result in substantial volume loss and must be controlled.

Arterial bleeding

Results from damage to arteries. Because arteries propel the blood under pressure, arterial bleeding may be substantial and dangerous. Damage to large arteries located in deep tissues will produce a very high volume of blood loss and may be difficult to control.

Internal Bleeding

Internal bleeding

Will occur when an internal organ, tissue or vessel has been damaged. It is not always visible from the outside and may be life-threatening.

7.4 Wound Management

Determining the severity of a soft tissue injury involves assessing the extent of the injury (surface area affected), the depth of the injury (layers of tissue that are involved) and its location on the body. Other considerations include assessing what adjacent tissues are affected and the cleanliness of the wound environment.

7.4.1 Principles of Wound Management

Regardless of the type of wound or its extent the principles of management remain the same.

1. Control the bleeding.
2. Prevent infection.
3. Promote healing.

7.4.2 1) Control Bleeding

The severity of bleeding is largely a function of the type of vessels that are damaged and the extent of the damage (see Types of Bleeding).

Different methods to control bleeding:

- Targeted local compression.
- Packing of the wound.
- Use of hemostatic dressings.
- Tourniquet.
- Conversion of the turnstile to another method.

Methods not recommended:

- Pressure point on artery upstream of the bleed.
- Elevation of the tip is no longer a recommendation.

Targeted local compression and wound packing

Direct pressure, directed precisely to the site of bleeding, is the preferred initial technique.

For light to moderate bleeding, local pressure for about 5 minutes with a compress will usually be sufficient to control most bleeding.

Direct pressure will stop most bleeding.

- Cover the wound with the cleanest cloth available (sterile gauze from your first aid kit is best).
- Apply pressure with your gloved hand directly over the wound.
- Apply just enough pressure to stop the bleeding.
- Do not peek as it will interrupt the body's natural clotting process.
- If bleeding persists and soaks the bandages apply an additional outer layer of bandage. You can replace the outer layer of dressings if blood flows through it. In this case, care must be taken not to remove the dressing that is in contact with the wound. Be careful not to apply too many layers as this will reduce the effect of the pressure.
- Areas of the body that are highly vascularised such as the scalp, face and hands may require more time before bleeding can be arrested. Apply a bandage and hold it in place using a larger bandage.
- Direct pressure should NOT be used on wounds that may include trauma to the underlying bone structures (such as in the head and face) or wounds in which the patient's air supply may be compromised (in the neck region).
- The patient should stop all activity to slow down the pumping action of the heart.

For larger bleeds or if simple local pressure is not sufficient to control the bleeding, a more aggressive approach must be taken quickly to avoid significant blood loss that can lead to hypovolemic shock.

Stages of care

Stop the bleeding.

- Immediately apply direct pressure to the wound, using gauze, a clean cloth, elbow, knee, whatever it takes to slow or stop the bleeding, until you have time to get out your wound care supplies.
- Place your gloved fingers with or without a dressing in the wound to apply initial pressure to the target area (your target being the injured vein, artery or both) and compress the source of bleeding. Keep in mind that blood vessels in the extremities often run along bone, so if possible, use a bone to help compress the vessels.

Fill the wound with gauze.

- Your goal is to completely and tightly fill the wound cavity to stop the bleeding. Begin to unroll the gauze at the bottom of the wound with your finger, while simultaneously maintaining pressure on the wound at the site of bleeding, until the wound is filled.

Apply very firm pressure to the packed wound for 3 minutes

- This step creates additional pressure on the bleeding site and helps with coagulation.

Secure with a pressure bandage for transport.

- After applying pressure for 3 minutes, place a tight pressure bandage over the wound. A splint or other means of immobilization will help prevent the pack from becoming dislodged during transport and causing rebleeding.

Complication of Persistent Hemorrhage

If bleeding persists, one can simply attempt to add more gauze to the wound and resume compression, otherwise, consideration should be given to removing the original pack and compression bandage and replacing it with fresh gauze and re-packing in case the initial attempt did not adequately compress the bleeding area. All of these maneuvers, however, should not interfere with or delay the decision to transport the victim to a medical facility.

Quickly consider the use of a tourniquet

In case of initial failure if the bleeding is located at the level of an extremity or even early in order to temporarily decrease the bleeding during the application of the pack and the pressure dressing (see tourniquet).

Using a Tourniquet to Control Severe Bleeding - a Last Resort

If direct pressure is neither effective nor possible, a tourniquet can be used to stop severe bleeding. This is not a long-term solution, however. The pressure applied by the tourniquet will interrupt blood supply to structures distal to its application. Over time, a tourniquet may have devastating consequences to the viability of the tissue and may lead to gangrene of the extremity, shock and even death.

Classically, the teaching was to use the tourniquet only as a last resort, but several recent studies and military experience show that rapid use (before signs of shock appear) of the tourniquet to control significant arterial bleeding is associated with a 90% versus 10% survival rate compared to late use (once signs of shock are present) or no tourniquet application.

The tourniquet is therefore no longer considered as a last resort but rather as a method of controlling temporary or permanent bleeding in the event of massive bleeding at one end.

Use of the Tourniquet is indicated if direct compression is ineffective (bleeding persists) or compression is impossible. Manual compression may be considered impossible in some situations:

- Traumatic amputation.
- Multiple bleedings.
- Hemorrhagic wounds with foreign bodies.
- In the event of a situation involving multiple victims.

Commercial vs. Improvised tourniquet.

It is strongly suggested that you have a commercial tourniquet in your first aid kit to minimize the time required to find the materials needed to make one. In addition, the superiority and lower complication rate of commercial tourniquets has been clearly demonstrated.

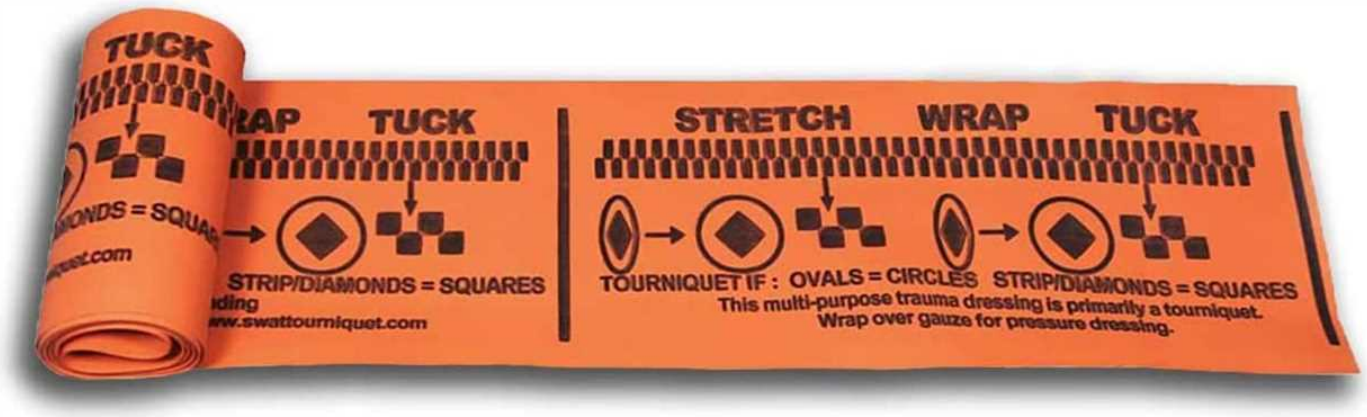
There are three tourniquets currently approved for use:

The Combat Application Tourniquet (C-A-T)

The Special Operations Forces Tactical Turnstile (SOF-TT) in two sizes

Emergency and Military Tourniquet (EMT)

Other type of tourniquet: The Junction Tourniquet is also approved for proximal bleeding but is mainly found in military situations.



The SWAT-T tourniquet is a multi-purpose elastic band that is approved for use as a tourniquet. Its advantages are its very light weight and its size which allows it to be included in any first aid kit, even the most minimalist. Its main disadvantage is that it takes a little longer to set up than conventional turnstiles and is more difficult to use on oneself. Another undeniable advantage is its great versatility, allowing it to be used as a pressure dressing, to hold a bandage in place or even to secure a splint.

In a high-risk tactical penetrating trauma environment the recommendations remain in favor of the conventional turnstile, with the SWAT-T in support, but in a lower-risk context, or when a conventional turnstile is not available, the SWAT-T remains a very valid option. As with any turnstile system, the most important component for safe and effective use is to obtain the necessary training for its optimal use and to practice its use regularly.

Key principles for the application of the improvised and commercial tourniquet :

- The Tourniquet should be easily and quickly accessible in the first aid kit. However, it should not be worn outside the kit to minimize the risk of wear and tear.
- The Tourniquet should be positioned close to the injury, 5-6 cm above the injury, avoiding the joints.
- The tourniquet must be tightened before applying tension to the mechanism.
- The application of a high tourniquet on the thigh is more difficult and the application of a second tourniquet is often necessary to control bleeding.

Steps for applying an improvised or commercial tourniquet

- Take a fairly large and strong piece of cloth (such as a triangular bandage) or a commercial tourniquet.
- Wrap the piece of cloth around the limb DIRECTLY on the SKIN (avoid placing the tourniquet on several layers of clothing), 5-6 cm ABOVE the wound - go around the limb twice.
- NEVER apply the tourniquet to a joint.
- Tighten and tie a knot
- Above the knot, place a solid bar (such as wood, metal rod, etc.) about 10-20 cm long, the bar must be rigid enough to tighten the tourniquet.
- If you can't find any material for the bar, tighten the withers knot as tight as possible by pulling on each end of the fabric and make a double holding knot.
- Tie two knots ABOVE the bar to hold it in place.
- Turn the bar to tighten the tourniquet until the bleeding stops and maintain the tightness. Usually with a commercial tourniquet it will take three full turns to get good bleeding control.
- Once installed, the tourniquet must always remain visible (do not cover it).

- It is important to note the time of application of the tourniquet. Whenever possible, ideally write on the tourniquet or even on the victim.

One of the most common mistakes is not tightening the tourniquet enough to stop the arterial bleeding. Check that the distal pulse is completely gone, it's an indicator that the tourniquet is tight enough. The tourniquet, when properly applied, is very painful for the individual, it's normal.

At equal pressure, a tourniquet installed in a wider position makes it easier for the distal pulse to disappear than a tourniquet made narrower, and a tourniquet that is too narrow will cause many more local complications (crushing of tissue, vessels and nerves).

Frequent re-evaluation of the distal pulse is important to ensure that the tourniquet is properly installed. Sometimes in the first few minutes after installation of the tourniquet, the muscles are more tense and then relax, which may cause the tourniquet to loosen and require the tension to be adjusted.

Tourniquet conversion

Tourniquet conversion is a term that describes the re-evaluation of bleeding control to consider transitioning to another method of bleeding control to avoid complications associated with ischemia (lack of circulation and tissue oxygenation) and trauma caused by prolonged tissue compression. The transition is usually from the tourniquet to the compression bandage.

Tourniquet conversion is a particularly important technique to master in remote areas where the patient's extraction time can take hours or even days.

If the time required to extract the victim from a hospital is LESS than 2 hours, leave the tourniquet in place.

The Tourniquet conversion should only be considered if:

- The individual is NOT in shock
- The victim can be closely monitored and assessed regularly for the risk of resumption of bleeding.

DO NOT attempt to convert in cases where:

- There's an amputation
- The tourniquet has been in place for 6 hours or more.
- In the event of an unstable clinical situation (state of shock)
- Rescue workers or resources are limited for the placement of a compression bandage or to provide constant supervision of the victim.
- The transfer time to the hospital is less than 2 hours.
- With Crush Injury.

If none of these contraindications are present, apply a compression dressing or wound pack BEFORE loosening, and gradually loosen the tourniquet.

- Watch closely for resumption of active bleeding.
- It has been shown that conversion should be initiated as soon as possible within the first 2 hours to minimize tourniquet time.
- If the initial conversion test did NOT work, it is NOT recommended to try again due to the risk of exsanguination.
- If the conversion is successful, leave the tourniquet in place, released, in the event that a quick re-application is required.
- Note the time you loosened the tourniquet.
- Transport the victim to a medical resource without delay.

Important points to remember

- The Tourniquet is used for heavy bleeding in the extremities that do not respond to usual control measures or in certain situations where their application is not possible.
- The tourniquet can be used as a temporary means of controlling heavy bleeding.
- After 6 hours, the tourniquet should only be removed in a hospital setting.
- A conversion is a transition to a less damaging means of bleeding control, but several conditions must be met in order to proceed.
- If the tourniquet is used as a temporary means it should be loosened as soon as possible (ideally within 2 hours) to minimize complications to the limb.

Other Factors that Could Affect Bleeding Control

Anticoagulants (Heparin, ASA and others)

Anticoagulation medication is taken as a prophylactic treatment against potential clot formation by people who have had an acute coronary syndrome such as a heart attack. When injured, patients on anticoagulants are therefore more prone to uncontrolled bleeding.

Blood-Clotting Disorders (Hemophilia)

Patients who have blood-clotting disorders such as hemophilia can bleed extremely easily. In these patients, even small wounds must be treated as critical cases. Hemophiliac patients must receive definitive care as soon as possible.

7.4.3 2) Prevent Infection

The second step in wound management is the prevention of infection.

- This is achieved in part by removing as much foreign matter as possible so as to reduce the bacteria count to levels that the body's natural defences can manage.
- Always wear gloves and protective eyewear. Start by cleaning the area around the wound with a non-toxic antiseptic solution or soap. Do not allow the solution to enter the wound.
- Never put anything into the wound that is toxic to live tissue. This includes detergents, hydrogen peroxide, mercurochrome, alcohol or any alcohol-based solutions (such as tinctures). Toxic agents create a layer of dead tissue in the wound and increase the risk of infection.
- When the skin around the wound is clean, irrigate the wound thoroughly with uncontaminated or disinfected water. Let the water dislodge and wash away the debris. The forceful jet of a pressure irrigation syringe (40-60 cc.) provides the most effective method of cleaning a wound and dislodging debris. A plastic bag with a pinhole in one corner, a bulb syringe or even the jet from a water bottle may also be used. Large or dirty wounds will require several litres of water and may take up to 15 to 20 minutes.
- Any foreign material that does not come out with irrigation can be removed by gently scrubbing with sterile gauze or pulled out with tweezers and cotton-tipped applicators. Another way is to wrap a sterile compress around the index finger and grasp the debris between the thumb and index finger. The debris will adhere to the gauze. Change the gauze frequently.
- Take the time to clean the wound thoroughly to prevent the possibility of infection. All infected wounds require re-opening and further cleaning, which is generally much more painful than any pain inflicted by a proper cleaning at the start.

Assessment of Infections

The degree of infection found in a wound will depend upon the depth and extent of the wound, the quantity of foreign particles that have entered the wound and the length of time these particles have remained there. Infections like other tissue wounds will trigger the inflammatory process. As a result, the signs and symptoms of infection resemble those of inflammation.

Signs of a Local Infection

- Redness
- Warmth
- Swelling
- Pain
- Pus formation (malodorous discharge that is yellow or green)

Some fluid discharge can be expected from all wounds and is considered a normal event in the healing process. Fluid that is clear or opaque is a normal sign of a healthy wound. Pus that is yellow or green in colour or large quantities of white pus is an indication of an infection and requires immediate attention.

> **NOTE**
>
> Remember that thin layers of new skin and the growth of new blood vessels will give the wound area a pinkish colour. This is a normal aspect of wound healing and should not be mistaken for early signs of infection.

Signs of a Systemic Infection

- Streaking under the skin proximal to the wound
- Swollen and painful lymph nodes
- Fever, shock, general malaise
- Signs and symptoms of the flu

Management of Infections

If an injury does become infected, it is important to re-clean and drain the wound.

Re-Clean Infected Wounds

Infected wounds must be re-cleaned and dressed. Remove all dirt, pus and dead tissue from the wound. This may require vigorous scrubbing with a sterile gauze, surgical scrub brush and extensive irrigation with a sterile solution or normal saline solution. You can also soak an infected wound in warm saline (40 degrees Celsius) for 10 to 15 minutes. This method removes some of the contaminated fluid from the wound and softens the dead tissue to help dislodge it.

Allow for Drainage

Pus and fluid must be allowed to drain freely from the wound. If a dressing covers the infected wound, it should be removed to allow for re-cleaning. Once cleaned, leave the wound open to the air to facilitate pus evacuation and access to oxygen. Place a “wick” of non-adhesive sterile gauze in deep wounds and cover with sterile dressings. Inspect the wound and change dressings at least twice daily.

Long-Term Patient Care

Ensure the patient is adequately hydrated. These three elements promote the body's ability to heal itself.

When to Administer Antibiotics

Topical antibiotics are useful to help prevent the growth of bacteria (see below), but have little effect on the management of established infections. Systemic antibiotics are generally not required on shorter excursions where medical care is available within a period of a few days. On longer expeditions, however, and where medical care is many days away, systemic antibiotics administered orally may help to reduce the spread of infection.

7.4.4 3) Promote Healing

Once the wound has been adequately cleaned the next step is to provide an environment that will promote healing and reduce the chance of infection. Tissue growth requires sterile moisture, oxygen and nutrients.

Keep the Wound Moist

A moist wound will heal up to 30 percent more rapidly than one that is left to dry out. Tissue that has dried is dead tissue and is highly prone to infection.

Apply an antibiotic ointment such as Neosporin® or Polysporin®. This will reduce the growth of bacteria and will help to keep the wound moist.

Dry Dressings

Cover the wound with a sterile dressing and bandage it in place. While the wound itself must be kept moist, dressings should be kept clean and dry. Dry dressings such as sterile gauze provide a barrier to infection from the external environment as long as they remain dry. Dressings soiled by dirt, bleeding, sweat or outside moisture provide an ideal colonization environment for bacteria. They must therefore be redone without delay.

Occlusive Dressings

Occlusive dressings such as Opsite®, Tegaderm® and 2nd Skin® are impermeable to water, bacteria and viruses while allowing oxygen into the wound.

These dressings are transparent and facilitate visual examination of the wound. Occlusive dressings are ideal for the long-term care of wounds in the backcountry. They may remain in place for several days if a wound does not become infected and they reduce the quantity of dry dressing materials that must be carried. They also serve to hold the surrounding skin in place, which reduces the chance that a wound will re-open from mechanical stress.

Wound Closure

Superficial wounds that do not close on their own may be closed using non-surgical wound closure strips (Steri-Strips®). These are placed on the surface of the skin and are easily removed if the wound needs to be re-opened for cleaning or inspection.

Wound Closure Strips (Steri-Strips®, Curi-Strips®)

- These are useful for shallow non-gaping wounds.
- Apply only after the wound has stopped bleeding and has been thoroughly cleaned.
- They have excellent retention with tincture of benzoin. Make sure the tincture of benzoin is applied next to the wound and not in it. The the tincture of benzoin should never come into contact with the wound.
- High-quality surgical tape may be used if these are not available.

Application of Tincture of Benzoin around wound.

Apply wound closure strips ¼ inch apart.

Wound covered with occlusive film dressing.

Large Gaping Wounds

Large gaping wounds and wounds that are excessively dirty require evacuation to a medical centre for cleaning and surgical closure. They should not be closed with non-surgical closure strips. To reduce the risk of an anerobic infection, pack the wound with non-adhesive sterile gauze and cover with a dry dressing.

Examine all wounds at least twice daily and watch for signs of infection (swelling, redness, pus). Apply new dressings as needed. In wet and dirty environments, the wound may need to be cleaned more than twice a day. Continue to monitor distal CSM.

7.5 Management of Specific Wounds

7.5.1 Closed Wounds

Closed Injuries

Contusions (or bruises) are the most common types of closed wounds. They're usually caused by blunt-force trauma. A contusion is a minor hematoma, in which damage to the blood vessels allows blood to seep into the surrounding tissue, causing swelling and the characteristic black and blue discolouration of the tissue. Infiltration of blood causes swelling and the characteristic blue and black discoloration of the skin. Over time, the blood at the wound site changes and the colour of the bruise turns dark purple, green, and sooner or later brownish-yellow. Contusions can be very painful. Small bruises are not dangerous, but larger bruises can be associated with more life-threatening hematomas. Careful attention must be paid to regions of the body that contain important organs. Damage to solid and blood-rich organs such as the liver, kidneys and spleen may result in severe life-threatening bleeding. Note that the depth of a contusion can easily equal its surface area.

Management

- Management of contusions includes having the patient rest, icing and compressing the contusion and elevating the part to limit swelling and promote healing.
- Contusions should be monitored closely in cold weather. They will freeze more easily than healthy tissue due to the diminished circulation in the area.

Crush Injuries

Crush injuries occur when the tissue has received a crushing force. Complications of this type of injury include internal bleeding, swelling and the risk of compartment syndrome where internal tissue pressure compromises circulation.

Management

- The management of crush injuries includes treating for shock and administering ice, immobilization and elevation to slow the process of tissue breakdown.
- Severe cases will require evacuation.

Ring Removal

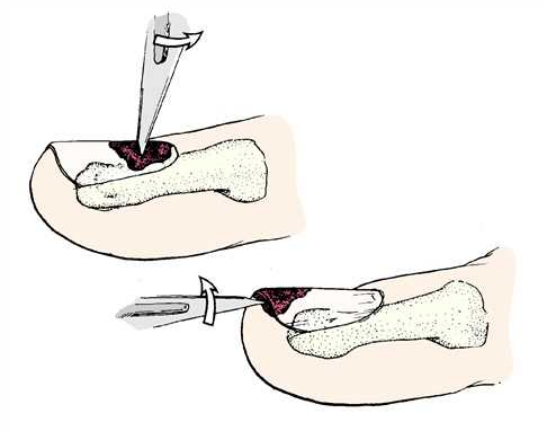
Injuries involving the fingers are often complicated by swelling. Remove any rings or jewelry that has the potential to compromise circulation.

Management

- Coating the finger with soap or petroleum jelly can ease removal in most cases.
- If this method does not work or if cutting is not possible (for lack of a specialized tool), wrapping string around the finger may work.
- The string should be wrapped tightly several times around the finger below or distal to the ring.
- Thread the other end of the string under the ring and then pull it over the top of the ring down towards the tip of the finger.
- Then unwind the string from the end under the ring.
- The ring is inched off as the string unwinds.

Subungual Hematoma

A subungual hematoma is a crush injury involving the nail bed.



Management

- The accompanying pressure and pain under the nail can be relieved by drilling a tiny hole in the nail to allow the blood to escape.
- This can be done with the help of a sterilized needle or similar sharp point.
- Alternatively, a metal pin or needle may be heated with a lighter, and a hole “melted” through the nail.

7.5.2 Open Wounds

Abrasions

Abrasions and abrasions are superficial lesions of the skin. They are characterized by capillary bleeding in the form of oozing. Although they do not bleed a lot, abrasions are painful and easily infected especially if the lower layers of the epidermis and dermis are allowed to dry out.

Management

- The most superficial abrasions may be scrubbed and allowed to air dry before bandaging.
- More extensive damage should be thoroughly scrubbed with a moistened gauze or surgical scrub brush and then covered with an occlusive bandage.
- For hard to clean abrasions, use tweezers.

Lacerations

A laceration is a cut caused by a sharp object. It can bleed profusely.

Management

- Control bleeding and clean with pressure irrigation.
- To treat a large gaping wound, clean and pack with sterile gauze.
- Make sure there is nothing inside the wound before applying direct pressure.

Avulsions

An avulsion is a flap of skin or tissue that has been torn loose or completely pulled off (amputated).

Management

- Rinse under the flap and bandage it in its normal position.
- The viability of the flap of tissue will depend upon how well cleaned it is and the condition of the blood supply to the area.

Amputations

An amputation refers to a part of the body that has been completely severed. The best environment for amputated tissue is one which is cool, moist and sterile.

Management

- Wrap the part in a moist sterile dressing and seal it in a plastic bag.
- Immerse the bag in another bag containing snow or cold water, and evacuate both the patient and the part to the hospital.
- Ensure that the tissue is not exposed to freezing which will create further damage.

Punctures

Puncture wounds are caused by hard sharp pointed objects such as nails, ice axes, picks or crampon points. Puncture wounds are difficult or impossible to clean as there is no access to the interior of the wound.

Management

- Clean punctures by irrigating under pressure.
- Let the wound bleed and monitor for signs of infection.
- Ensure that the patient has had a tetanus inoculation within the past 10 years.
- If not, recommend that the patient see a doctor or get vaccinated as soon as possible.

Impaled Objects

Some puncture wounds will still have the object imbedded in the body part.

Management

- It is usually best to stabilize the object and evacuate.
- While the application of direct pressure is not possible with this type of wound, pressure can be applied on the blood vessels above the injury site.
- Packing bandages around the injury site will not only control bleeding, it will also help to stabilize the object.
- The joints above and below the wound should be immobilized to minimize aggravation.

Complications

In some cases leaving the object in the wound will actually cause further injury. Consider removing an impaled object in the following cases:

- It is in an extremity.
- It is metal in a cold environment.
- It is through the cheek (which both poses the risk of impaired breathing and is extremely difficult to bandage).
- It is too hard to cut off and too large to evacuate.
- Attempts to stabilize the object have been unsuccessful.
- The object is preventing the rescuers' ability to manage ABCs.

NEVER attempt to remove an impaled object in the skull, chest, abdomen or eye.

Splinters and Slivers

Wooden splinters and metal and glass slivers can be removed with sterilized splinter forceps.

Management

- Clean the area completely.
- Determine the splinter's angle of entry and withdraw along the same angle.

- Treat as a puncture wound.
- Control bleeding accordingly and monitor for signs of infection.

Gunshot Injuries

Gunshot injuries are generally demarked by entrance and sometimes exit wounds. Significant internal damage can also occur and depends on the type of gun used, the speed and path of the bullet and the location of the injuries. The trajectory of a bullet passing through the body does not always follow a straight line. As a result, it is difficult to know precisely which tissues, organs or vessels are damaged. Shotgun shells expell hundreds of small balls that will travel throughout the body, each following a different route.

Management

- Treat according to the resulting wound and evacuate.
- Gunshot injuries to the torso should be treated as spinal injuries.

Animal Bites

See Mammal Bites (p. 184).

Human Bites

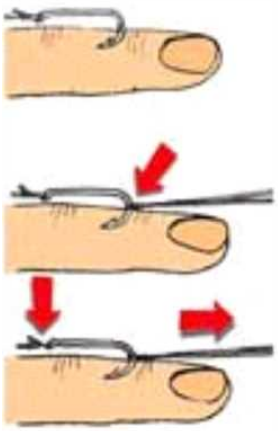
The human mouth is home to a very large number of bacteria. This is why any injury caused by a human bite is considered at risk of infection.

Management

- Management includes thoroughly cleaning the wound, covering with a dry sterile dressing, monitoring for signs of infection and seeking medical help.

Fish Hooks

Fish hook injuries are considered puncture wounds.



Management

- When the barbed end of the fish hook is fully or almost poking through the fleshy part of the skin, it can be pushed through so the barb can be cut off.
- The remaining portion can then be pulled out from the other end.
- As well, you can push down against the fish hook with one hand while gently pulling it out with the other.
- The downward pressure helps disengage the barb from under the skin and make removal easier.
- If the hook is deeply imbedded, near an artery or joint or in an area where removal is not possible as in the case of an eye, the hook should be stabilized and the patient removed for more definitive medical care.

Pressure Injection Injuries

Pressure injection injuries are caused by high-pressure tools or any high-pressure air or hydraulic fluid line such as those found on excavation equipment, tractors and portable drill rigs used in remote mineral exploration sites. Pressure injection of foreign material such as dirt, oil or solvent, will further complicate the injury and increase the risk of infection.

7.5.3 Evacuation Guidelines for High Risk Soft Tissue Injuries

Monitor carefully and consider evacuation for any of the following cases:

- Wounds accompanied by severe blood loss.
- Major injuries to blood vessels.
- Deep wounds that extend into muscle, ligament, tendon or bone.
- Significant cuts to the face, joints or genital area.
- Gaping wounds that cannot be closed with tape or wound closure strips.
- Large or deep penetrating wounds or wounds with embedded objects that cannot be removed.
- Wounds that compromise neurological, respiratory or cardiovascular function.
- Wounds that compromise distal CSM.
- Wounds that cannot be adequately cleaned.
- Severe burns (see Evacuation Guidelines for Burns below).
- Serious bites ¾ of human or animal origin.
- Wounds that have developed a local infection that cannot be contained.
- A patient with signs of a systemic infection.
- Amputations.

7.6 Burns

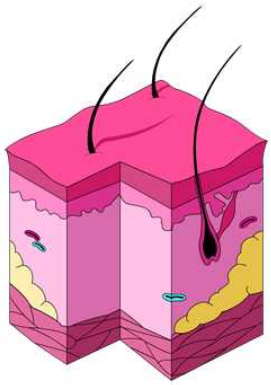
Burns are a type of soft tissue injury caused when the skin comes into contact with a source of heat. The severity of the burn depends on the depth of the injury, the location of the burn and the extent of surface area affected.

7.6.1 Depth

Burns are classed by degree according to the depth of the damage.

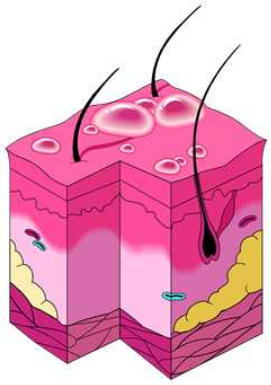
First Degree Burns

First-degree burns are superficial wounds that affect the outer layer of the epidermis. These burns appear red and are painful, but do not blister.



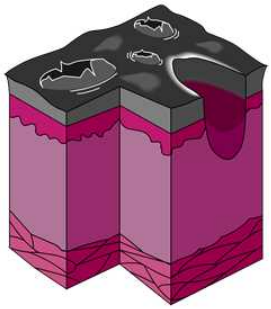
Second-degree Burns

Second-degree burns are partial-thickness wounds that extend into the dermis and are very painful. These burns will appear swollen and red and will have blisters or open wounds. Extensive second-degree burns will impair the body's ability to control temperature and retain moisture. The patient is at increased risk of fluid loss, hypothermia and eventually infection.



Third-degree burns

Third-degree burns or full-thickness wounds extend down through the epidermis and dermis into the underlying layers of subcutaneous tissue, such as muscle or bone. The immediate area may be numb because the skin nerves are destroyed, but the area around the third-degree burn may have varying degrees of superficial and partial-thickness damage and could be painful. Third-degree burns appear hard, dry and charred. They almost always require skin grafts. After the first 24 hours, they tend to become infected very easily.



7.6.2 Location

The severity of a burn is also determined by its location on the body. Burns to the face, respiratory tract, hands, feet or genitalia are considered critical because of the complex and urgent functional nature of these areas.

Extent

The extent of a burn is described in terms of percentages of total body surface area. An area the size of a person's palm represents approximately 1percent of total skin surface while the full arm is 9 percent.

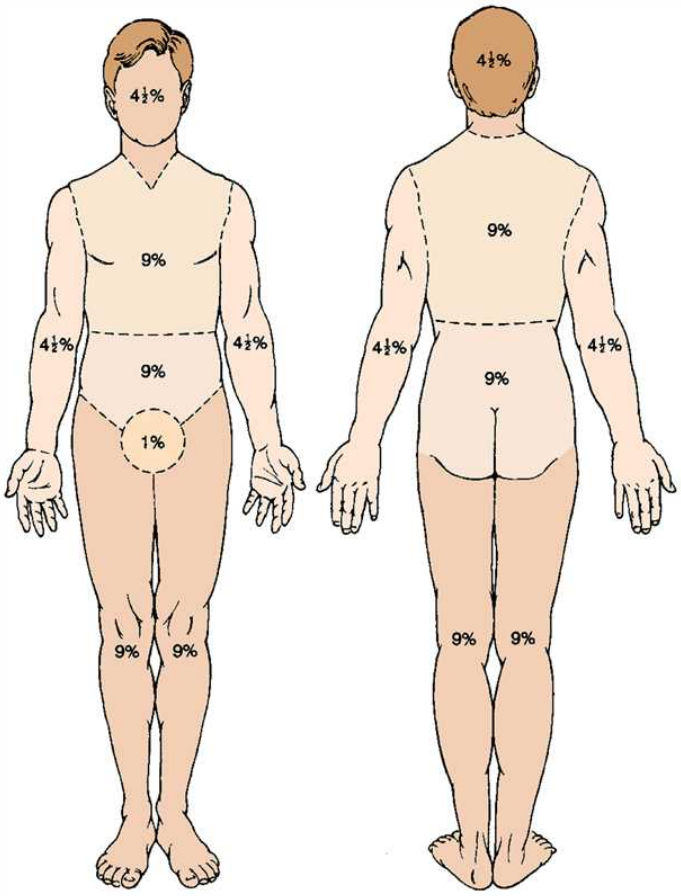
Rule of Nines

The rule of nines can be used to estimate extensive areas damaged by burns in adult patients (see figure below). Because of developmental differences, the percentages change proportionally in infants. The head of an adult is considered 9 percent, for instance, while that of a child is considered 18 percent.

Any partial-thickness or full-thickness burn covering more than 15 percent of the body's surface requires medical attention and should be evacuated. This includes extensive sunburns, which are often accompanied by dehydration and damage to the vascular bed and can result in vasogenic shock.

Children and the Elderly

Because infants and children under 10 have more surface area relative to body mass, burns to children are considered more serious than those to adults. Children are also more likely to go into shock, develop hypothermia and experience airway problems. Burns in people over the age of 50 are also considered more serious because their skin is thinner. In addition, people in this age group often have pre-existing medical conditions.



7.6.3 Burn Management

General Burn Management

Burn wounds are initially sterile. General management involves keeping the wound clean, reducing pain and regulating fluids and body temperature. First aid is initially the same for all types of burns regardless of the cause or severity of the injury.

- Follow universal precautions.
- Remove the patient from the source of heat and check ABCs.
- Assess the burn's severity.
- Cool area with copious amounts of cold water, either by immersing the body part in water or by pouring water over the affected area.
- Remove any burned clothing, rings and other jewelry that may become restrictive as tissue swells. Do not remove anything stuck to the wound.
- Beware of applying ice or snow as this may cause further tissue damage.

First Degree Burns

- As long as the skin is intact, a moisturizing cream, such as aloe vera lotion, can help promote healing.

Second and Third Degree Burns

- In second-degree burns and third-degree burns, gently irrigate the wound to remove dirt or debris with copious amounts of cool, clean water. Pat dry. Cold compresses may help relieve pain.
- Do not break blisters as this will increase the chance of infection.
- Do not apply hydrating creams or steroid preparations to broken blisters or to open wounds as these can inhibit healing and may encourage infection.
- If the patient with a second- or third-degree burn cannot get to a burn unit within 24 hours, apply a thin layer of antibiotic ointment under the dressing.

Additional Considerations

The risk of hypothermia.

- In burns that cover large surfaces of the body, beware of the risk of hypothermia. Evacuate as soon as possible.

Dressings

- Where available, cover the burned area with an occlusive burn dressing, such as 2nd Skin®, Watergel® or Coolwrap®.
- This will prevent drying out and reduce pain. If specialized burn dressings are not available cover the burn with dry sterile dressings.

Hydrate and Treat for Shock

- Encourage any patient with extensive burns to drink as much water as he or she will tolerate to prevent severe dehydration and shock. Use caution if the patient complains of nausea or vomits.
- Treat for shock and hypothermia if necessary.

7.6.4 Specific Types of Burns and Additional Treatment Considerations

Chemical Burns

Most chemical injuries are caused by either acids or bases that initiate chemical reactions upon contact with the skin.

Management

- The rescuer must take care to avoid contact as well.
- Clothing that has come into contact with the chemical must be removed.
- If the chemical is dry, first remove it as quickly as possible by brushing it off the patient.
- The affected area must be flushed for at least 20 minutes with large amounts of water.
- If the chemical is in the eye, care must be taken to keep the eye open and to continuously flush with water for at least 20 minutes.
- If only one eye is affected, keep this eye below the other while flushing to minimize contamination.

Electrical Burns

The electrical source must be turned off before a rescuer can safely approach the patient. Contact with the electrical source may have caused the patient to be part of an electrical circuit and may result in electrical abnormalities to the heart.

Management

- Monitor ABCs.
- Damage to the head, neck and spine should be suspected if the patient was thrown from the point of contact.
- Entrance and exit wounds should be treated accordingly.

Inhalation Burns

These types of burns can occur as a result of inhalation of very hot air or steam, fire smoke or chemical gases. Thermal injuries can cause the airway to swell and compromise breathing. The poisonous substances and fumes in fire smoke can damage the airway and cause respiratory and even cardiac arrest. Smoke inhalation patients will cough, suffer from respiratory distress and will sometimes have breath that smells of smoke or chemicals.

Management

- They should be immediately moved to a safe area.
- Monitor ABCs and administer CPR if necessary.
- Administer oxygen if available.

Sunburns

Sunburns are caused by exposure to the sun's ultraviolet rays. Sunburns can be first degree, second degree or more rarely third degree burns.

Management

- Remove the patient from the sun and cover the burned skin with damp compresses to cool the area.
- Ensure the patient is adequately hydrated.

7.6.5 Evacuation Guidelines for Burns

First-degree burns rarely require evacuation unless they are extensive, such as extensive sunburns.

Consider evacuation for any of the following burns:

- Second-degree burns greater than 15 percent of total body surface (or greater than 10 percent in a child or an elderly person) as they are at high risk of infection
- Extensive third-degree burns
- Any serious burn to the face or airway
- Deep burns to the hands, feet, genitals, eyes or mucous membranes
- Chemical, electrical or inhalation burns

7.7 Friction Blisters

A friction blister is a soft tissue injury caused by friction and pressure against the skin. When the friction and pressure are significant enough, the body responds by initiating a series of protective measures. The outer layers of the epidermis separate from the sensitive inner layer where skin tissue is generated. The space between the two layers, known as the roof and the base, fills with fluid from the circulatory system to protect the damaged area while it heals.

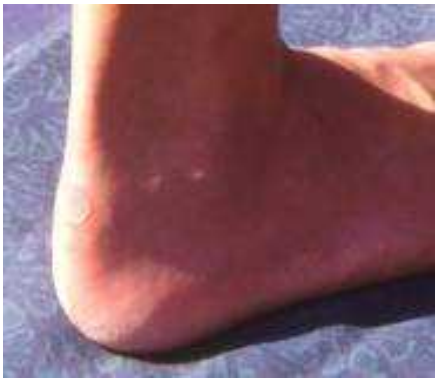
Hot Spots

Hot spots are sensitive areas that tend to develop before the full blister does.

7.7.1 Blister Management

The object of blister treatment is to get to the problem as soon as it starts and to prevent further damage by reducing or eliminating the friction. If the problem is not addressed immediately treatment will shift from general blister management to treating an open wound.

- Treat blisters before they form. As soon as a hot spot appears, cut a piece of moleskin or other protective material large enough to cover the hot spot. Coat the skin around the sensitive spot with benzoin dye and adhere the piece of moleskin. The rescuer can also use a piece of 2nd Skin® dressing with the outer layer of cellophane still in place. However, these bandages should be changed as soon as they dry out.
- If a blister forms, clean the site well with antiseptic solution.
- Reduce or eliminate the agent causing the blister.
- Protect the area from further damage.
- Avoid breaking blisters if possible as this will increase the risk of infection to the underlying layers of skin.
- If blisters must be drained do so by creating a small hole at the base of the blister using a sterile blade, needle or pin. Slowly express the fluid. Clean and cover with a lubricating and a protective layer, such as 2nd Skin®. Do not remove the roof of the blister, which provides protection from infection and prevents the sensitive underlying layers from drying out.
- Moleskin may also be used by building a "donut" and taping it in place.





7.7.2 Prevention

- Shoes must be adapted to the feet. Before wearing them for the first time in the wilderness, it is sometimes necessary to "break" them, that is to say, to make them take the shape of the foot.
- Fit your boots with the socks you intend to wear on the trip.
- Wear two pairs of socks, one thin pair and one heavier pair.
- Avoid wearing cotton socks. Change socks frequently and keep your feet as cool and dry as possible.
- Keep laces tight enough to prevent feet from sliding inside the boot.
- Lace the top of the boot tighter to hold the ankle during climbs. Lace the bottom of the boot tighter to hold the feet during the descent.
- Stop regularly to adjust your shoes. Protect sensitive points as soon as they occur.

7.8 Dressings and Bandages

A dressing is any material that directly covers the wound. There is a wide variety on the market. It generally needs to be held in place by a bandage.

Sterile Dressing

A sterile dressing is one that is manufactured to be free of bacteria or similar agent by process of heating, chemical treatment or irradiation. It is packaged in a sealed protective wrapping. Sterile dressings are ideal for open wounds as they reduce the risk of infection. These dressings require careful handling during application. Once the dressing is unpackaged and comes into contact with any other surface it is no longer considered sterile. Some sterile dressings are specially designed with a protective covering that prevents lint and other pieces of material from adhering to the wound surface.

Non-Sterile Dressing

A non-sterile dressing is a clean dressing that can be applied over a sterile dressing or closed wound or used for wound preparation and cleaning, etc. Non-sterile dressings may be improvised with material at hand such as a cut sheet, T-shirt or any other type of fabric that will serve the purpose.

Bandages

Bandages are any piece of cloth used to hold wound dressings in place, to secure splints, to give support, to apply pressure and to help limit movement of a body part.

- General Bandaging Principles
- A bandage should cover a sterile dressing completely.

- A bandage should be tight enough for the purpose for which it is intended (i.e. to secure a splint).
- A bandage should not inhibit circulation and digits should remain exposed to enable the rescuer to monitor distal CSM.
- All bandage fastenings should be easily accessible in case the bandage needs to be removed, loosened or tightened.

7.8.1 Bandages, Dressings and Tapes

Triangular Bandage

These are for bandaging and as improvised compression bandages.

Abdominal Pad

Abdominal pads are very absorbent and useful for large bleeding wounds.

Sterile Gauze Pad

2”X2”and 4”X4”

Sterile gauze pads are used for bleeding control and dressing.

Non-Stick Gauze Pad (Telfa®)

Various sizes

These pads will not stick to the wound when removed.

Non-Sterile Gauze

Non-sterile gauze is useful for wound cleaning.

Sterile Gauze Roll

High quality cotton sterile gauze rolls are useful for securing dressings.

Elastoplas®t Fabric Tape Strip

This adhesive tape with gauze is used for dressing small scrapes and cuts. Cut to size.

Trainer's Tape

This 1.5" quality cotton athletic tape is used for taping joints, bandages, splints.

Trainer's Foam Under-Wrap

Foam wrap is a thin foam substrate that is strong and highly porous. It is used under adhesive sports medicine tapes for comfort and painless tape removal.

Surgical Hypoallergenic Tape

This is a 1/2" tape with a non-zinc-based adhesive.

7.8.2 Technical Dressings

Technical dressings are designed for more complex and specific wound care.

Sterile Wound Closures (Steri-Strips®)

These are non-elastic adhesive topical wound closures.

Spenco Second Skin®

This is a sterile water-based gel on semi-permeable film used for burn management, wound dressing and blister care. It is placed directly on an open wound.

Occlusive Dressings (Tegaderm®, Opsite®)

These are oxygen-permeable sterile dressings that create a transparent barrier to bacteria and water. They are excellent for long-term management of burns and wounds.

Moleskin

Moleskin is a tough adhesive dressing. It helps displace pressure and friction associated with blisters.

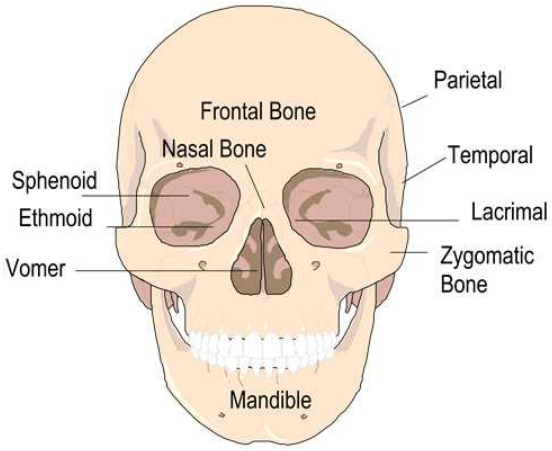
8. Traumatic Injuries

The following chapter treats soft tissue injuries that require specialized attention. These include injuries to the head, face, neck, spine, chest and abdomen. Because they are for the most part caused by trauma, they are grouped under the general heading “Traumatic Injuries.”

8.1 Face Injuries

8.1.1 Anatomy of the Face and Neck Area

The head can be divided into two parts, the face and the skull. The face includes the eyes, the ears, the nose, the cheeks and the mouth. It is made up of eight bones – the nasal bone, the lower jawbone or mandible, two upper jawbones or maxillae, two cheekbones or zygomatic bones and two orbital bones. The neck contains the esophagus, the trachea, the carotid arteries, the jugular veins and is supported by the cervical spine. The cervical spine is made up of the seven vertebrae of the neck.



Soft tissue injuries to the face include penetrating wounds, avulsions and blunt trauma wounds, such as contusions or hematomas.

General Assessment for Injuries to the Face and Neck

Any substantial injury to the face carries the risk of damage to the skull and the complications associated with injuries to the head and cervical spine. Blunt trauma to the face can easily cause facial bone fractures such as a jaw fracture. Any facial trauma can be accompanied by eye injuries. Injuries to the face also carry the risk of obstruction of the upper airway and can sometimes be difficult to see. Airway obstruction can result from swelling (generally associated with any soft tissue injury), from heavy bleeding (particularly blood clots) or from loosened teeth or dentures that are swallowed or aspirated. With trauma to the jaw and mouth with impaired function, suspect injury to the lower jaw if the victim has difficulty opening and closing the mouth, or if the alignment of the teeth appears abnormal. Monitor all facial injuries and carefully assess the airway and mechanism of injury.

In addition to traumatic injuries, many conditions can affect the different structures of the face: gum, eye and ear infections, nosebleeds, snow blindness... A good questionnaire, a careful evaluation of the mechanisms of the injury and a detailed examination of the different structures will allow a good understanding of the condition and the treatment plan.

First of all a careful examination for asymmetry will identify a possible fracture. Also, the contour of the eye orbit, the jaw bones and the jaw (mandible) should be methodically and gently palpated for deformity, bone crackling or small air bubbles under the skin (subcutaneous emphysema) resulting from a fracture of the maxillary sinus.

- The mouth, nose, eyes and ears are sensitive areas that will need examiner :
- The mouth : Is there any bleeding? A broken tooth or a tooth that has come out of its socket? Gum infection or abscess? Does the mouth open completely and is the occlusion normal? (Feels like the teeth are in the right place when you clench your jaw)

- Nose : Bleeding? Deformity or pain on palpation?
- Eyes : Is the look normal and do the eyes move in all directions in a coordinated way? Is there a foreign body, penetrating trauma? An infection or inflammation? Blurred vision? Is there any redness? Use an indirect beam of light to highlight a possible foreign body and make an eversion of the upper eyelid (see short video) to examine the entire surface of the eye.

General Management for Injuries to the Face

- Monitor the airway and ensure drainage if bleeding is present.
- Do not insert an artificial airway into a severely traumatized mouth or nose. Put the patient in recovery position to facilitate drainage from the mouth.
- Remove impaled objects from cheeks.
- Apply pressure to the inside and outside of penetrating cheek wounds.
- Applying ice to bruises and contusions of the scalp and face (but not the eyes) helps to relieve swelling and bruising.
- Do not apply excessive pressure when arresting bleeding so as not to damage underlying structures or the delicate bones of the face.
- Carefully inspect the inside of the mouth for damage that may not be evident on the surface of the cheek. Blunt trauma to the outside of the face, for instance, may result in cuts inside the mouth from teeth. Any heavy bleeding inside the mouth carries the risk of blocking the airway.
- With injuries around the mouth, check as well for bleeding inside the mouth and for any airway obstruction. If a conscious patient is bleeding from the tongue or gums, have him or her apply pressure on the injured area with sterile gauze.

8.1.2 Soft Tissue Injuries to the Neck Area

Neck injuries can involve potentially serious damage to arteries, veins or the spinal cord, and may result in airway blockage.

Assessment and Management

- Until you have ruled out any possibility, always assume cervical spine involvement (see Spinal Injuries (p. 126)).
- For penetrating wounds, apply direct pressure to the bleeding site with both your gloved fingers and a sterile dressing.
- Secure the dressing with roller gauze wrapped diagonally across the torso and under the opposite arm.
- Do not wrap the gauze around the patient's neck as this could obstruct the airway.
- In the case of a damaged artery, apply pressure above and below the wound site and evacuate immediately.
- Maintain pressure throughout the evacuation.

8.2 Eye Injuries

Foreign Bodies in the Eye

Management

- Carefully remove the contact lenses (see Eye Injuries (p. 118)).
- Visually inspect the surface of the eye. Visually inspect the surface of the eye by placing a cotton swab horizontally on the outer surface of the upper eyelid and rolling the eyelid up and over the swab.

- Direct a small beam of light onto the eyeball from the outer side of the eye to create a backlight on the cornea. This technique exposes particles and small scratches.
- Irrigate the affected eye (always from the medial side) allowing the fluid to drain towards the ear. Sterile saline solution designed for eye use (e.g. Tears®, Murine®) is useful. Otherwise drinking quality water will suffice.
- Foreign bodies may be carefully removed using a cotton swab covered with ophthalmic ointment such as Polysporin®. The use of the ointment will also reduce the risk of infection.
- Never place anything into the eye that is not an ophthalmic solution or suspension (i.e. it must be specifically designed for use in the eye).
- Ensure that all foreign bodies are removed.

Impaled and Embedded Objects in the Eye

Management

- Do not attempt to remove impaled objects or embedded foreign bodies.
- In the case of an embedded foreign body, cover the injured eye with sterile gauze.
- In the case of an impaled object, stabilize the object using a “doughnut” ring secured with a gauze dressing.
- Cover the unaffected eye leaving a small area in the centre uncovered. This will help reduce peripheral vision and restrict the movement in both eyes.
- Evacuate immediately.

Eye Infections

Management

- Irrigate or soak eyes regularly with clean warm water or eye solution.
- Apply antibiotic eye drops or ointment to both eyes.
- Avoid spreading infection to others (sharing towels, etc.).

Blunt Trauma and Eye Contusions

Management

- Cover both eyes and evacuate the victim from a seated position, if injuries permit, to limit eye movement and allow the victim to rest .
- In extremely remote and difficult terrain, activity should be restricted to walking purely for evacuation purposes.
- Eye contusions should not be treated with ASA as this will encourage bleeding.

Eye Lacerations

Management

- Do not apply direct pressure to a lacerated eyelid or eyeball. Control bleeding by placing a sterile dressing over the eyelid to protect the wound from contamination. Cover both eyes to restrict eye movement and allow the victim to rest.
- In the case of an avulsion or open-eye injury, both eyes should be covered with a moist sterile dressing.

Extruded Eyeball

Management

- Never reposition the eyeball.
- Moisten the injured side with sterile saline solution to prevent it from drying out, then cover both eyes with dry sterile compresses to limit eye movement and allow the victim to rest.
- The injured eye should be protected from any pressure using some form of rigid material held in place by light bandaging.
- The patient must be transported in a supine position with the head stabilized.

Snow Blindness

Management

- Remove contact lenses if used.
- Cover both eyes with sterile compresses to limit eye movement and allow the victim to rest.
- Patient must rest and avoid light.
- Manage as you would a severe corneal abrasion.

Chemical Burns in the Eye

Management

- Flush continuously with copious amounts of clean water for up to 20 minutes. Make sure not to contaminate the other eye.
- Cover both eyes with sterile compresses to limit eye movement and allow the victim to rest.
- Evacuate if condition does not improve after a few hours and additional flushing.
- Take note of the fluid that caused the irritation.

8.3 Nose Injuries

8.3.1 Anatomy of the Nose

The nose is used for smelling and also for conditioning and humidifying the air as it is breathed into the body. It is composed of bone and cartilage. The nasal bone, or arch of the nose, forms the back third of the nose. The other two thirds are cartilage. The nasal septum divides the nasal cavity into two chambers or nostrils. The nostrils are lined with a protective mucous membrane and the anterior or front portion of each nostril has coarse hairs to protect the nasal cavity from large airborne particles, such as dust and sand.

8.3.2 Problems that affect the nose

Colds and the flu can dry out the mucous membrane, making it more susceptible to bleeding. Anterior nose bleeds caused by blowing or picking the nose are usually not serious. Blunt trauma, on the other hand, can cause more serious injuries to the nose and the structures around and behind it.

General Management of Nose Injuries

- In cases of bleeding caused by trauma, monitor for signs and symptoms of head and cervical spine injury. With brain injuries, CSF may escape through the nose.

- Do not attempt to control bleeding following any trauma to the head since this may increase pressure on the brain.
- Beware of bleeding into the airway.
- Where there is no obvious trauma to the head or spine, have the patient sit up with the head tilted forward to assist drainage.
- Keep mouth open to prevent swallowing blood.
- Pinch the nostrils together or have the patient do so for at least 15 minutes.
- Apply a cold compress to the bridge of the nose to reduce swelling and bleeding.
- If bleeding persists beyond 20 minutes, gently pack the bleeding nostril with cotton gauze.
- If the bleeding cannot be controlled, if it recurs or if there is a significant amount of blood loss, consider evacuating the patient.

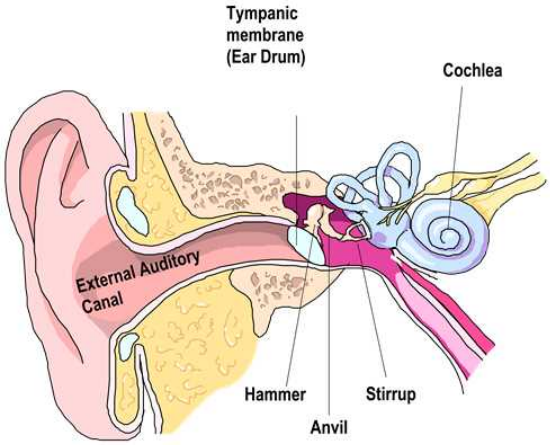
Sinusitis

Sinusitis is an inflammation of the sinuses, air-filled cavities around the nose. Sinusitis is mostly caused by viral infections or allergies. The swollen mucous membrane of the sinus can block the flow of mucus and cause headaches or ear aches. Saline nasal sprays help reduce the inflammation and allow mucus to drain into the throat. Inhaling steam is an alternative to medications.

8.4 Ear Injuries

8.4.1 Anatomy of the Ear

The ear has two functions – hearing and equilibrium. The organ is made up of three parts – the outer ear, the middle ear and the inner ear.

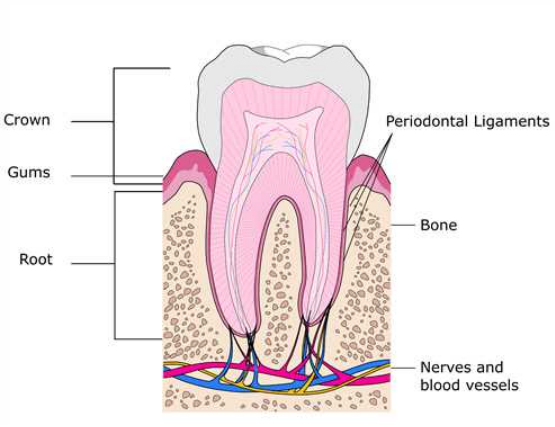


Soft tissue damage to the ear.

8.5 Tooth injuries

8.5.1 The anatomy of the tooth

Teeth are used for cutting, crushing and chewing food. The visible portion of the tooth is called the crown. The root of the tooth is the portion extending down into the jawbone. It contains blood vessels and nerves that supply the tooth with sensation and circulation respectively.



8.5.2 Tooth injuries

Injuries to the mouth are usually the result of trauma. Monitor airway and inspect for signs of loose or broken teeth, dentures or other material in the mouth. Assume injury to the cervical spine or skull until it can be ruled out. Place the patient in a position where blood can drain from the airway. Injuries to teeth exposing nerves can be especially painful. Cover exposed nerves with gauze to protect them from cold air.

Avulsed Tooth

An avulsed tooth is an injury in which a tooth has been pushed out of its socket. It usually occurs following an impact of considerable force. Therefore, the area should be carefully examined for damage to neighbouring teeth or the jaw.

Management

- Handle the tooth as little as possible.
- Rinse teeth carefully but do not scrub. Inspect the tooth to ensure that it is intact.
- Compare the tooth to its counterpart on the opposite side of the jaw. This may help to indicate the tooth's proper aspect (often difficult to tell when inspecting the avulsed tooth on its own).
- Align the tooth carefully and push it back into its socket. This generally creates an uncomfortable sensation but is rarely very painful.
- Evacuate to a dentist or to definitive medical care as soon as possible. The success for a re-implanted tooth decreases dramatically after 30 minutes.
- If you are unable to reinsert and the patient is conscious, place any avulsed teeth inside the patient's mouth between the remaining teeth and cheek. This should not be done with unconscious patients or if there is any risk of the teeth being swallowed or of blocking the airway. Alternatively, teeth can be transported in a moist and sterile wrapping, in milk or in saline solution. Keep the container cool.

Management of Avulsed Fillings and Dental Fractures

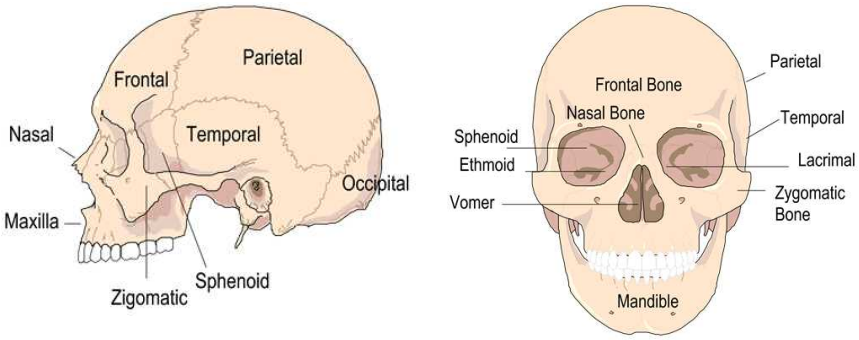
- Dry the tooth with sterile gauze.
- Keep saliva and tongue from coming in contact with the tooth, which will increase the risk of infection.
- Apply a topical analgesic containing 20 percent benzocaine (Orajel®) on surrounding gums.
- Cover the broken edges of the damaged tooth or the cavity from an avulsed filling with dental wax or temporary filling material (Cavit-G®). Do not fill cavities that are infected or abscessed with Cavit-G®, as this prevents gas produced by a bacterial infection from escaping and increases the pressure and pain.

8.6 Head Injuries

8.6.1 Anatomy of the Head

Skull and Face Bones

The bones of the skull and face are fused together to form the characteristic rounded shape of the head and defining facial features of each individual. The cranium or skull includes the frontal bone, two parietal, temporal and sphenoid bones and the occipital bone. The face includes the nasal bone, two orbital, maxilla and zygomatic bones and the mandible or lower jaw.



Brain

The brain is located inside the cranial vault. It is surrounded by a triple layer of membrane called the meninges. The innermost layer, the pia mater, is attached to and envelops the brain. The outermost layer, the dura mater, is adjacent to the skull. It surrounds and supports the large veins that carry blood from the brain to the heart. The middle layer, the arachnoid, is attached to the dura mater. It takes its name from its shape, which is reminiscent of a spider's web. Between the arachnoid and the mother magpie is the subarachnoid space. This is filled with a clear fluid called cerebrospinal fluid (CSF). The CSF has several functions. Among other things, it serves as a vital cushion or shock absorber for the brain and helps to keep the pressure of the brain at a constant value. This pressure is called intracranial pressure (ICP).

Meninges

The meninges (singular – meninx) is the collective term used to describe the three layers of membrane covering the brain and the spinal cord.

Cerebrospinal Fluid (CSF)

The CSF is a colorless liquid that is secreted from the blood between two layers of meninges. The CSF serves to maintain pressure within the brain and the spinal cord and acts as a shock absorber. It also delivers nutrients to the brain and carries waste materials out.

Intracranial Pressure (ICP)

Brain cells are extremely sensitive to pressure changes in the cranial vault. Changes in pressure may be caused by the swelling of soft tissue due to trauma, infection, fluid imbalances or rapid changes in blood pressure.

8.6.2 Mechanisms and Types of Head Injuries

A head injury is any injury to the scalp, skull or brain. The mechanisms of injury include falls and blunt or penetrating trauma. External head injuries are easy to recognize. Internal injuries to the brain may not be immediately evident following an accident and serious complications can often arise. These injuries may require rapid evacuation to a medical facility. Always assess head injuries for potential airway problems and spinal injuries as well.

Given the serious nature of a head injury, prevention should be a priority. Paying attention to safety and using well-fitted protective equipment, such as helmets, will help reduce the incidence and severity of head injuries.

Open Head Injuries

An open head injury is an injury in which the skull has been fractured, whether or not the skin has been broken.

Closed Head Injuries

A closed head injury is an injury to the brain where there is no break in the integrity of the skull.

8.6.3 Head Injuries

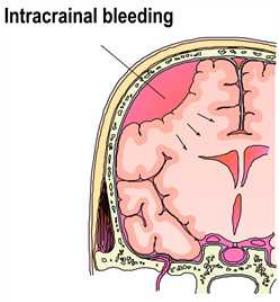
Scalp Lacerations

Head injuries may also involve open or closed soft tissue wounds to the scalp. A scalp laceration is an open soft tissue wound. The skin of the scalp is highly vascularised and covers the head with some tension. Relatively small wounds may gape open and will often bleed profusely. Significant blood loss, however, is rare due to the small vessels in the area. A scalp laceration on its own is not a serious injury.

8.6.4 Brain Injuries

Concussions

A concussion is a temporary loss of consciousness due to trauma to the head. Concussions may vary in severity, ranging from headache to altered levels of consciousness to unresponsiveness. A patient may recover fully from a concussion within a short period of time. A concussion can also be a precursor to increasing intracranial pressure (see below). Patients of concussions should be monitored for 24 hours.



Intracranial Pressure (ICP)

The skull serves to support and protect the sensitive brain tissue. It has a fixed volume and cannot expand. Any internal injury to the brain tissue that results in bleeding or swelling therefore leads to an increase in pressure on the brain and on the surrounding blood vessels.

Increased pressure inside the skull compresses the blood vessels and interferes with the vital supply of oxygen to the brain. This interruption in oxygen supply (hypoxia) has a direct impact on the patient's level of consciousness (LOC). The earliest LOC changes are combativeness, disorientation and changes in personality.

As the oxygen supply decreases the body responds by dilating blood vessels in an effort to increase the flow of oxygen-rich blood to the injured area. This of course has the negative effect of further increasing tissue swelling and intracranial pressure, which in turn continues the negative downward cycle and quickly worsens the patient's condition.

Increasing intracranial pressure also has the effect of compressing the brain stem, which controls the basic life processes, including respiratory and cardiac function. Over time a compressed brain stem will therefore compromise both breathing and cardiac function and undermine oxygen supply not only to the brain but also to the body as a whole.

8.6.5 Assessment of Head and Brain Injuries

Determine the precise mechanism of injury. Carefully check the entire face and skull area. Changes in vital signs indicate an advanced state of the problem.

The earliest LOC changes are combativeness, disorientation and changes in personality.

Early Signs and Symptoms

- Headache
- Dizziness
- Deteriorating LOC
- Nausea and vomiting
- Vision problems

Late Signs and Symptoms

- Increased rate of respiration – breathing may also become deeper, irregular or cease altogether
- Decreasing heart rate with stronger pulse
- Widening blood pressure (systolic rises faster than diastolic)
- Reddened skin due to increased peripheral vasodilation
- Changing or unequal pupils (late signs)
- Paralysis, weakness in the extremities, seizures
- CSF leaking from head wounds, mouth and ears
- Bruising behind the ears – Battle's sign (late signs)
- Bruising around the eyes – raccoon eyes (late signs)

Determine if there are complicating factors that could alter or mask signs of head and brain injury, such as medication, alcohol or other medical problems.

Management of Head and Brain Injuries

- Maintain ABCs, especially if the patient is unconscious.
- Immobilize neck and spine (see Spinal Injuries).
- Evaluate neurological function (AVPU).
- Monitor and record all vital signs – watch for changes in early signs.
- Do not control bleeding or drainage from the head. Do not apply direct pressure to scalp lacerations.
- Administer oxygen if necessary.
- Monitor head injury patients for 24 hours as their condition may deteriorate.
- Transport ASAP on a full spinal board maintaining the head position above the level of the body to reduce ICP.

Monitor anyone with an altered level of consciousness for developing signs of increased ICP. Advancing signs and symptoms of a head injury indicate an immediate life-threatening condition. Evacuation becomes a priority over managing other injuries or considerations related to patient care.

If the victim has suffered only a brief loss of consciousness, usually less than 30 seconds, and there are no other injuries requiring evacuation, he or she may resume normal activities. However, it is important to continue to monitor it for 24 hours to detect any signs of an increase in ICP.

8.6.6 Complications of Head Injuries

Vomiting and Airway Obstruction

Complications of head injuries can include seizures and vomiting. Vomiting is always a concern because it can compromise a patient's breathing. If a patient vomits while immobilized, the risk of airway obstruction is especially high. For patients immobilized on full spinal boards, the board can be tilted to one side to allow for proper drainage.

Cervical Spine Injury

Significant trauma to the head will often involve injury to the cervical spine. Assume cervical spine injury for all traumatic head injuries.

Headaches

Most headaches are the result of changes in intracranial pressure because of fatigue and dehydration. Manage headaches with rest, adequate nutrition, hydration and, if necessary, mild analgesics. If these do not provide relief, monitor carefully and consider evacuation.

A severe headache with a rapid onset is often a sign of a more serious problem.

8.6.7 Prevention

Given the serious nature of a head injury, prevention should be a priority. Paying attention to safety and using well-fitted protective equipment, such as helmets, will help reduce the incidence and severity of head injuries.

8.7 Spinal Injuries

8.7.1 Anatomy of the Spine and Spinal Cord

The human body is held upright by a series of joints known collectively as the spinal column. It includes the vertebrae and surrounding cartilage, ligaments, muscles, tendons and other connective tissue.

The Spine

The spine consists of 33 vertebrae. It is divided into five segments: the cervical, thoracic and lumbar regions, the sacrum and the coccyx.

Cervical Spine

The cervical spine is made up of the seven vertebrae of the neck. It is the most flexible area of the spine and supports the weight of the head. Injuries of the cervical spine often result from head injuries.

Thoracic Spine

The thoracic spine is made up of the next 12 vertebrae of the chest, each of which is connected to a rib. The thoracic spine is the most stable portion of the spine due to the support provided by the thoracic cage and the associated musculature. Most injuries to the thoracic spine occur from direct blows to the posterior rib cage.

Lumbar Spine

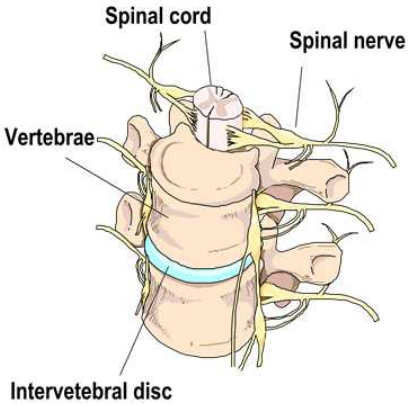
The lumbar spine is made up of the five vertebrae that join the rib cage to the pelvis. The spinal cord extends down to the level of the second lumbar vertebra (L2), although the nerves extending out from the spine continue further down. The lumbar spine is the most common area injured because of the excessive strain placed on the muscles here. Often associated with work-related accidents, these injuries are the most frequent cause cited in worker compensation claims and chronic injury.

The Sacrum and the Coccyx

The sacrum is a wedge-shaped bone made up of five fused vertebrae. Attached to it is the coccyx (tailbone), which is made up of four fused bones. While injuries to these vertebrae are most commonly associated with fractures of the pelvis, an injury to the sacrum or coccyx may also indicate an injury to other segments of the spine.

The vertebrae

Each vertebra contains a body or weight-bearing portion. Transverse processes project laterally from either side of the body and serve as sites for muscle attachment. The two transverse processes are also connected by two laminae, which join together to form the spinous process. Together the spinous processes form the bumps that can be felt through the skin along the length of the spine. The hole in the middle of the vertebra's circular bony structure encases the spinal cord and is called a vertebral foramen. Additional hollows, called intervertebral foramina, allow nerves to run to or from the enclosed spinal cord.



The vertebrae are connected by ligaments. Cushioning intervertebral discs lie between the vertebrae. They act as shock absorbers, prevent bone-to-bone contact and allow for some mobility among vertebrae.

Spinal Cord

The spinal cord is an extension of the brain and is part of the central nervous system (see The Nervous System (p. 40)).

8.7.2 Injuries to the Spinal Cord and Associated Structures

As with other joints in the body, damage to any of the spinal structures may result in inflammation. This will in turn impinge on the transmission of nerve impulses along the spinal cord. Injuries to the vertebrae are therefore always accompanied by the risk of damage to the spinal cord. Indeed, most injuries to the spinal cord are secondary injuries as a result of inflammation.

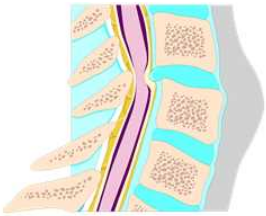
Damage to the spinal cord may be devastating and permanent. It can result in a deficit of function in all areas of the body served by the spine from the point of injury and below.

Mechanisms of Spinal Injury

Understanding the mechanism of injury helps the rescuer determine the likelihood and nature of a possible spinal injury. A fall can result in a compression injury in which the head is pushed down against the spinal cord, for instance. Motor vehicle accidents, on the other hand, can involve excessive flexion, extension, rotation or lateral bending of the spine.

Nerve Injuries

Nerve injuries are caused by a narrowing of the vertebral foramen (bony passageways of the vertebrae), which impinges on (or pinches) the nerve. The narrowing can result from injury to the vertebrae or disc or from arthritic changes in the bony structure of the vertebrae.



Anterior dislocation of the cervical spine

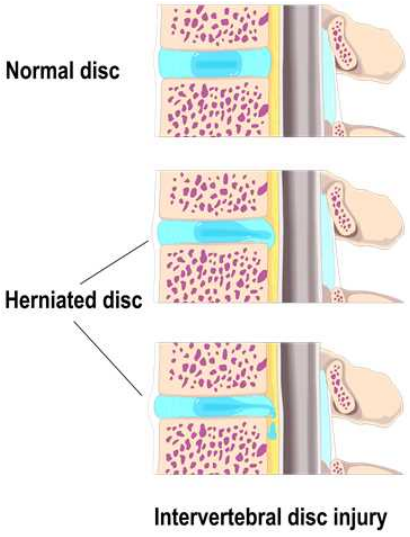
A spinal nerve injury results in sensory and motor deficits. The signs and symptoms of nerve damage are similar to those of more serious injuries to the head and spine. That's why we treat them the same way. They require adequate immobilization of the spine.

Vertebral Dislocation and Fractures

Unstable dislocations and fractures of the vertebrae carry the greatest risk of further injury to the spinal cord and nerves if not properly immobilized. As with all suspected spinal and head injuries, the patient requires full immobilization and transport to a medical facility for further evaluation.

Injuries to the Intervertebral Discs

Any stress occurring on the spine may contribute to disc injury, causing the disc to become herniated. This means that the gel-like nucleus of the intervertebral disc has broken through its fibrous encasing and is putting pressure onto the spinal cord. A herniated disc will result in numbness, weakness and pain in the area.



Intervertebral disc injury

Strains and Sprains of the Back Muscles or Spine

Among non-traumatic injuries to the spine, back strain and overuse injuries are among the most frequently encountered. The common causes of these types of back injuries are improper body mechanics, repetitive motion and forceful efforts. Care should be taken when lifting heavy items, such as heavy tools, boxes, backpacks, canoes, etc. Management should include a proper evaluation of the working position and if necessary modifying the task involved or the equipment used to accomplish the task.

8.7.3 Complications of Spinal Injuries

Respiratory Difficulties

Any trauma to the head and neck may have an impact on respiratory function, which is controlled by the brain and nervous system, and thus may compromise a patient's ability to breathe or cough to clear the airway. The rescuer must be prepared to manage any airway obstructions and support a spine-injured patient's ventilation.

Neurogenic Shock

Spinal cord injuries at T6 or above can cause severe trauma to the central nervous system and result in neurogenic shock. In such cases, vasomotor and reflex control can be partially or severely inhibited leading to a dramatic drop in the patient's blood pressure and slower than normal heart beat.

8.7.4 Assessment and Management of Spinal Injuries

When assessing a victim of trauma occurring in an isolated setting, the management of spinal injuries quickly becomes a major consideration. The following questions must be answered quickly: Should the victim be immobilized and if so, what means and resources are available for safe and rapid transport to EMS?

Contrary to the principles of urban first aid, which advise against moving victims at risk of spinal injury while waiting for pre-hospital services, a different approach is required in remote areas where it is generally necessary to :

- Move/remove the victim from the situation.
- Conduct a detailed assessment.
- Stabilize vital functions.
- Prepare the victim for transport and evacuation to medical services.
- Insulate from cold and bad weather.

In order to guide the level of spinal protection needed for a casualty's evacuation, it is essential to first establish the history and mechanism of injury to properly assess the risk of spinal integrity damage. The rescuer should assume a spinal injury whenever a victim is unconscious AND the history of the injury cannot be obtained.

The reasons why spinal precautions should be taken are:

- Presence of a mechanical instability caused by a loss of integrity of the bone and ligament structures protecting the marrow (e.g.: Fracture of an unstable vertebra).
  - OBJECTIVE = To prevent neurological damage secondary to displacement of structures during evacuation or transport.
- Presence of neurological instability demonstrated by an impairment of neurological functions due to damage to the spinal cord (e.g. compression of a nerve or spinal cord by a fracture).
  - OBJECTIVE = To avoid a deterioration of the situation.

Long considered the standard, the spine board has been gradually replaced by the immobilizing mattress in many regions/countries as a means of immobilization. However, it remains omnipresent on many sites in remote areas as well as industrial. It is therefore important to know how to use it judiciously even if its indication of use has changed considerably.

The literature has in fact shown that prolonged immobilization is generally harmful to the victim, which has led many pre-hospital services around the world to replace "mechanical spinal immobilization" with "spinal motion restriction" since the latter seems to offer a better risk/benefit ratio.

The vast majority of pre-hospital services now use the immobilizing mattress as an immobilization tool. Although the use of the immobilization mattress probably causes fewer complications than the spine board, it is still recommended that the mattress be removed as soon as possible once safe transportation has been achieved, in the same manner as the spine board or any other immobilization tool.

In the majority of isolated environments, none of the above solutions will be readily available. The main issue will therefore be first to assess the risk of spinal injury and then to choose the most appropriate means of transport according to the means available.

- Risks of "classic" mechanical spinal immobilization with spinal board and cervical collar.
- Risk of respiratory compromise due to the straps that reduce the victim's breathing amplitude and capacity.
- Aspiration risk: the victim who suddenly vomits and is immobilized on his back is at high risk of aspiration if the responder is not ready to act quickly.

- Risk to tissue circulation and pressure points: by imposing a static position and preventing even minimal movement of the victim.
- Risk of increasing intracranial pressure: by placing the cervical collar, which could decrease cerebral venous return, and by the decubitus position during deceleration of the ambulance vehicle in motion.

Other potential disadvantages to prolonged immobilization:

- Complicates objective assessment and monitoring of injuries: Once immobilized, it can sometimes be difficult to access certain areas of the body and monitor vital signs.
- Pain caused by immobilization: prolonged immobilization can cause pain, complicating medical evaluation and resulting in greater use of medical resources (medical imaging tests or use of analgesic medications).
- Increased transport time to definitive care: Immobilizing a victim takes a long time, even when in an ideal environment, and can delay access to essential medical care.

According to the Wilderness Medical Society; Spinal motion restriction is currently shown to be the best and safest means of spinal protection.

In summary, the restriction of spinal movements is :

- Minimize the victim's spinal movements while avoiding prolonged mechanical immobilization;
- Aim to protect the spinal cord by minimizing the disadvantages of mechanical immobilization while adapting to the situation and realities of transportation in a non-urban environment.
- Minimize response time and time to EMS for the unstable victim.

Terminology:

- Spinal Precautions: Includes all measures that are used to limit spinal movement in individuals at risk of spinal injury.
- Spinal Movement Restriction (SMR): Specific to measures used to limit spinal movement as much as possible, during the transport of the victim, without necessarily using classical means such as the board and the rigid cervical collar, but any other method allowing to achieve the desired objective.
- Mechanical immobilization: restrict spinal movements with the use of mechanical tool(s) (e.g. mattress or board).
- Evacuation/Extraction: The time prior to the victim's arrival at the ambulance stretcher or other final means of transport.

Mechanism of Injury Assessment

Carefully assess whether or not the mechanism of injury indicates a possible spinal injury and thus establish the level of spinal precautions required.

- Did the victim fall more than 1m from a height (note approximate height)?
- In what position did it hit the ground, is it an axial force mechanism (e.g., shallow water dive or landing from a flat jump).
- Did the accident involve a collision? Document the direction of impact.
- Is speed a factor? How fast was the victim going? Was she ejected? What did it hit, what did it land on?
- Did an object or vehicle hit the victim?
- Direct impact or acceleration-deceleration mechanism?

Other risk factors to consider:

- Victim over 65 years old more at risk.
- Pre-existing condition such as severe cervical arthritis. Inflammatory diseases such as ankylosing spondylitis increase the risk.

If a scene survey indicates a mechanism for a spinal injury, a detailed secondary survey will enable the rescuer to confirm or rule out the possibility of significant spinal injury.

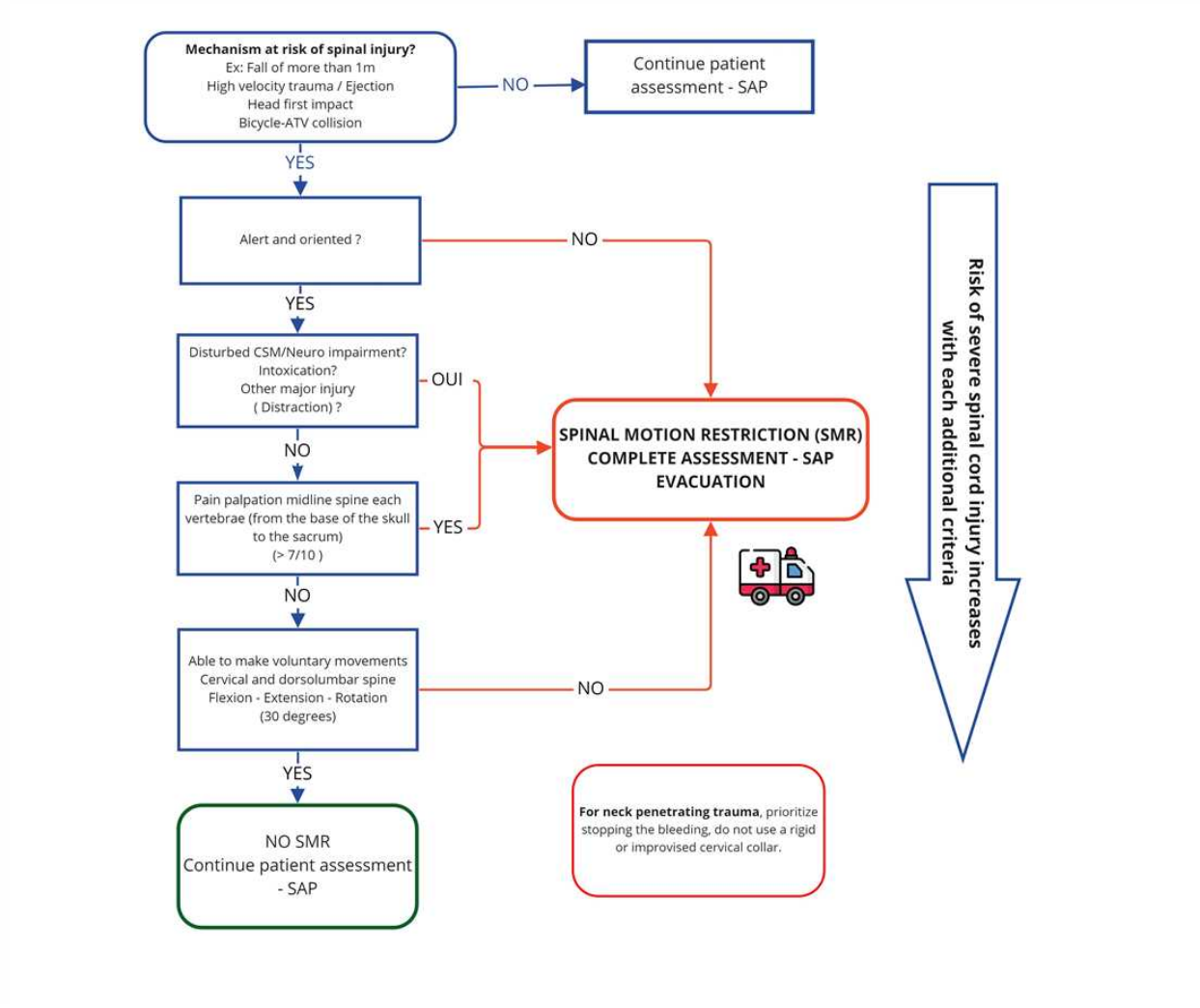
Assume a spinal injury has occurred if the answer to any of the following is yes:

- Significant pain preventing voluntary movements of the neck or cervical and dorsolumbar spine: ROTATION, FLEXION and EXTENSION (30 degrees).
- Deficit on neurological examination including: paralysis, lack of strength, numbness, tingling of fingers/hands or toes/feet.
- Significant pain on central palpation (7/10 and above) of the spine?
- Defense or muscle spasms limiting mobility?
- Visible signs of trauma or deformity?

Criteria for eliminating risk of significant spinal injury:

- A detailed assessment has revealed no signs or symptoms of potential spinal injury.
- The patient is calm, fully alert and oriented and has recovered from the stress of the accident.
- The patient is not under the influence of medication or alcohol that could mask some signs or symptoms.
- There are no other painful injuries that may make an evaluation of the spine difficult, distract the patient or mask symptoms. It is usually a significant and predominant pain, for example following a major bone fracture or dislocation.
- A neurological examination of the patient's sensory and motor control is completely normal.

Use the following decision tool to rule out the need to initiate spinal movement restriction measures:



This decision tool is based on the 2019 Wilderness Medical Society recommendations and draws on the NEXUS and Canadian C-Spine Rules radiology decision criteria. It does not exclude beyond doubt the possibility of a spinal injury, but it greatly reduces the risk of the victim suffering any consequences by letting him move. In any case, a victim who moves easily and without great pain is a good sign.

Spinal evaluation is an ongoing process. The effects of soft tissue swelling may develop slowly over time. Evaluate periodically for changes in the patient's condition.

It is important to note that these decision rules have not been validated in children and have been validated primarily as a decision aid for the need for radiology following cervical spine trauma. They were not directly validated for the decision to immobilize or not.

Management of Spinal Injury

The management of spinal injuries requiring Spinal Motion Restriction (SMR) involves stabilizing the spine in an anatomical position to minimize the effects of muscle contractures and swelling that result from most joint injuries.

Basic principles to be respected in SMR:

- Respect the anatomy (neutral/comfortable position).
- Limit the mobility of the spine as much as possible.

- Ensure comfort and minimize secondary complications due to movement restriction means.

Methodology:

- Lay the victim on his or her back on a stable, cushioned surface while supporting the head and neck. If the neck is not in neutral, gently pull in line with the position the head was in, and slowly move the head to what is called the neutral position: eyes forward, ears aligned with the shoulders, and mouth aligned with the sternum.
- If you feel resistance when you try to return the head to the neutral position, stop the movement and improvise a neck support to protect the neck in the position you found it.
- If the victim cannot be placed on his or her back (e.g., respiratory condition, vomiting, third trimester pregnancy), the side or semi-sitting recovery position can be used, making sure to support the cervical spine. (Pad the empty space with blankets, clothes, insulating mattress, etc.). Consider even sitting with a cervical support or shield in the victim with isolated, ambulatory neck pain.
- Support the cervical spine or have the casualty restrict movement until you can apply a SMR measure.
- Monitor vital signs and maintain Responsiveness.
- Monitor neurological signs (LOC and Distal CSM).

Extraction / initial movevement

Victims requiring emergency extrication/extraction should be encouraged to reduce neck movements, especially painful ones, and allowed to exit the situation on their own if they are alert and reliable. If the severity of the injuries or other circumstances such as unconsciousness prevent controlled self-extraction, the victims' cervical spine should be protected to reduce passive movement and the airway should be adequately managed without the goal of absolute immobilization.

The use of a rigid, commercial or even improvised cervical collar is not necessary if the cervical spine can be supported by other means.

When moving a victim with an actual or potential spinal injury: Lift and slide transfer (BEAM) with cervical stabilization by trapezius clamp is preferable to roll transfer when restriction of spinal motion is required. In the case of a facial fracture, unconscious victim, or other scenarios that may compromise the airway, the lateral position may be considered. Light to moderate traction should be used to return the cervical spine to the anatomical position and transfer the victim.

Secondary Survey and stabilization for transport

Once the initial management has been completed and appropriate spinal precautions have been implemented, it is then time to conduct a careful secondary examination and address the less urgent issues and prepare the victim for transport/evacuation to emergency medical services.

Different mechanical immobilization modalities can be used depending on their availability. If spinal movement restriction cannot be assured during evacuation of a victim at high risk of spinal injury, unless a life-threatening emergency exists, wait for the search and rescue team, aeromedical transport, or other appropriate means of transportation.

Spinal transport and stabilization devices

There are different strategies to ensure spinal motion restriction during evacuation to emergency medical services. The rescuers' job will be to assess the situation and select the preferred method(s) to maintain alignment and support of the column, taking into account available resources, evacuation time and the condition of the victim. Among the existing means, we list the following:

Stabilization in an immobilizing mattress

Stabilization in an evacuation basket

Secure the spine on a SCOOP stretcher

Secure the spine with a K.E.D. (Kendrick Extraction Device)

When extraction requires spinal precautions with restriction of movement for victims at high risk of spinal cord injury. Mainly used in car accidents with a victim in a seated position or for an emergency wall evacuation.

Stabilization of the spine with Spine Board

The Spine Board serve as a stabilizing platform for the transport of victims. It is not a long-term immobilization tool. The standard board is 1.8m x .45m. Patients can be secured with nylon straps, triangular bandages, non-stretch adhesive tape or rope.

- If a cervical spine injury is suspected, apply a cervical collar.
- Using a body roll or lift, position the patient on the board.
- Secure chest, hips and thighs in this order. Feet and hands may be secured if required.
- Fasten the head last.
- Pad all body hollows, between the legs and both sides of the head.

Placing Patient on Spinal Board by Lifting or Rolling

Apply cervical spinal motion restriction measures.

Prepare the spinal board and arrange rescuers alongside patient.

Log roll the patient onto her side.

Lower the spinal board and patient together.

Fasten the straps on the board while the patient's head is supported. Fasten the head last.

Monitor Airway and breathing and beware of vomiting.

In some cases a direct lift will be required to place the patient onto a spinal board.

The rescuers coordinate their actions to make the move. A rescuer supports the head and neck.

Application of a Cervical Collar

As with the rigid Spine Board, the use of the rigid cervical collar is increasingly being questioned, if not completely abandoned, particularly in isolated settings. As its use is still widespread and is still part of many first aid protocols, it is still useful to know its application and to be able to use it judiciously or when indicated by a protocol.

WMS 2019 Recommendation:

Commercial or improvised soft cervical collars should be considered one of many tools available to help reduce cervical spine motion, if that is the goal. It should not be used if the presence of the collar itself compromises the urgent care of the victim. There is no required role for rigid cervical collars in out-of-hospital trauma care in isolated settings (Level of Evidence: 2B).

Maintain head and neck alignment and stability until the collar can be applied.

Measure the distance between the jaw and the shoulders.

Select the appropriate size collar or select the size on an adjustable collar.

Maintain head and neck stability while a second rescuer slides the collar under the neck.

Fasten the collar and ensure that airway and breathing are not compromised. Monitor the patient.

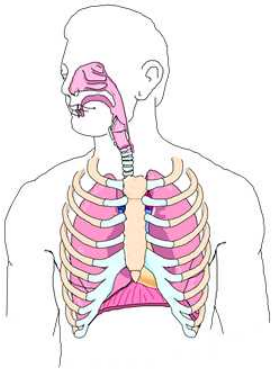
Maintain manual support until head is fastened to spinal board.

If using an improvised collar ensure proper position of the head and neck and monitor airway carefully. Ensure that the airway is not compromised.

To apply a cervical collar to a patient who is not supine, maintain head and neck alignment until a collar can be applied.

8.8 Chest Injuries

Trauma to the upper portion of the body can result in a variety of injuries to the structures and organs of the chest. These include injuries to the chest wall, pleura, lungs, heart and blood vessels. Chest injuries may be caused by falls, direct blows from falling objects or accidents involving vehicles of any kind (cars, snowmobiles, all-terrain vehicles, bicycles, etc.). The chest is most commonly injured by either compression or penetrating trauma. Any injury to the chest wall, soft tissue or underlying structures that elicits pain or reduces function will greatly reduce respiratory function and is regarded as potentially life-threatening.



See Body Systems (p. 33) for the anatomy and physiology of the respiratory system.

8.8.1 Mechanism of Chest Injuries

The mechanism of chest injuries includes blunt and penetrating trauma, crush injuries, inhalation burns and aspiration of foreign bodies.

Closed Chest Injuries

Closed chest injuries are caused by blunt trauma. The extent of injury may not be immediately apparent on the surface of the skin. The severity of a closed chest injury is determined by the extent of damage to underlying tissues and organs and the extent of interference with the function of the respiratory system. Closed chest wounds may include broken ribs, bruising of the lungs, lacerated blood vessels and injury to the heart.

Open Chest Injuries

Open chest injuries are caused by objects that penetrate the chest wall such as ski poles, ice axes or tree branches. Air enters the pleural space through the wound, causing loss of the normal negative pressure and collapse of the lung. Structures in the thoracic cavity and upper abdominal cavity may also be affected. In these cases, internal bleeding and functional alterations may occur.

8.8.2 General Assessment and Management of Chest Injuries

Assessment

Determine the Mechanism of Injury indicating trauma. An open chest wound is the most obvious sign of a chest injury.

General Signs and Symptoms

- Difficulty breathing
- Pain at site of injury or pain aggravated by breathing
- Depressed respiration rate and volume due to pain
- Coughing up or spitting blood (the urge to cough may be suppressed due to pain)
- Visible deformity of chest wall
- Abnormal movements across one or both sides of the chest
- Failure of the chest wall to expand with inspiration
- Gurgling or obstructed breathing
- Signs of shock
- Air moving in and out of an open wound (sucking chest wound)
- Rapid, weak pulse and low blood pressure
- Cyanosis or bluish discoloration of the skin

General Management of Chest Injuries

General management of chest injuries involves maximizing respiratory function and reducing any pain in the chest area.

- Maintain airway and provide supplemental oxygen if it is available.
- Encourage the patient to breathe as deeply as possible.
- Place patient in a position of comfort to maximize respiratory function.
- Stabilize chest wall.
- Record vital signs.
- Treat for shock.
- If conscious, transport patient in semi-sitting position or position of comfort.

8.8.3 Types of Chest Injuries

Blunt Injuries

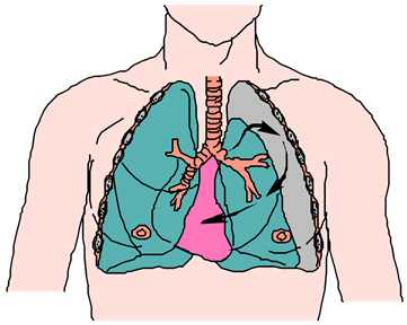
Blunt trauma can deform the chest wall and cause the heart to move, rupture the aorta or fracture the rib cage. In this type of trauma, the liver, spleen and kidneys may even be affected.

Penetrating Injuries

The most serious complications of penetrating injuries are hemorrhage and the compromise of respiratory function.

Pneumothorax

Pneumothorax means air in the chest. Damage to a lung or an opening in the chest wall will allow air to enter the pleural cavity around the lungs. This breaks the fluid bond between the pleurae and the lung on the affected side will collapse. If air enters the pleural cavity from the outside, it is known as an open pneumothorax. If it enters the pleural cavity from the lung, it is known as a closed pneumothorax.



Signs and Symptoms

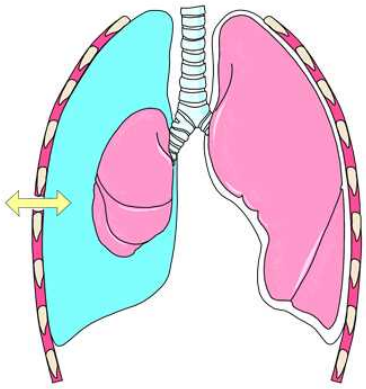
- Wound to the chest or lung
- Progressive respiratory distress
- Pain during inspiration
- Subcutaneous emphysema – air forced into the space under the skin
- Injured side eliciting hollow sounds on percussion
- Decreased motion of the injured side when breathing
- Signs of shock

Open Pneumothorax Management

- To limit the loss of negative pressure in the pleural cavity and prevent the lung from collapsing, the wound must be sealed as quickly as possible with any occlusive dressing available.
- Tape the dressing securely in place.
- Monitor the patient for signs of a Tension Pneumothorax (see below).
- Reduce activity.
- Administer oxygen where available.
- Monitor vital signs.
- Treat for shock.
- Evacuate in a position of comfort.

Spontaneous Pneumothorax

A pneumothorax may also happen spontaneously to a previously uninjured person and is known as spontaneous pneumothorax. Spontaneous pneumothorax is more common in tall, thin young men over 16 years of age. It is usually the result of weak lung tissue.

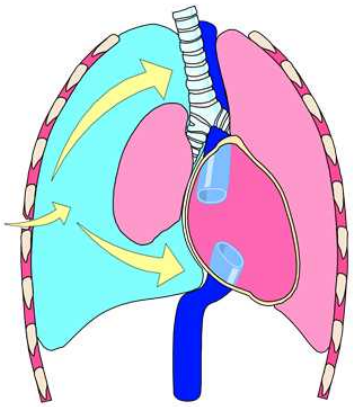


Pneumothorax

Tension Pneumothorax

Tension pneumothorax is a complication of a pneumothorax that occurs when air enters the pleural space but is unable to escape. This may be caused by damaged lung tissue, which acts as a one-way valve. Each time the patient inhales, the valve opens and air enters the pleural space. Upon exhalation the valve closes and the air cannot escape. Air pressure gradually increases in the pleural cavity, compressing the lung on the affected side and gradually affecting all structures of the rib cage, such as the heart, arteries and mediastinum. These, in turn, put pressure on the healthy trachea and lung.

A tension pneumothorax may occur with spontaneous pneumothorax and with both open and closed chest injuries. It may also occur after a sucking chest wound has been sealed with an occlusive dressing.



Tension Pneumothorax

Signs and Symptoms

- Increasing respiratory distress over time
- Signs of rapidly progressing hypotension.
- Distension on injured side of the chest
- Signs of shock
- On palpation, tracheal deviation can be detected (towards unaffected side and up)
- Hollow sounds on percussion of injured side
- Distended veins of the neck

Tension Pneumothorax Management

If an open wound has been treated with an occlusive dressing, relieve the pressure by lifting the adhesive on one corner of the dressing to allow air to escape. This will provide a one-way valve preventing air from entering the chest but providing a release of any pressure that develops.

- Evacuate rapidly in a position of comfort.
- Monitor vital signs.
- Treat for shock.

Hemothorax

Hemothorax results when blood from damaged tissue and vessels accumulates in the pleural space. In cases of trauma, a hemothorax is often accompanied by air in the pleural space. The signs and symptoms may therefore be similar to and difficult to distinguish from those of a pneumothorax. Follow the same management principles as those for chest injury and monitor for signs of tension pneumothorax.

Chest Fractures

Fractured Ribs

Fractured ribs are the most common type of chest injury. Patients will generally experience pain on breathing, and the pain may be sufficient to reduce respiratory drive. These patients should receive oxygen and must be monitored carefully. Fractured ribs also carry the risk of lacerated internal organs, especially the lungs, which may in turn result in pneumothorax or hemothorax.

Flail Chest

A flail segment is a section of ribs that has broken away completely from the rest of the rib cage. In some cases the section of broken rib moves independently from the rest of the chest, moving inwards on inhalation and outwards on exhalation. This is known as paradoxical movement.

Fractured Sternum

Sternal fracture rarely occurs alone. It is usually accompanied by other severe chest injuries. Emergency management includes providing oxygen and ensuring prompt evacuation to definitive care.

Chest Fracture Assessment

Signs and Symptoms

- Local point tenderness at the site of the injury
- Bruising and discoloration
- Shallow breathing and pain associated with breathing
- Guarding the injured side

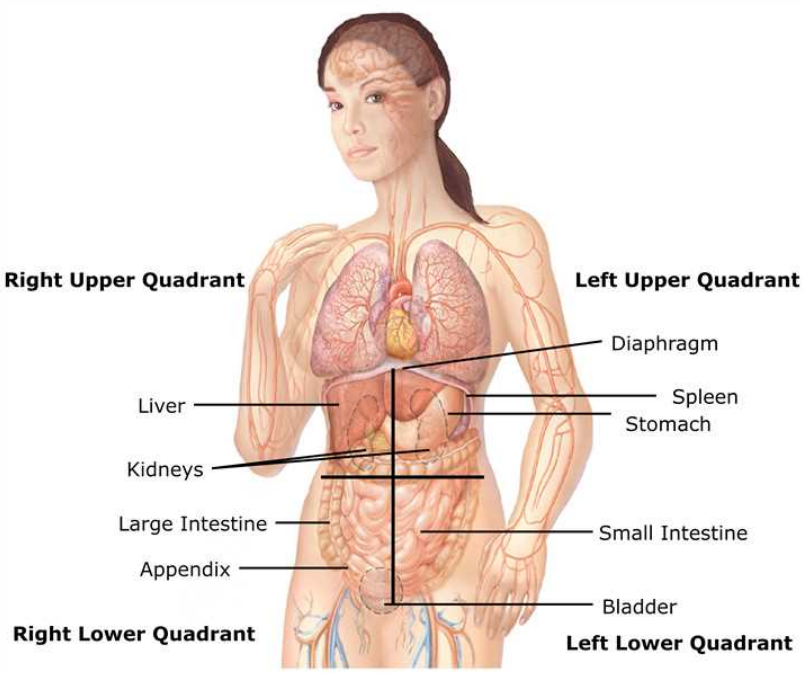
Chest Fracture Management

- Reduce activity.
- Monitor vital signs carefully.
- Treat for shock.
- Stabilize the damaged area by taping from the sternum to the spine. Do not tape around the entire chest as this reduces thoracic capacity.
- Evacuate for medical attention.
- Provide oxygen if available.

8.9 Abdominal Injuries

8.9.1 Anatomy of the Abdomen

The abdominal cavity is located in the region between the diaphragm and the pelvis, or pelvis. It is covered by a membrane called the peritoneum. The cavity consists of four quadrants, which are divided for medical purposes horizontally and vertically by two perpendicular lines intersecting at the umbilicus (navel).



Organs located in the abdomen are characterized as either solid organs or hollow organs.

Hollow organs include all of the tubular structures that digest and process food and excrete substances such as urine and feces. Hollow organs are less prone to injury from blunt and penetrating trauma than solid organs and bleed less profusely when injured. When ruptured or lacerated, however, the highly acidic and bacteria-rich contents of these organs will spill into the peritoneal cavity causing a severe and life-threatening inflammatory reaction called peritonitis (see description below).

Solid organs include the liver, spleen, pancreas and kidneys. These organs constitute the chemical laboratory and the filtration system of the organism. These are richly vascularized organs. Solid organs are more easily damaged than the hollow viscera of the digestive system. Most solid organs are located in the upper quadrants where they are partially protected by the rib cage. Trauma to solid organs could result in significant blood loss and severe shock. Any trauma to the upper quadrants of the abdomen must be assessed and monitored carefully.

Hollow Organs

Hollow Organs	
Oesophagus	Muscular tube leading from the mouth to the stomach.
Stomach	J-shaped organ located in the upper left quadrant. Digestive enzymes and acids are secreted into the stomach and mixed with the food stored there.
Gall bladder	Stores bile that is secreted into the small intestine.
Small intestine	Responsible for most food absorption.
Large intestine	Upper area is responsible for absorption of water and some nutrients. Formation of stool in the lower portion.
Appendix	Located at the junction of the small and large intestine in the lower right quadrant. The appendix has no function.
Rectum	Stores feces for expulsion from the anus.

Hollow Organs	
Urinary organs	Ureters, bladder, urethra
Reproductive organs	Female: Uterus, Fallopian Tubes

Solid Organs

Solid Organs	
Pancreas	Flat organ made up of two glands. One secretes digestive enzymes into the small intestine; the other secretes insulin, which helps break down sugar for use by cells.
Liver	Removes impurities from the blood and produces bile and chemicals necessary for the digestion of fats. It also stores glucose, proteins, fats and vitamins.
Kidneys	Two organs located in the retroperitoneal cavity behind the abdominal cavity. Responsible for filtering waste and impurities from the blood and regulating body fluids.
Spleen	Involved in the removal and replacement of red blood cells.
Reproductive organs	Male: testes and prostate gland Female: ovaries

8.9.2 Traumatic Abdominal Injuries

Injuries to the abdomen pose a significant assessment challenge to the rescuer. Many serious injuries are often overlooked or mistaken for common problems that do not present an immediate threat to the patient. Signs and symptoms of abdominal injuries may only develop over time and may be masked by other injuries. Initial assessment must be thorough and accurate to determine whether a rapid evacuation is necessary.

Damage to any of the vital organs requires immediate medical attention. These patients should be evacuated without delay.

Closed Injuries

Closed injuries generally result from blunt trauma to the abdominal area. For example, the abdominal or genitourinary organs may be crushed or compressed as a result of a fall or crush injury. In these cases, the abdominal wall shows significant bruising. Blunt trauma can also rupture any of the solid organs or blood vessels resulting in severe intra-abdominal hemorrhage. Other blunt injuries include tears to the peritoneal tissue that attaches the intestines to the abdominal walls and ruptured hollow organs resulting in peritoneal inflammation. These injuries may be hard to detect initially as signs and symptoms may not be immediately apparent.

Open Injuries

More immediately apparent than closed injuries, open injuries result from penetrating trauma caused by sharp objects such as pick axes, knives, broken glass or bullets. These include lacerations of any depth: penetrating the skin alone, penetrating the peritoneal wall or even reaching down to the abdominal organs. Rupture of the peritoneum is always serious even if no organ is directly affected. It can cause a severe bacterial infection, such as peritonitis. A ruptured peritoneal wall can also result in an evisceration – an open abdominal injury in which the intestines protrude from the abdomen.

8.9.3 General Assessment and Management of Abdominal Injuries

Accurate assessment of abdominal injuries requires a detailed and thorough history and patient exam. While some minor illnesses such as gastrointestinal infection may present severe pain, a life-threatening traumatic injury may present only few or subtle symptoms. History is a critical element in the assessment of abdominal problems.

Assessing Pain

- Assess nature of pain — sharp, stabbing, gnawing, cramping, constant, intermittent
- Assess location, any change in location and radiation of pain
- Determine exact time of onset
- Determine nature of onset — gradual or sudden
- Assess severity and progression of pain since onset
- Assess factors provoking or relieving pain — coughing, deep breathing, voiding, bowel movements, menstruation, position of body

Signs and Symptoms

- Penetrating wounds to the abdomen, pelvis, middle and lower back
- Large bruised area or deep bruise in area of abdomen or lower back suggesting blunt trauma
- Pain in the abdominal wall area or back area
- Blood in vomit, stool or urine
- Signs of shock
- Abdominal distension
- Rebound tenderness
- Lack of gastrointestinal sounds
- Tenderness or guarding of the abdominal wall
- Inability to move

General Management

- Log roll patient to supine position.
- If there is no spine injury flex the patient's knees to help relax abdominal muscles.
- Monitor vital signs and treat for shock.
- Give nothing by mouth.
- If vomiting, turn patient to the side to clear the airway.
- Evacuate.

Additional Considerations for Open Abdominal Injuries

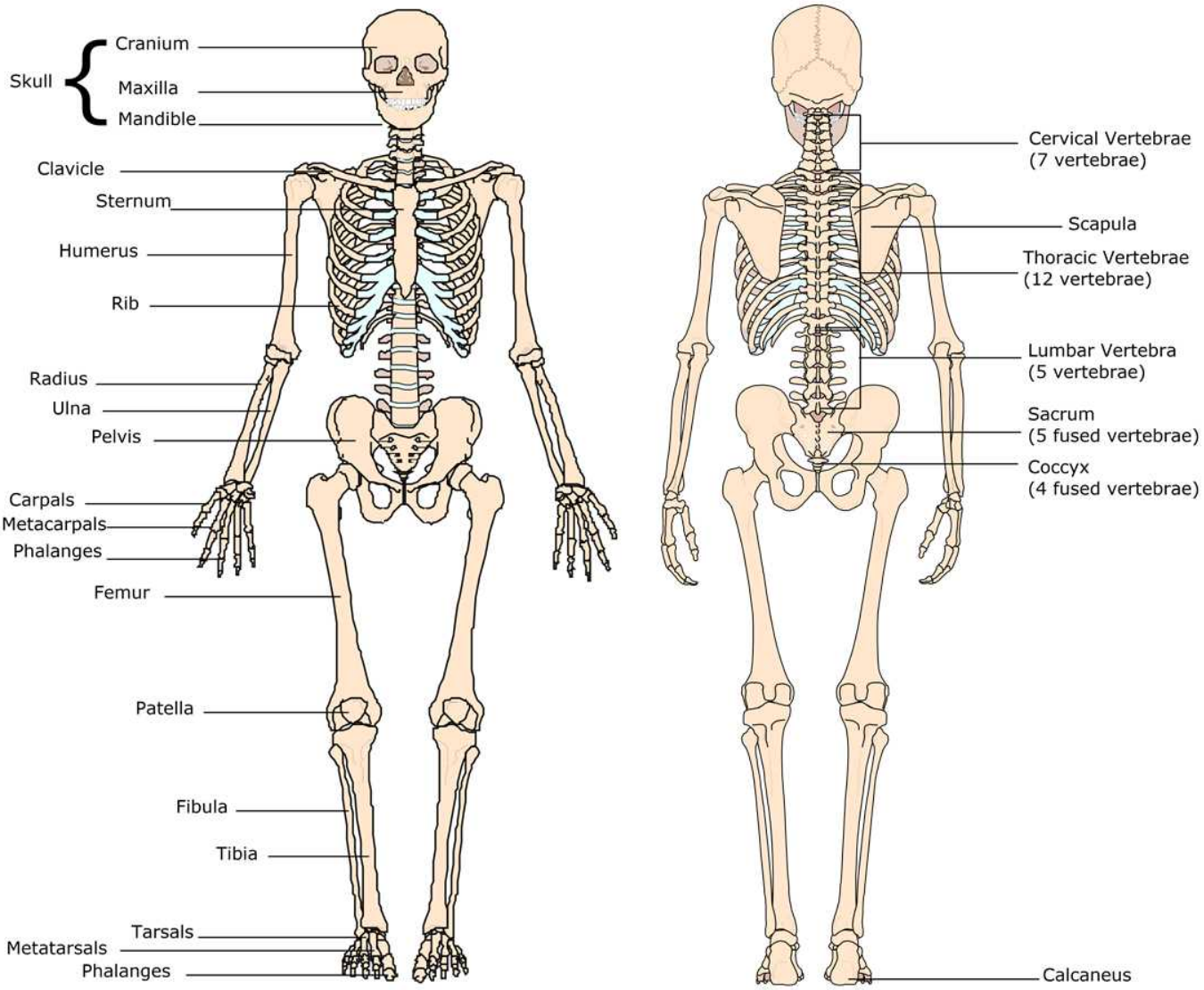
- Always use Universal Health Precautions and Personal Protection Equipment.
- Control bleeding and dress wounds.
- Do not attempt to replace eviscerated organs. Apply a moistened sterile dressing over the wound and keep warm.
- Do not remove impaled objects. Stabilize with bulky dressings bandaged in place.

9. Musculoskeletal injuries

Musculoskeletal injuries, especially injuries to the lower extremities, are common wilderness accidents. They may involve any of the structures of the muscular and skeletal systems.

9.1 Anatomy and Physiology of the Musculoskeletal System

The musculoskeletal system is made up of two systems, the muscular system and the skeletal system. Together they give the body its form, hold the body upright, protect internal organs and allow the body to move. The principal components of the musculoskeletal system are the bones, joints, ligaments, cartilage, muscles and tendons.

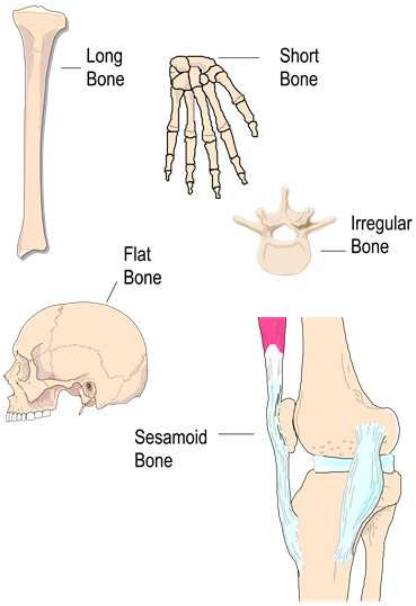


9.1.1 Bones

The Human Skeleton

The skeleton has six functions.

- It provides a framework and support for the body.
- Its bones provide attachment for muscles and ligaments.
- It facilitates movement.
- It provides protection to vital organs.
- It is the site for red blood cell production.
- It provides mineral storage.



Types of Bones

The skeleton is made up of 206 bones, divided into five types.

- Long bones: recognizable by the length of their diaphysis (e.g. femur).
- Short bones: cubic in appearance (e.g. carpal bones).
- Flat bones: thin and sometimes curved bones (e.g., skull bones).
- Irregular bones: as the name implies, these bones have an irregular shape (e.g., vertebrae).
- Sesamoid bones: develop in certain tendons (e.g., patellas).

9.1.2 Axial and Appendicular Skeleton

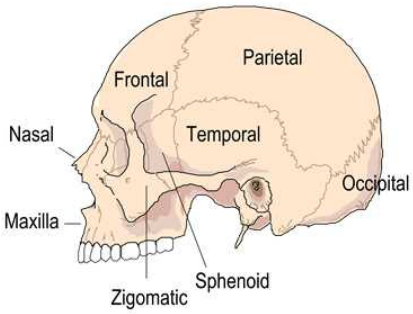
The skeleton is divided into the axial skeleton and the appendicular skeleton.

The Axial Skeleton

The axial skeleton is made up of the skull, sternum, ribcage and spinal column.

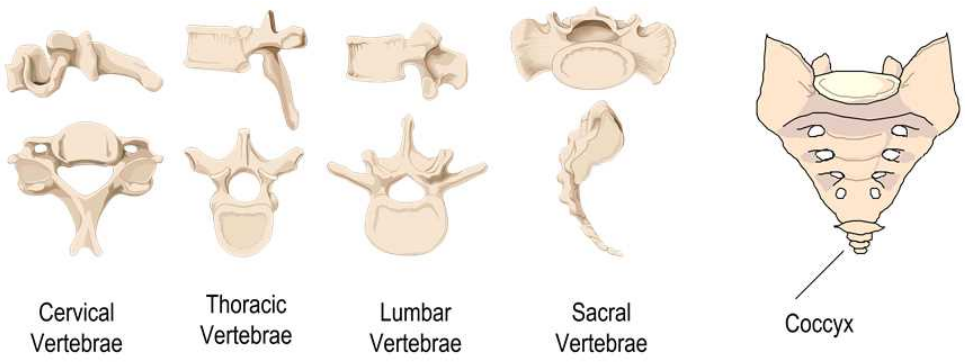
The Skull

The bones of the skull constitute the bony protection of the brain (see Head Injuries (p. 122)).



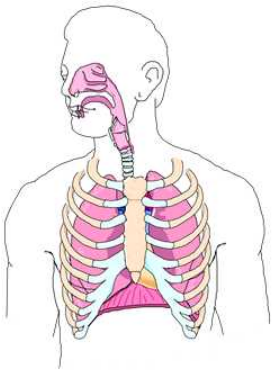
The Spine

The spine consists of 33 vertebrae. It is divided into five regions: cervical, thoracic, lumbar, sacral and coccygeal (see Spinal Injuries (p. 126)).



The Chest

The thorax or bony structures of the chest protect the heart and the lungs. It includes twelve pairs of ribs. These connect at the back of the spine to the thoracic vertebrae. At the front, the ten pairs of upper ribs are joined to the sternum directly, or indirectly by costal cartilages (see The Respiratory System (p. 33)).



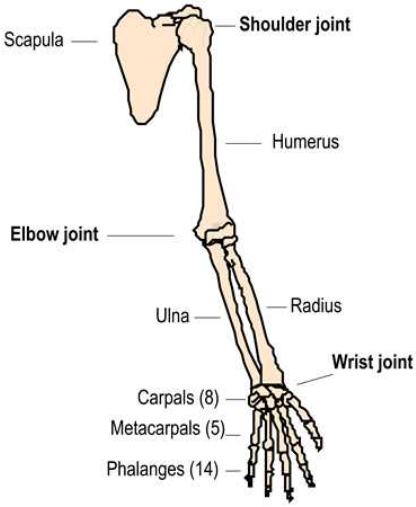
The Appendicular Skeleton

The appendicular skeleton is subdivided into six main regions. Of these six regions, three belong to the upper appendicular skeleton and three belong to the lower appendicular skeleton.

The Upper Appendicular Skeleton

- The arms and forearms
- The wrists and hands
- The shoulder girdle – a set of bones connecting the spine to the arms and including the scapula and the clavicle

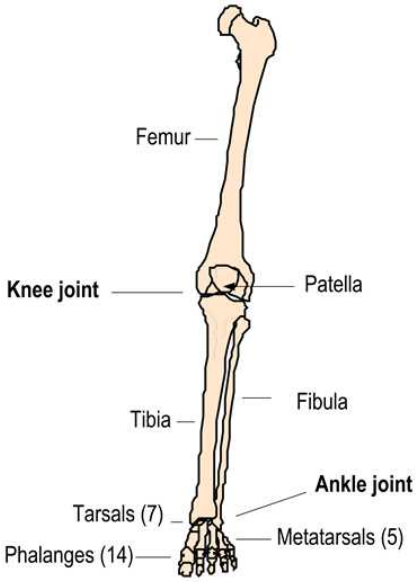
The upper appendicular skeleton contains three major joints on either side of the body: the shoulder, the elbow and the wrist.



The Lower Appendicular Skeleton

- The thighs and legs
- The ankles and feet
- The pelvic girdle – a basin-shaped structure of bones connecting the spine to the thighs and including the hip bones, sacrum and coccyx

The lower appendicular skeleton contains three major joints on either side of the body: the hip, the knee and the ankle.



9.1.3 Joints

Wherever two bones meet, they are connected by a joint or articulation.

Types of Joints

Joints may be classified according to their range of motion. Joints that do not allow any movement at all, such as the joints between the different bones of the skull, are called immobile joints. Semi-mobile joints are those that allow very little movement, such as the joint between the tibia and fibula in the lower limbs. Others are freely movable and permit a wide range of motion, such as the joints of the shoulder, hip, knee, elbow, wrist, ankle, digits, etc.

Freely Movable or Synovial Joints

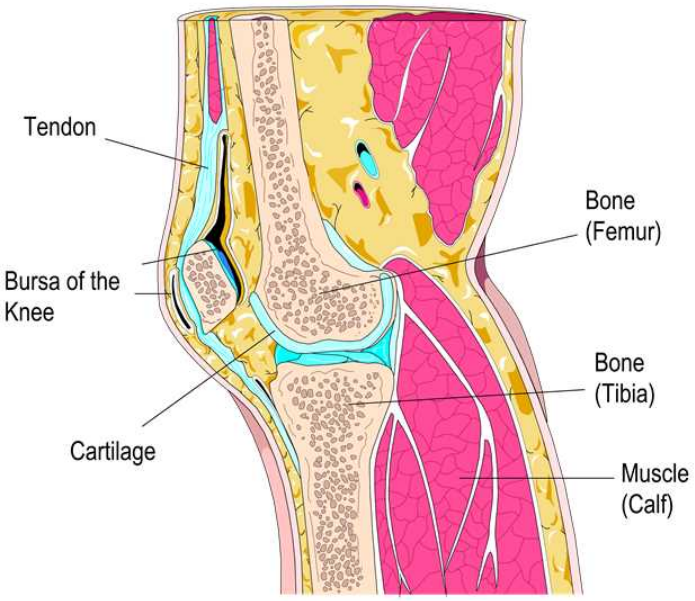
Articular cartilage covers the bone ends of freely movable joints, to prevent bone-to-bone contact.

A joint capsule sits within the space between the two covered bones.

Synovial fluid fills the cavity of the joint capsule to lubricate and reduce friction between the moving surfaces of the joint.

Ligaments join the cushioned bones.

Bursae are small fluid-filled pockets that provide additional lubrication around a synovial joint where tendons or muscles rub against bone.

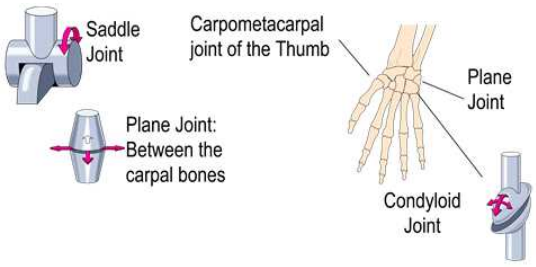


Types of Synovial Joints

In the **saddle joint**, the two bones behave like a rider in the saddle.

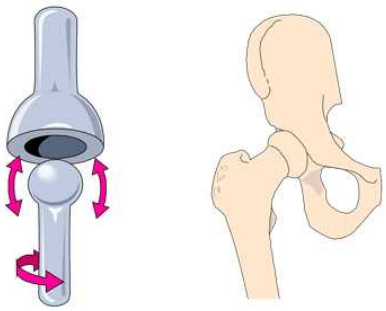
The **carpometacarpal joint** of the thumb is an example of this type of joint. The movements of flexion, extension, abduction, adduction and circumduction occur at this joint.

A **plane joint** is also referred to as a sliding joint. The articulations between the carpal bones are an example of this type of joint where movement is relatively restricted.



A **condyloid joint** resembles a saddle joint in movement. It is the articulation between two bones, one with a concave surface, the other with a convex surface.

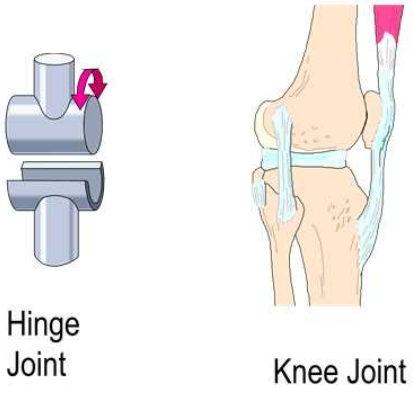
A **ball and socket joint** describes a joint where the articular surface of one bone ends in a ball, while the articular surface of the second bone is cup-shaped and able to receive the ball. The hip and shoulder joints are examples of this type of joint.



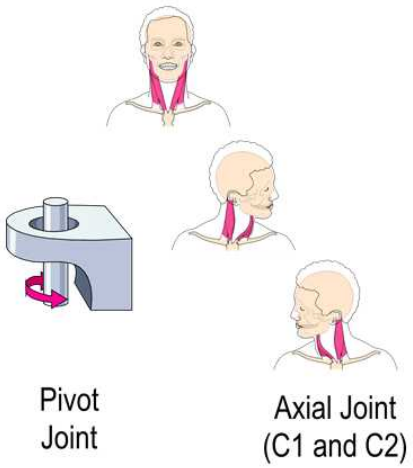
Ball and Socket Joint

Hip Joint

A **hinge joint** is made up of two bony surfaces that hinge together allowing motion in only one plane. The knee joint, which is the articulation between the thigh (femur) and the leg bones (tibia and fibula), allows only flexion and extension and is therefore considered a hinge joint.



A **pivot joint** allows rotation around an axis. It is best illustrated by the interaction between the first two vertebrae of the cervical spine. The atlas (C1) vertebra sits on an axis (C2) and is able to pivot.



9.1.4 Muscles and Tendons

Muscles

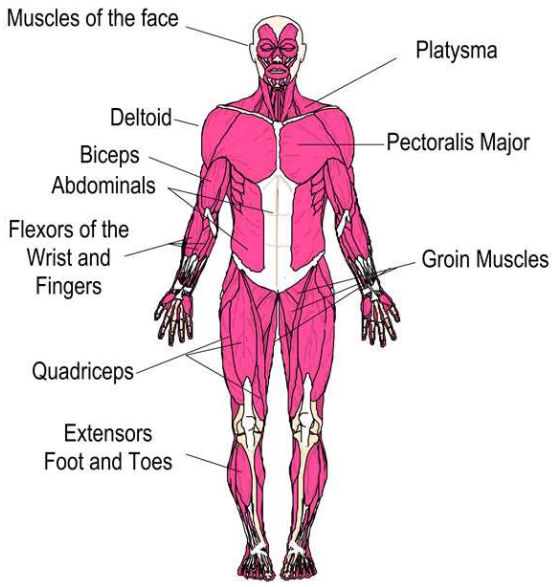
Muscles are highly elastic and highly vascularized contractile tissues. Muscles support and strengthen the joints, and they produce the movement of different parts of the body. They also store and generate heat. Their elasticity allows them to accommodate better than other body structures to increased activity. There are three types of muscles in the body.

Skeletal muscles, as suggested by the name, attach to the bones of the skeleton. They appear striated or lined under microscopic view and are also sometimes called striated muscles. Because they are under the direct voluntary control of the central nervous system, they are known as voluntary muscles.

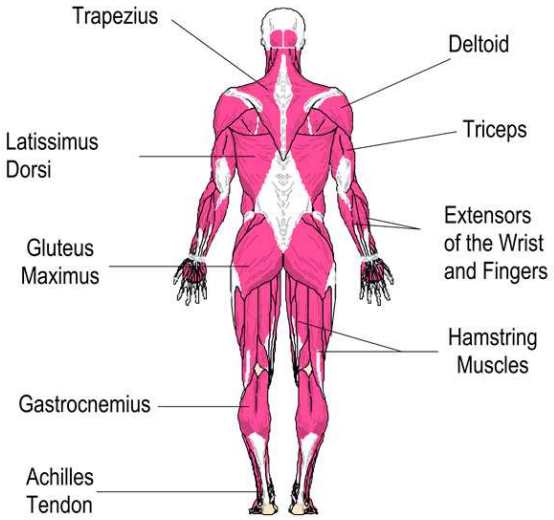
Smooth muscles are found in the viscera of the body, specifically, the gastrointestinal tract, the urinary system, the blood vessels and bronchi. Their function is to regulate the flow of blood, body fluids and other substances. Because they carry out most of the automatic tasks of the body they are known as involuntary muscles.

Cardiac muscle is a type of striated involuntary muscle found only in the heart.

Major Musculoskeletal Groups of the Body



Anterior view of the muscles of the body



Posterior view of the muscles of the body

Tendons

Muscles are attached to bone by a tough fibrous connective tissue called a tendon. Tendons are capable of withstanding a great deal of tension and work together with muscles to exert a pulling force.

Origin and Insertion

The action and force of a muscle are determined by its points of origin and insertion. These are the two end points at which the muscle attaches to bone via tendon. The origin of the muscle attaches to the bone which does not move during a contraction. The muscle insertion attaches to the bone, which moves as the muscle contracts.

9.2 General assessment and management of musculoskeletal injuries

9.2.1 Mechanisms of Musculoskeletal Injuries

It takes significant force to fracture a bone or tear a muscle. This force can be direct, indirect or twisting.

- Direct injury damages the bone at the point of impact. For example, a fracture of the femur caused by the impact of a hard object on the thigh.
- An indirect injury will injure structures that are not found at the site of impact. An impact against the thigh, for instance, may cause an injury at the hip or knee joint.
- A torsional injury occurs when a bone or muscle structure is twisted out of its normal position. For example, in a skiing accident, when the knee and lower limb are excessively twisted, they are stretched beyond their natural point of extension.

General Assessment of Musculoskeletal Injuries

Assessment of musculoskeletal injuries requires a detailed history. One of the goals is to determine the level of function or "usability" of the affected area. Identifying which tissues and structures are involved will also assist in establishing an appropriate plan of care. This will help maximize the function of the injured area while minimizing the risk of further injury.

- Assess for changes in stability, structure and function.
- Examine limbs one at a time to find exact location of pain and point tenderness.
- Compare for symmetry with the opposite limb.
- Evaluate distal CSM.
- Evaluate range of motion in joints.
- Expose the area and examine for swelling, discolouration, tenderness and deformity.
- Determine the mechanism of injury: the type, direction and magnitude of forces that were involved.
- Using PQRST have patient describe the pain and note its exact location.
- Note grinding sounds (crepitus) or instability.

General Management of Musculoskeletal Injuries

All fractures, dislocations and soft tissue sprains and strains will very quickly result in swelling and sometimes muscle spasms and a great deal of pain. The most effective immediate first aid treatment is known as RICE, an acronym for Rest, Ice, Compression and Elevation. RICE will reduce swelling, relieve pain, slow down any bleeding and protect injured tissue.

RICE	
R Rest	Get off the affected part as soon as possible and reduce activity. Rest is essential to prevent further injury.
I Ice	Apply cold for 15-20 minutes and allow to rewarm passively for 1-2 hours. Monitor circulation distal to the injury site. Ice is ideal if available but cold water or any other cool substance (such as snow) may be substituted. Beware of snow and ice that may be cold enough to cause tissue damage. Cold should not be applied to fractures that have impaired CSM.
C Compression	Apply compression at the site of the injury using an elastic bandage. Monitor distal CSM during and after application of compression. Area may need to be built up if located in a hollow such as the area below the "ankle bones."
E Elevation	Elevate and support the affected part above heart level to help prevent fluids from accumulating in the extremities.

9.3 Fractures

A fracture is a term used to describe any type of break in a bone. A fracture can range in severity from a hairline crack to a complete break with multiple segments. The extent of a fracture may be difficult to assess in the backcountry without the aid of sophisticated diagnostic equipment.

9.3.1 Closed Fractures

Closed fractures are broken bones that do not penetrate the skin. They may nevertheless be accompanied by significant soft tissue trauma and internal bleeding depending on the severity of the injuries and the type of soft tissue structures involved.

Management

- The first priority is to limit aggravation to the soft tissue trauma.
- Detect any pressure placed on blood vessels or nerves by bone ends or fragments.
- Immobilize the limb in a position of function to limit unnecessary movement and prevent closed fractures from becoming open fractures.
- Create a well-padded and rigid splint.
- For long bone injuries, immobilize the joints above and below the injury.
- For joint fractures or injuries, immobilize the bones above and below the joint.
- Monitor Distal CSM.
- Evacuate.

9.3.2 Open Fractures

Open fractures are broken bones that penetrate the skin. The management of open fractures is complicated by the increased risk of bleeding and infection associated with open wounds.

Management

- Control any serious bleeding.
- Thoroughly clean and dress all wounds prior to splinting.
- Maintain access to the wound site.
- Do not scrub exposed bone as this may damage its delicate covering (periosteum).
- Ensure that exposed bone ends are protected so that they will not freeze or dry out.
- Monitor carefully for signs of infection.
- Antibiotics are indicated in cases of long evacuations.

9.3.3 Anglulated and Displaced Fractures

Angulated or displaced fractures are fractures in which the broken bone lies at an angle to the normal alignment of the bone. Displacement may be assessed by the degree of deformity at the fracture site. However not all displaced fractures will present a marked deformity.

Rapid evacuation is important, especially if CSM are compromised. If it is not possible to evacuate quickly, if there is a compromise of the CSM or for some angulated fractures, the reduction will be considered closed in order to realign the limb in a more anatomical position and possibly restore the CSM.

Reduction

The realignment of a fracture is referred to as a reduction.

Angulated fractures that can be reduced without too many risks and difficulties are especially those of long bones (e.g., fingers, forearm, and tibia.) Displaced fractures near joints (knee / elbow / wrist / ankle) are more complex and it is preferable to immobilize them in the recovered position. Good analgesia will often be required for fracture reduction.

Angulated fractures should be reduced as soon as possible to:

- Diminish the pain
- Diminish muscular spasms and inflammation that will increase over time
- Diminish damage to nervous tissue, blood vessels and other soft tissue
- Facilitate immobilization of the limb and patient transportation

Reduction of Angulated Fractures and Dislocations

- Relax patient and the muscles in the area.
- Support the proximal aspect of the limb while applying gentle traction to the distal portion in line with the angulated portion.
- Continue traction while moving the limb to a position of function (i.e. a position of normal alignment)
- Slow down or discontinue attempt if you are significantly increasing pain or if you meet resistance.
- Assess the position of the limb with the alignment of the uninjured side.
- Maintain traction in a position of function until a rigid and well-padded splint can be applied.
- Follow reduction with RICE to reduce inflammation.
- Monitor wound site and distal CSM every 15 minutes.

9.3.4 Specific fractures

Forearm Fractures

Falls absorbed by an outstretched hand and arm are the most common mechanism of injury resulting in fractures to the bones of the forearm (radius and ulna). Management includes immobilization with a rigid splint that encompasses the proximal and distal joints of the fractured bone. The hand must be held in the neutral position. Bend the elbow at a 90 degree angle before splinting to elevate the forearm and reduce swelling.

Wrist Injuries

The wrist joint is the articulation between the forearm and the small bones of the wrist called the carpal bones. Injuries to the wrist are often caused by falling directly onto the outstretched hand. Management of this type of injury includes immobilizing the wrist and hand in a position of function (hand shake position).

Fractured Leg

Fractures to the tibia and fibula can occur when an ankle is severely sprained.

Assessment Signs and Symptoms

- Pain
- Deformity
- Swelling
- Shortening of the leg
- Inability to use limb

Management

- Splint the leg, immobilizing the joints above and below the fracture site.

9.4 Ligament Injuries

9.4.1 Sprains

Sprains are ligament injuries caused when a joint is extended past its normal range of motion.

Sprains have various degrees of severity depending upon the extent of the damage.

- Grade I sprains are stretched ligaments with minuscule or minor tears to tissue.
- Grade II sprains are stretched ligaments with more serious partial tears to tissue.
- Grade III sprains are ligaments that are completely torn away from the bone.

Assessment

Carefully assess the limit of function of the injured joint. Can it be used?

Signs and Symptoms

- Point tenderness at the sites of the ligament's origin and insertion
- Swelling and discolouration

- Lack of mobility and range of motion
- Deformity of joint with severe sprain
- Pain associated with passive joint movement at the limit of normal range of motion

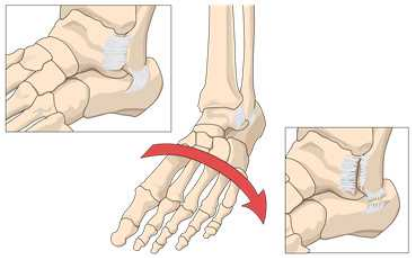
Management

Since ligaments have limited circulation, their healing time is long when injured.

- Manage badly sprained joints as fractures.
- Regular application of RICE will reduce pain and inflammation.
- Joints with minor sprain injuries may be used with caution.
- Support taping may reduce the stress placed on ligaments and joints.

Ankle Sprain

The ankle joint is the joint formed by the leg bones and the tarsal bones of the foot. Most ankle injuries are inversion sprains that occur when the foot is turned inwards. Assess ankle injuries carefully and evaluate for fractures. Point tenderness located above the medial and lateral malleolus may indicate a fracture. Pain may also result from damage to the interosseous membrane, which runs between the tibia and fibula.



Mechanism of injury
Inversion ankle sprain

Assessment

Remove footwear and socks to allow for visual inspection.

Signs and Symptoms

- Swelling and discolouration on the lateral side below the malleolus
- Point tenderness at the insertion and origin of the ligaments below the lateral malleolus
- Limited range of motion
- Pain on inversion

Management

- Reduce activity and apply RICE for 20 minutes.
- Fill hollow below the lateral malleolus with U-shaped pad and apply figure-8 bandage for additional compression.
- Re-assess the injury and provide the appropriate care.
- If the victim can walk with support on the injured side, maintain compression by means of an elastic bandage that passes under the shoe. Walk the victim carefully.
- Additional support may be provided by applying athletic tape over the bandage. This will prevent further injury by limiting the range of motion.
- If the patient is unable to walk or use the affected area, immobilize the limb with a splint.
- Keep elevated when not walking to reduce swelling.
- Monitor distal CSM.

- Swelling may take time to develop. Monitor the ankle regularly to ensure that the condition does not deteriorate.

Knee Sprain

Because of its design, the knee joint is very vulnerable to injury. The knee is a modified hinge joint allowing flexion and extension and some rotation. Knee sprains result from abnormal bending or twisting forces.

Assessment

Symptoms vary from mild to severe depending on the degree of the injury and of the structures involved.

Signs and Symptoms

- Pain and swelling
- Inability to bear weight
- Pain on movement

Management

- Apply RICE.
- Immobilize in a slightly flexed position or a position of comfort.

9.5 Tendon and Muscle Injuries

9.5.1 Strains

Muscle strain is an injury to muscles or tendons caused by overstretching. Tendons and muscles may be damaged from sudden over-loading or, more frequently, from repeated movement. Muscle soreness after a day's activity is an indication that the capacity of the muscle-tendon system has been surpassed. Continued activity of the same intensity will most likely lead to chronic inflammation of the tendons or other joint-related problems. A chronic irritation of the tendon is called tendonitis.

Tendons contain a rich nerve supply, including stretch receptors that warn of impending damage due to overexertion or overextension. As result, when injuries occur in these structures, a great deal of pain can be felt. Because tendons have a poor blood supply, on the other hand, they are slow to heal when injured.

Factors Contributing to Overuse Injuries

- Stress from a high intensity activity
- Repeated stress from a low intensity activity
- Participation in a novel activity or lack of appropriate physical conditioning
- Poor technique
- Improper equipment or footwear or tools that are poorly adapted for the intended task
- Previous injury that has not completely healed
- Tissue dehydration

Signs and Symptoms

- Burning pain at the outset of the activity
- Muscle soreness and stiffness
- Localized pain developing along tendon or at the site of tendon's insertion
- Crepitus (grating sensation) when joint is flexed or extended

Management

- Cease activity at the first sign of pain or discomfort.
- Attempt to reduce the duration or the intensity of the activity.
- Change the dynamics of the activity to incorporate other muscle groups or joint angles.
- Apply ice to the affected area for 15 minutes 3 times a day.
- Support joint or structures with athletic tape.
- Adjust any equipment that may have contributed to the problem.

9.6 Immobilization

Immobilization of an injured limb reduces the possibility of aggravating the injury or causing further injury through motion. Immobilization will also help relieve the pain and allows muscles in the area to relax. Immobilization can be achieved by bandaging a limb against the body or by applying a mechanical device called a splint. After any immobilization, the distal CSM should always be checked.

9.6.1 Types of Splints

Splints come in many shapes and sizes and are made of different types of material. They can be soft, rigid, anatomic or traction-type splints.

Soft Splints

Soft splints are made of soft and pliable material like sleeping bags, clothing, foam padding and bandages.

Rigid Splints

Rigid splints are made of rigid material like wood, plastic and metal. Spine boards can also be used.

Anatomical Splints

Anatomical splints use a part of the body to aid in the immobilization of the injury.

9.6.2 Splints

Kendrick Traction

Device prepared prior to application.

Kendrick Traction Device applied to leg.

Application of Speed Splint

Select appropriate size of splint and assemble components.

Provide adequate padding.

Apply splint.

Support the splint with a sling if necessary. Monitor distal CSM.

Applying a SAM® splint

w.i.p.

Application of Sling

Place bandage under arm with point at elbow

Fold lower corner over shoulder and fasten behind neck.

Application of Tubular Sling

Place bandage across chest under arm.

Tuck loose point over and behind arm and twist ends.

Fasten ends behind back.

Splint using foam sleeping pad

Forearm splint using foam sleeping pad.

Splint using inflatable sleeping pad.

Leg splint using inflatable sleeping pad.

General Principles of Splinting

In most urban settings, unless the patient is required to move or be evacuated, immobilization will be limited to providing support to the limb in the position found while waiting for the arrival of EMS.

If the patient must be moved or evacuated, however (as is likely the case in wilderness settings), the following principles are useful to ensure the proper application of splinting material:

- Open wounds must be managed before the application of any splint.
- CSM must be assessed both before and after splinting.
- The rescuer must determine the precise purpose of the splint.
- The injured limb should be supported while preparing the splint.
- If possible, the limb should be splinted in a position of function (normal position of limb at rest).
- The splint should be completely prepared before being put on – material, size, shape and padding.
- If possible, the splint should be tested on an uninjured limb or someone of similar size and weight for effectiveness.
- The splint should be tied tight enough to keep it in place and loose enough to prevent it from compromising circulation. Tape works well as it neither loosens nor tightens with time.
- Always leave an area at the extremity where distal CSM can be checked.
- For joint injuries, immobilize the bones above and below the joint.
- For long bone injuries, immobilize the joints above and below the injury.
- When splinting an injured thigh or lower leg allow for a slight amount of knee flexion – about 5 to 10 degrees – and add padding behind the knee to support the leg in this position.
- A leg splint may be fixed to the uninjured limb to provide additional support.
- Monitor the injured limb and assess the effectiveness of the splint regularly.

Cold Weather Considerations

In a cold environment, immobilized patients produce less heat and are at greater risk of hypothermia. Similarly, traffic slows down in immobilised limbs, causing an increased risk of frostbite (see Cold-Related Injuries (p. 165)).

10. Environmental injuries and emergencies

10.1 Cold-Related Injuries

Humans are warm-blooded creatures. To function properly, the human body must maintain its core temperature within a very narrow range – between 35.5 and 38 degrees Celsius. It is only within this range that effective enzyme and metabolic activity can occur. When the body is no longer able to adapt to increases or decreases in environmental temperatures, injuries occur. Cold-related injuries, in particular, occur when the body is unable to balance heat production against heat loss.

10.1.1 Mechanisms of Heat Transfer

Heat naturally flows from areas of warmer temperature to areas of cooler temperature to create a thermal equilibrium. Heat transfer occurs by the following mechanisms:

- Radiation is the transfer of heat by electromagnetic waves from all matter that is above absolute zero.
- Evaporation is the conversion of water into vapour.
- Conduction is the transfer of heat through physical contact.
- Convection is the transfer of heat through air or fluids moving between areas of differing temperatures.

Heat Production

The body naturally produces heat through a number of homeostatic processes.

Digestion and Metabolism

The process of digestion and storage of food generates heat. This is referred to as the specific dynamic action (SDA) of food or the thermal effect of food (TEF). Heat is also produced as a by-product of the work our cells do through cell metabolism. This value is called the metabolic rate. The basal metabolic rate (BMR) represents the minimum energy expenditures of an awake person at rest in a thermo-neutral environment and 12 hours after a meal. Our internal sources of heat production rely on having adequate quantities of carbohydrates, fats and proteins for fuel. Adequate water intake is also essential for proper metabolism of foods and plays a major role in helping to maintain sufficient blood volume for circulation, which is the body's heat transport system.

Exercise

Controlled use of skeletal muscles through exercise is another primary method of generating heat. Seventy-five percent of muscular energy is produced as heat. Physical activity is the key to staying warm. Conversely, exhaustion, or the body's inability to continue muscular activity will reduce the body’s ability to generate heat.

Shivering

Shivering can increase the rate of producing heat by 500 percent over the resting rate of heat production. On the other hand, it is a highly inefficient method of heating the body and can quickly deplete muscle glycogen stores and energy substrates.

External Factors Contributing to Heat Gain

Radiation

The body also receives radiated heat from external sources such as the sun, a heater or a campfire. Depending on weather conditions and ambient temperature, the sun can provide a great deal of heat to the body. However, if the radiation source is weak, only the exposed parts of the skin get warm. The resulting vasodilation increases circulation in the extremities and may even promote heat loss.

Heat Loss

To maintain a constant body temperature, the body must compensate for its constant production of heat with homeostatic mechanisms for heat loss. Heat is lost from the body in the following ways:

Radiation

At rest, more than half of our heat loss occurs through simple radiation of the body's electromagnetic waves.

Evaporation

When the body sweats, the process of evaporation has a cooling effect on the surface of the skin. At rest, perspiration accounts for approximately 20 percent of our heat loss.

Conduction

Heat is lost from the body through direct contact with a colder object, when we sit on snow or cold rock, for instance.

Convection

When exposed to cold air or water, heat is conducted away from the body. Through the process of convection, the air or water receiving the body's heat quickly rises or disperses to be replaced by colder air or water. At rest, convection accounts for 15 percent of our heat loss.

Respiration

Body heat is also released through the simple process of breathing.

External Factors Contributing to Heat Loss

Other external factors affect the body's capacity to maintain heat. These include the ambient temperature, inadequate clothing, the effects of wind chill and exposure to water.

Clothing

Inadequate clothing will expose the body to the effects of the environment. Dressing in layers helps form a protective heat barrier around the body to maintain body temperature. It is highly recommended to carry extra waterproof and insulating clothing for unexpected changes in weather. Because cotton and denim provide poor insulation and do not dry rapidly they should be avoided.

Wind Chill

When wind passes over the body, the heat generated by the body dissipates through convection, making us feel colder. The wind chill factor refers to the perceived air temperature from the combined effects of the wind and the cold air that together increase the rate of heat loss from the body. For example, if the outside temperature is -10 degrees Celsius and the wind chill is -15 degrees Celsius, it means that your exposed skin will feel as cold as it would on a day with no wind and a temperature of -15 degrees Celsius. The table below offers a quick calculation of wind chill based on air temperature and wind speed.

Wind Chill Calculation Chart								
° Celsius	**5**	**0**	**-5**	**-10**	**-15**	**-20**	**-25**	**-30**
km/h (10 m. elevation)								
5	4	-2	-7	-13	-19	-24	-30	-36
10	3	-3	-9	-15	-21	-27	-33	-39
15	2	-4	-11	-17	-23	-29	-35	-41
20	1	-5	-12	-18	-24	-30	-37	-43
25	1	-6	-12	-19	-25	-32	-38	-44
30	0	-6	-13	-20	-26	-33	-39	-46
35	0	-7	-14	-20	-27	-33	-40	-47
40	-1	-7	-14	-21	-27	-34	-41	-48
45	-1	-8	-15	-21	-28	-35	-42	-48
50	-1	-8	-15	-22	-29	-35	-42	-49
55	-2	-8	-15	-22	-29	-36	-43	-50
Frostbite guide								
Low risk for most people								
Increasing risk for most people in 10 to 30 minutes of exposure								
High risk for most people in 5 to 10 minutes of exposure								
High risk for most people in 2 to 5 minutes of exposure								

Water Exposure

Accidental submersion in water or exposure to rain or snow will conduct heat away from the body very rapidly, up to 25 times more quickly than exposure to air.

10.1.2 Hypothermia

Hypothermia is a condition in which the body loses heat faster than it can produce it. This results in a lowering of the core temperature. Patients are considered hypothermic when their core temperature is below 35 degrees Celsius.

Definitions of Hypothermia

Hypothermia may be classified in different ways depending upon the mechanism of injury or the severity of the condition.

Chronic Hypothermia

Refers to the lowering of the core temperature over several hours. In a chronic hypothermia patient, depressed core temperature is often complicated by other physiological conditions such as severe dehydration, tissue acidosis, electrolyte imbalance and hypoglycemia.

Acute Hypothermia

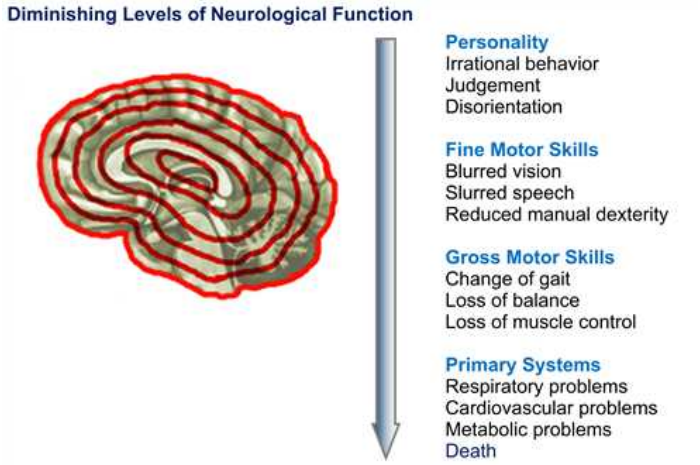
Is the term used to describe a rapid onset of hypothermia, such as sudden exposure to severe cold. Rapid cooling has fewer deleterious effects on body systems than cases of chronic hypothermia and as a result is often associated with positive recoveries.

Immersion Hypothermia

Is a form of acute hypothermia caused by immersion in cold water. With cold water accidents there is the additional risk of drowning. As the body cools, the patient loses control of the extremities, reducing the ability to swim or maintain the head above the water's surface.

Physiological Adaptations to a Cold Environment

The brain is the most sensitive organ to a lowered core temperature. It is designed to function optimally at a temperature of 37 degrees Celsius. If our ability to keep up with heat lost to the environment is impaired and our core temperature falls, various brain functions begin to fail. The first functions affected are our perception of danger, problem solving and judgement.



When the body begins to cool, the following occurs:

- Blood is shunted to the core and away from the periphery and extremities.
- The increased volume of fluid in the core is then removed by the kidneys through urination. Known as cold diuresis, this condition has the effect of decreasing total blood volume and leads to dehydration.
- Individuals may instinctively adopt a fetal position, which minimizes exposure of high heat loss areas to the cold environment. This position is known as the Heat Escape Lessening Position. (HELP)

Levels of Severity

Mild Hypothermia

Signs and Symptoms of Hypothermia		
Normal Temperature Range	37 to 36° Celsius	Shivering may begin
	36 to 35° Celsius	Patient feels cold Goose bumps Inability to perform complex tasks with hands Shivering
Mild Hypothermia	35 to 34° Celsius	Shivering intensifies Lack of muscle coordination Mild confusion but patient may appear alert
	34 to 32° Celsius	Violent shivering Difficulty speaking Sluggish thinking Inability to use hands Stumbling gait Signs of depression Irrational behaviour
Moderate Hypothermia	32 to 30° Celsius	Shivering gradually stops Inability to walk Patient is incoherent Exposed skin may appear blue or puffy Patient may be unable to maintain posture or remain responsive
	30 to 28° Celsius	Muscles become rigid Patient loses ability to rewarm Pulse and respiration are slow
Severe Hypothermia	Below 28° Celsius	Unconsciousness Pulse and respiration may appear non-existent Muscle reflexes cease Heart is at risk of ventricular fibrillation Death may occur before this point

Acute Hypothermia

Hypothermia is considered moderate at core temperatures between 32 and 28 degrees Celsius Mild hypothermia is characterized by violent shivering, poor judgment, uncoordinated movements, fatigue, apathy, depression and uncharacteristic or irrational behaviour.

Moderate to Severe Hypothermia

Hypothermia is considered moderate at core temperatures between 32 and 28 degrees Celsius. Severe when below 28 degrees Celsius. Obtaining an accurate core temperature reading at such low levels requires a low-reading rectal thermometer. Few rescuers, however, carry such specialized equipment in the backcountry and obtaining a rectal reading unnecessarily exposes the patient to the stress of further cold. A patient who is no longer shivering or is unconscious is considered to be moderately to severely hypothermic.

Management of Hypothermia

General Management of Hypothermia

Management of hypothermic patients involves two important steps.

- Reduction of heat loss
- Increase heat gains.

The rescuer must also address other related conditions, such as dehydration, malnutrition, loss of electrolytes, injury or fatigue. Successful hypothermia management is largely based on an accurate assessment of patient history and the mechanism of injury.

Management of Mild Hypothermia

Management of Mild Hypothermia	
PROTECTION	Provide the patient with shelter from the elements, such as the wind, rain and snow.
	Remove wet clothing and replace with lots of dry insulating layers.
	Insulate the patient from the ground. Place the patient in a hypothermia wrap, if necessary.
WARMING UP AND ACTIVATION	Have the patient drink lots of warm sweet fluids if they are available. Warm fruit juices are ideal. Avoid alcohol as it is a diuretic and will dehydrate the patient further.
	Have the patient eat to help supply the internal heat-producing mechanisms that need a constant supply of fuel. Shivering burns this fuel up at an alarming rate.
	If the patient is injured or unable to move, place him or her in a hypothermia wrap. Add heat in the form of hot water bottles placed in high heat loss areas such as the neck, armpits, groin, hands and feet.
	If the patient has adequate supplies of energy stores and fluids, is not exhausted and has adequate insulation, mild exercise will help increase body temperature. Exercise may be delayed until after the patient has spent 45 – 60 minutes in a hypothermia wrap.
MONITORING AND FOLLOW-UP	Monitor for changes in the patient's condition every 15 minutes.
	It is not necessary to evacuate victims in a state of mild hypothermia who are well warmed up and have regained full mental alertness. However, continue to monitor their condition closely.

Management of Moderate to Severe Hypothermia

Management of Moderate to Severe Hypothermia	
PRECAUTIONS AND PROTECTION	Patients with moderate to severe hypothermia must be rewarmed in a medical facility. Focus all your efforts on preventing further heat loss and transporting the victim.
	Protect from further heat loss by replacing wet clothing with dry layers. Place the patient in a hypothermia wrap with heat packs or bottles filled with warm water lined with thin layers of clothing under the arms and over the chest.
	Handle patient very gently and maintain in a horizontal position.
	Minimize movement and do not rub extremities as cold tissue and organs are extremely fragile and easily damaged. In addition, too vigorous activation of the victim could help precipitate a drop in temperature by an influx of cooled blood to the central circulation (After Drop Effect)
	Warmed and humidified oxygen (bag and mask or rescue breaths) can improve or at least inhibit further deterioration in cardiovascular and mental function.
RESUSCITATION	Assess the pulse for a maximum of 10 seconds in an unresponsive patient
	If the pulse is absent or uncertain you should rapidly begin CPR.
	Proceed to the usual BCLS standards otherwise
	At less than 30 degrees central body temperature, defibrillation and the use of vasoactive medications is significantly less effective. It is suggested to attempt up to 3 defibrillations and then continue CPR afterwards. Defibrillation attempts can be resumed once again above 29 degrees.
	Do NOT administer chest compressions to patients who have ice formation in the airway, whose chests are too stiff from cold to receive compressions or who have a core temperature of less than 10 degrees Celsius.
	A victim should not be declared dead until effective resuscitation and body warming has been performed. As the saying goes: no one is dead until warmed up and dead! CPR is therefore continued until the victim is transferred to a healthcare facility.

SPECIAL CONSIDERATIONS IN RESUSCITATION

Management of Moderate to Severe Hypothermia (Continued) SPECIAL CONSIDERATIONS IN RESUSCITATION	
STOPPING / DURATION OF CPR	In hypothermia, many cases of survival without neurological sequelae even after periods of prolonged resuscitation have been reported. However, when evacuation to a hospital is not possible either due to extreme isolation, bad weather, lack of communication, or cannot take place within the next 3 to 4 hours, perform chest compressions for 30 minutes while warming up the victim. If resuscitation is unsuccessful after 30 minutes, it is reasonable to consider the interruption of CPR.

Management of Moderate to Severe Hypothermia (Continued)	
SPECIAL CONSIDERATIONS IN RESUSCITATION	
INTERMITTENT CPR	If CPR cannot be performed continuously while the victim is being transported, consider intermittent CPR: If the body temperature is below 28 degrees or unknown: you can do 5 minutes of CPR for every 5 minutes (or less) that you stop the maneuvers, allowing transport of the patient. If the body temperature is below 20 degrees: You can do 10 minutes of CPR for every 10 minutes (or less) that you stop the maneuvers allowing you to transport the patient.
E.C.M.O.	Organize patient evacuation toward an hospital that can provide ECMO (extracorporeal membrane oxygenation) within 6 hours of the incident. The exception for ECMO are patient with major trauma, unwitnessed cardiac arrest before the hypothermia or any patient buried under the snow in an avalanche for less than 35 minutes, these patients should be transport to the closest facility.
AVALANCHE BURIAL VICTIM	Make sure the premises are safe before proceeding.
	The main causes of death from avalanche burial are asphyxiation, hypothermia and/or trauma.
	Assess the Airway and immediately start artificial respiration if the victim is not breathing.

Complications of Rewarming

It is contraindicated to warm a victim in a state of severe hypothermia on the spot. This is a complex task with many complications associated with it. The problems most often faced by medical staff when treating a severely hypothermic patient include afterdrop, circulatory complications and tissue acidosis. These are all complex situations and best managed in a clinical setting.

Afterdrop

Afterdrop is a condition in which the core temperature continues to decline after treatment has been initiated. Heat is lost from the body's core through a gradient between the warmer core and cooler tissues. As rewarming starts, a return of cold fluids from the periphery to the core will result in further cooling, potentially endangering the heart.

Circulatory Complications

A reopening of the peripheral circulation upon rewarming will result in a drop in blood pressure. This is due to an imbalance between the total circulating blood volume and the size of the vascular bed. The potential for hypovolemic shock upon rewarming in the field is increased with severely hypothermic patients and those with chronic hypothermia.

Tissue Acidosis

Tissue acidosis may accompany rewarming in severe cases. This may result in ventricular fibrillation as the acidic by-products from anaerobic metabolism are returned to the core.

Prevention of Hypothermia

With the exception of accidental injury, most hypothermia situations can be prevented. The best defence against hypothermia is to avoid overexposure and by following these steps:

- Participants should have proper levels of physical conditioning and nutrition prior to and during the trip.
- Participants should be encouraged to eat and drink often and avoid alcohol while on the trip.

- Participants should carry extra warm clothing, a warm hat and raingear.
- Clothes should be layered in layers according to the onion peel principle. The outer layers are removed before sweating, and put back on before cooling.
- Travel should be at the speed of the slowest member in the party and rest should be scheduled often. Watch all members of the party for signs of fatigue.
- Deal with a hypothermia patient as soon as the problem is recognized.
- Know all group members' limitations.
- Carry emergency and survival equipment at all times (see Leader's Essentials (p. 228)).

10.1.3 Frostbite

Frostbite is localized tissue damage caused by exposure to subfreezing temperatures. Frostbite may occur on any part of the body. Fingers, toes, cheeks, chin, nose and ears are the areas most commonly affected. Frostbite may occur on any part of the body. The fingers, toes, cheeks, chin, nose and ears are the most affected areas.

The onset of frostbite involves the sensation of cold followed by pain. As the cold injury progresses, the pain decreases and the area becomes numb. The patient's inability to perceive pain or cold in this area makes it vulnerable to further injury, with a risk of skin freezing. If the skin freezes, it is a frostbite. The risk of frostbite increases greatly with the following factors:

Contributing Factors

- Being under the influence of alcohol.
- A temperature of -15C or lower, with wind chill increasing the risk.
- Psychiatric conditions affecting decision making.
- Sports competitions and extreme adventures with minimalist and/or inadequate equipment.
- Hypothermia.
- Medical conditions affecting vascular flow (e.g. Raynaud's phenomenon).

Prevention of frostbite

The risk of frostbite can be significantly reduced through the following strategies:

- Maintain peripheral perfusion by:
  - Avoid restrictive clothing, jewelry or shoes that compromise circulation.
  - Maintain good hydration.
  - Maintain an adequate caloric intake.
  - Avoid skin contact with metal and volatile liquids such as stove fuel.
  - Allow time for acclimatization (to the cold and the altitude).
- Exercise.
- Protect from cold.
  - Avoid exposure to cold environments.
  - Wear warm layers and avoid overexposing your skin.
  - Recognize frostbite before it becomes more serious.

Evaluation of frostbite

Do not confuse frostbite with superficial frostbite. Superficial frostbite is a superficial lesion caused by non-ice cold. The onset of frostbite can be extremely rapid if the exposed areas of skin tissue are wet and subjected to very cold and windy conditions. The skin is white, numb and cold to the touch, but still soft and flexible. The best way to treat superficial frostbite is to warm it up immediately by direct contact with warm skin. Do not rub or massage the skin or place it near a source of intense heat. The affected area must be protected from further cold. There is no residual damage to the skin.

Field classification

Accurate assessment of frostbite severity is impossible in the field while the room is still frozen. The extent of tissue damage is more accurately assessed after tissue thawing. Tissues that appear severely damaged may recover over time. If possible, evacuate all cases of frostbite to a medical facility for further evaluation and treatment. After spontaneous or formal warm-up, but before imaging, we consider the following assessment:

- SUPERFICIAL TISSUE INJURY: No or minimal anticipated tissue loss, consistent with first and second degree injuries. Non-bleeding blisters may be present.
- DEEP TISSUE INJURY: Anticipated tissue loss, consistent with a third and fourth degree injury. Recognized by the presence of a hemorrhagic vesicle.

The evolution of frostbite injuries after thawing shows the difficulty of the initial clinical assessment.

Blisters and blebs formed immediately after rewarming.

Tissue damage apparent 1 week after rewarming.

Obvious tissue death of all toes 6 weeks after rewarming.

Progression of frostbite lesions after reheating.

Blisters and blebs formed immediately after rewarming.

Tissue damage apparent 1 week after rewarming.

Obvious tissue death of all toes 6 weeks after rewarming.

Signs and symptoms of frostbite

Progression of frostbite lesions after reheating.

INITIAL: Pallor, waxy appearance, blue.

Numbness, paresthesia (pins and needles), cold skin.

After thawing: Pink, red, blue, grey 24 H: Blisters, swelling.

Pain, burning sensation.

48H after thawing: Dark skin areas (bedsores, necrotic tissue).

Generally painless.

Four-level classification

Traditionally, frostbite is classified into four degrees of severity, like burns.

- First-degree frostbite causes numbness, redness and mild swelling.
- Second degree frostbite (partial thickness) causes blisters; clear or milky fluid is present in the blisters, surrounded by redness and edema.
- Third-degree frostbite causes deeper hemorrhagic blisters, indicating that the injury has spread to all layers of the skin.
- Fourth degree frostbite goes completely through the skin and affects the tissues underneath, down to the muscles and bones.

Management of Frostbite

Accurate assessment of the severity of frostbite is impossible in the field while the part is still frozen. The extent of tissue damage is most accurately assessed following tissue thawing. Tissue that appears severely damaged may recover over time. If possible, evacuate all cases of frostbite to a medical facility for further assessment and treatment.

The initial management of frostbite

- Frozen skin should NEVER be heated by direct contact with heat (fires, stoves). No massage or friction!
- Keep your patient warm and treat hypothermia first, if present. Frozen areas should not be reheated until the patient's core temperature has reached 35 degrees Celsius.
- Remove wet clothing, jewelry and restrictive footwear.
- Is the patient more than 2 hours away from a medical center?
  - NO: Protect from further cold injury and evacuate to the nearest medical facility.
  - YES: Consider the reheating protocol.
    - If rapid reheating is not possible, the second best treatment is spontaneous thawing.
  - After rewarming, avoid refreezing and evacuate the patient to the nearest medical facility.
- Protect from cold.

Protocol for Rapid Rewarming

The decision to thaw frozen tissue in the field must be carefully considered. Although frozen tissue is susceptible to mechanical damage, a patient can walk on frozen feet with caution if evacuation is essential. However, the longer the tissue remains frozen, the greater the tissue damage will be. Under appropriate circumstances, the following field warming method is the definitive first step in treating frostbite:

- Field rewarming should be undertaken only if the frozen area can be kept thawed and warm until the victim arrives at final care and if all the necessary conditions described below can be met. The best care will usually be obtained in a medical facility.
- The water should be heated to between 37°C and 39°C, using a thermometer to maintain this temperature. If a thermometer is not available, the water temperature can be determined by placing a caregiver's uninjured hand in the water for at least 30 seconds to confirm that the water temperature is tolerable and will not cause burns.
- The circulation of water around the frozen tissue will help maintain the correct temperature.
- Because the water can cool quickly after the heating process begins, it must be reheated continuously and carefully to the target temperature. If the frozen part is reheated in a pan, the skin should not press against the bottom or sides.
- Warming is complete when the involved area turns red or purple and becomes soft and pliable to the touch. This is usually accomplished in about 30 minutes, but the time varies depending on the extent and depth of the injury.
- Affected fabrics should be allowed to air dry or gently blotted dry (without rubbing) to minimize further damage.
- Follow the usual blister management (see chapter on blister).
- Gently apply 100% Aloe Vera to the injured skin.
- The patient should take 600 mg of ibuprofen twice daily (not used as an analgesic).
- Pain medication is strongly recommended during the procedure. Ideally, you would work with a medical director to administer narcotics.

Ibuprofen is used to inhibit the inflammatory response and minimize the extent of injury and should be started in the field at a dose of 12 mg/kg/day divided twice daily (minimum to inhibit harmful prostaglandins) to a maximum of 2400 mg/day divided 4 times daily.

Spontaneous thawing

Spontaneous thawing consists of letting the metabolism itself warm up the frostbite. This is best accomplished by providing excellent environmental protection, adding a warm water bottle to the hypothermia wrap, and not isolating the frozen body part from the rest of the body.

Evacuation Considerations

- Avoid walking on a frozen lower limb after it has been warmed up in the field.
- Elevate the thawed end if possible.

Raynaud's Phenomenon

This phenomenon is a blood circulation disorder in which exposure to cold or emotional stress abnormally restricts circulation of the extremities, particularly the digits. This decrease in circulation causes the digits to become very white or even bluish. Massaging the affected area helps bring back circulation. Management includes reassuring the patient, protecting his or her hands from cold temperatures and wearing warm gloves to perform work.

10.1.4 Immersion Foot

Immersion foot or trench foot is a non-freezing cold injury associated with prolonged exposure to cool and wet conditions. Injury may occur during long periods of immobility, such as during rafting or kayaking where the feet are immobile for long periods of time. Other factors include constrictive footwear or inactivity with compromised circulation.

Prevention

The risk of dip foot can be significantly reduced through the following strategies:

- Use of appropriate equipment for the activity
- Daily cleaning of the feet with soap and water
- Keep feet dry and warm for at least 8 hours each night if not possible during the day.

Assessment and management of the immersion foot

Signs and symptoms of immersion foot

Early signs:

- Red skin.

Late signs:

- Swollen skin, white or bluish in color.
- Cramp at the foot.
- Loss of sensation.

During the warming up process:

- Stabbing pain, discoloration, blisters and ulceration

Management of Immersion Foot

Caution: the immersion foot is prone to infection.

Manage the submerged foot by following these steps:

- Clean, dry and warm the affected area
- Protect the affected area from further exposure.
- Consult a physician for severe cases.

10.2 Heat Illnesses

Hyperthermia denotes an increase in the body's core temperature. Contrary to core cooling (hypothermia), hyperthermia results when the heat produced or gained is greater than the heat lost. The body's principle cooling mechanisms are largely dependent on adequate blood volume, tissue hydration and blood circulation. Most heat-related problems arise when the body is unable to keep up with fluid loss through sweating.

Factors Contributing to Heat Illness

Several factors contribute to the occurrence of heat illnesses.

High Air Temperature

Air temperatures above 37 degrees Celsius inhibit heat loss in resting individuals.

High Humidity

High humidity inhibits heat loss by slowing the evaporation of sweat.

Physical Activity

Exertion usually causes an increase in core temperature. Physical activity in combination with high humidity and air temperature may increase the body's temperature significantly.

Dehydration

Fluid loss from sweating can easily lead to dehydration and electrolyte depletion if not monitored carefully. Ensure adequate fluid and electrolyte intake while exercising in the heat.

Body Build

Large muscular or obese persons are at greater risk in hot environments.

Clothing

Heavy and dense clothing retains heat. Light clothing is best for hot humid environments. A well-ventilated, open weave hat will also reduce heat gained through radiation.

Failure to Acclimatize

When moving from a cool or temperate climate to a hot one, the body requires seven to ten days to acclimatize before it can make all the internal adjustments to compensate for the change. People who are acclimatized to a hot environment will sweat at a lower temperature, sweat sooner and more profusely to keep their core temperature down. Their perspiration will also contain lower electrolyte levels.

Illness

Any person with a condition that affects thermoregulation will be more susceptible to heat illness.

Drug Interactions

A large number of drugs will increase susceptibility to hyperthermia. Drugs that affect vasodilation, metabolic activity, fluid volume or the thermoregulation centre in the brain may contribute to temperature gain.

10.2.1 Heat-Related Injuries

Heat illnesses occur when the body is unable to dissipate heat. The severity of the illness increases with increasing exposure to the hot environment. Heat emergencies are generally divided into three categories of increasing severity: heat cramps, heat exhaustion and heat stroke.

Heat Cramps

Are muscle spasms caused by strenuous exercise, excessive sweating, muscle dehydration and electrolyte depletion.

Heat Exhaustion

Refers to an initial form of hyperthermia, which is distinguished from heat stroke by a temperature above 37.5 but below 39.5 degrees Celsius and an unimpaired state of consciousness. It occurs in cases of strenuous work or exercise in hot and humid conditions that promote excessive sweating but diminish the effects of cooling through evaporation. The combined loss of fluid and dilated vasculature can also cause blood pressure to drop and can result in shock. Heat exhaustion often results in flu-like symptoms such as headache, general malaise, nausea and vomiting. It may also present the signs and symptoms of shock.

Heat Stroke

Rarer, but it is a life-threatening condition. It is defined as a rise in core temperature to over 39.5 degrees C due to a failure of the cooling system and associated with an altered state of consciousness. It is often accompanied by severe hypovolemia. The excessive increase in body temperature leads to tissue necrosis, which occurs in many organs. Heat stroke may develop quickly while exercising in a hot environment. It may also develop more slowly and without the trigger of exercise in people who are elderly or have a medical condition that inhibits adaptation to a hot environment. Untreated heat stroke is always fatal.

Assessment and Management of Heat-Related Disorders.

Assessment and Management of Heat-Related Disorders.		
	Assessment	**Management**
Heat Cramps	Cramps in working muscles	Reduce activity and cool off Replace fluids and electrolytes Gently stretch, ice and massage muscles

Assessment and Management of Heat-Related Disorders.		
Heat Exhaustion	Headache Dizziness Nausea, vomiting Early signs of shock Temperature: slightly elevated Pulse: slightly increased Respiration: slightly increased Skin: pale, cool, moist	Remove patient from sun Have patient lie down in a cool place Remove extra layers of clothing Wet or immerse patient in cool water to increase evaporation If no nausea, replace lost body fluids and electrolytes Evacuate if no improvement or symptoms worsen
Heat Stroke	Headache Skin: pale, cool, moist Elevated body temperature Disoriented, confused, combative Hallucinating Unresponsive Advanced stages of shock Convulsions	Remove from heat Remove clothing Immediately cool the victim by immersing him/her in an ice bath or the nearest ice bath. Where possible give oxygen Do NOT force fluid intake Do NOT treat with drugs Cool the victim before transporting to bring the temperature below 39 degrees C in less than 30 minutes. Evacuate the victim to a hospital.

10.2.2 Dehydration

Dehydration is a state in which fluid loss is greater than fluid intake. Dehydration is a major concern in remote settings. High altitudes, for instance, are known to provoke temporary diuresis, which can lead to dehydration if not checked with adequate fluid intake. In warm humid climates, prolonged heavy exertion can increase normal fluid loss through perspiration and breathing by as much as 2 litres an hour, while the rate at which water can be absorbed through oral consumption is approximately 1 litre per hour. Diseases such as gastroenteritis and diabetic coma can also cause dehydration (see Medical emergencies (p. 200)).

Dehydration can be mild, moderate or severe. Mild to moderate dehydration (2-5%) has been shown to be relatively well tolerated and not to have a major impact on performance. Once this limit is exceeded, however, dehydration can lead to more serious consequences. Severe dehydration can lead to shock and even be fatal. Consequently, emergency administration of intravenous fluids may be required.

The best indication of adequate tissue hydration is clear and copious urine output.

Signs of Dehydration

- Headache
- Fatigue and feeling cold
- Apathy and depression
- Confusion and poor judgment
- Lack of thirst and appetite
- Low urine output – usually dark yellow or orange in colour
- Constipation
- Decreased skin elasticity or turgor
- Dry mucous membranes
- Decreasing blood pressure
- Altered level of consciousness

Rehydration

Prevention of dehydration is best achieved by ensuring adequate fluid intake over the duration of any activity. Schedule rehydration stops every 20 – 30 minutes. Drinking small amounts (150 – 250 ml) at frequent intervals helps to maintain reasonable hydration without excessive gastric filling.

Oral Rehydration Solutions (ORS)

In general, any significant loss of body fluid can cause electrolyte imbalance. For this reason, electrolyte replacement may be recommended and in severe cases becomes essential. Oral rehydration solutions were originally developed by the World Health Organization (WHO) to combat the dehydrating effects of severe diarrhea. They are now available commercially for wider use.

Circumstances Requiring Oral Rehydration Solutions

- Severe diarrhea or vomiting
- Treatment of mild to moderate heat illness
- Heavy, prolonged exercise with high-volume sweat loss
- Injury with significant blood loss or fluid loss from burns

ORS Ingredients

Commercial oral rehydration solutions such as Gastrolyte® and Hydralyte® contain sodium, potassium chloride, citrate and glucose. Home solutions can be as effective, however. The following homemade preparation can be made with little difficulty.

Home Rehydration Preparation

Add to one litre of disinfected water

- ½ teaspoon of baking soda
- 1 teaspoon salt
- 8 teaspoons of sugar

In wilderness settings, baking soda may not be available.

A solution of 4 tsp. of sugar and 1/2 tsp. salt per litre of water is also adequate.

The home-made fluid must contain both sugar and salt in the appropriate proportions. Liquids without both should be avoided. Appropriate prepared drinks include salted yogurt drinks and salted vegetable and chicken soups. Drinks to be avoided include soft drinks, high carbohydrate sports drinks, sweetened juices, sweetened teas and coffees since their high sugar content does not provide the appropriate proportions of sugar to salt. These drinks should therefore be avoided.

For adults, an ORS should be administered at a rate of 250 ml (8 oz) every 30 minutes for the first 4-6 hour period and repeated until signs of dehydration disappear. Children should drink 200-250 ml (6-8 oz) of ORS per hour and as much water as they want.

10.3 Lightning Injuries

Lightning is an electrical discharge in the atmosphere that generally occurs during a thunder storm. It is thought to result from the forced separation of positively and negatively charged ice particles within clouds. A positive charge develops at the top of the cloud, while a negative charge accumulates on the bottom of the cloud. When a sufficiently strong electrical field is formed, a discharge in the form of lightning reaches out to equalize the difference.

10.3.1 Cloud-to-Cloud Lightning and Cloud-to-Ground Lightning

Approximately 90 percent of all lightning strikes occur within or between clouds. That's why they're called lightning between clouds, or diffuse lightning. In general, they are not dangerous to people on the ground. The remaining 10 percent of lightning strikes are cloud-to-ground, such as fork and bolt lightning. These can be extremely dangerous.

Facts about Lightning

- A lightning strike delivers a massive electrical current in a fraction of a millisecond.
- The current in a lightning bolt can reach 300,000 amperes while its force may exceed 2 billion volts.
- Lightning bolts may reach several kilometres ahead of a lightning storm.
- Lightning flows downhill, like water, seeking the path of least resistance to the ground.
- Lightning bolts are unpredictable and may strike randomly.

Types of Lightning Injuries

Lightning can injure an individual in a number of ways:

- Through a direct strike
- Through contact with another object that is struck
- Through a splash of current from another body or object
- Through contact with the ground when the lightning has struck nearby (almost 50 percent of all cases)
- Through trauma caused by being thrown in the blast

10.3.2 Problems Associated with Lightning Strikes

Despite their extreme brevity, lightning strikes can cause serious and sometimes permanent injuries that are not always immediately apparent.

Management of Lightning Injuries

Apply resuscitation techniques to any victim who does not have a pulse or is not breathing (see Basic Life Support (p. 239)). The incidence of spontaneous recovery with lightning strike patients is very high.

Proceed with a full patient assessment, including a complete a neurological exam.

Manage all injuries as they are found and monitor patients carefully.

Treat patients for shock.

Evacuate all patients to a medical facility for examination of possible unsuspected complications.

Cardiopulmonary Failure

Close to 30 percent of all lightning strikes are fatal. The primary cause of death is cardiac arrest. The electrical charge sustained by a patient struck by lightning can cause a dissociation of the electrochemical activity of the heart causing it to stop altogether. The strike can also paralyze the respiratory centre in the brain, which if untreated will result in a secondary hypoxic cardiac arrest. Without immediate CPR, a lightning patient will die from lack of oxygen.

Neurological Disorders

Approximately 70 percent of lightning strike patients become unconscious. Transient amnesia, confusion and paralysis are also common. Bleeding in or around the brain can result from a direct lightning strike, with the risk of more permanent damage.

Burns

Deep burns are uncommon because of the brevity of the strike. Superficial burns may produce a linear or feathered pattern as electrons flow down the path of least resistance along the skin. Thermal burns resulting from heated clothing and metal objects are usually more serious.

Traumatic Injuries

Blunt trauma can result from being thrown by the blast. Traumatic injuries resulting from the explosive force of rapidly expanding air may include ruptures to eyes, ear drums, lungs, capillaries and soft tissues.

10.3.3 Prevention of Lightning Injuries

- Be aware of weather patterns and the potential for lightning in the areas you are travelling through.
- Get to a safe location before a storm reaches you.
- Avoid dangerous areas such as bodies of water, high and/or open places, tall objects, metal objects, low and damp places, tree roots, shallow caves.
- Minimize contact with the ground. Sit in a ball on an insulating layer such as a pack or sleeping pad.
- While keeping eye contact, spread group out to minimize the damage should a strike occur nearby.
- Beware of falling trees.
- Remove any metal objects from the body. While they do not attract lightning, they become extremely hot and can cause severe burns.

10.4 Bites and Stings

10.4.1 Mammal Bites

Domestic dog bites occur frequently across Canada. Wild animal attacks, on the other hand, are relatively rare. The most frequently cited wild animals in these incidents are bears and cougars. Few animals attack people without some form of provocation. The only exceptions to this rule are large carnivores and rabid animals (see Rabies (p. 185)).

Animal bites have a higher incidence in children. In this population, bites are more likely to be found on the face, particularly on the lips, nose and cheeks. If a child is bitten on the neck, face or head, consider immobilizing the patient's cervical spine because of the associated risk of cervical fracture. Limit children's risk of animal bites by teaching them not to use provocative behaviors with animals such as pulling their tails or playing too close to their faces.

Assessment of Mammal Bites

Mammal bites can result in penetrating wounds or blunt wounds, including contusions, crush injuries or extensive tissue damage.

With blunt injuries, such as from the bite of a large herbivore, the tissue, nerves and vessels beneath the skin may be severely crushed or damaged.

In deep penetrating injuries, such as from dog or wild cat bites, the lacerations are rarely clean and the surrounding tissue is often crushed and devitalized. This greatly increases the risk of infection.

Management of Blunt Bite Injuries

- Apply ice.
- In cases of extensive tissue damage, seek medical help.

Management of Penetrating Bite Injuries

- Assess the extent of bleeding and judge whether bleeding control should be applied. When this one is mastered, move on to the next step.
- Using clean water, irrigate the wound with a stream strong enough to dislodge bacteria and debris. However, be careful not to damage the tissue. Use a syringe of at least 10 mL if possible; if not, refer to the chapter on Wound Management for other irrigation methods. The water you use must be safe to drink: either boiled, filtered or treated.
- If possible, use a 1 percent povidone-iodine solution. It is an effective bactericidal agent and is not damaging to tissue at such a low concentration. The required contact time is at least 2 minutes. Do NOT use other antiseptic solutions as they are toxic to tissue. Soapy water can also be used to irrigate the wound, but it is important to rinse with non-soapy water afterwards.
- Do not swab the wound itself unless the wound is very contaminated or treatment has been delayed. If you need to apply the solution to the wound to dislodge contaminants, use a sterile compress.
- You can apply a topical antiseptic to abrasions and cuts.
- In general, it is not recommended to close a bite wound due to the high risk of infection. However, some wounds on the face, ears, lips and scalp can be closed with steri-trips or skin glue due to the potential cosmetic damage and their lower propensity to become infected. Cat bites, on the other hand, are very prone to infection and should not be completely closed in the first instance. (if the wound is very large, it is still suggested to reapproximate the edges without completely closing it).
- Cover the wound with a sterile dressing.

- Ask the patient if he or she has been immunized against tetanus within the last ten years. If not, recommend the patient receive an inoculation as soon as possible.
- Evacuate to a medical facility for follow-up care.
- For the majority of bite wounds, prophylactic antibiotic therapy (prevention) should be started as soon as possible.

Rabies

Rabies is a viral infection that is generally transmitted through the saliva of an infected animal, most often by a bite. Non-bite routes of transmission include scratching and contact of an existing wound with saliva or spinal fluid. It can occur in any warm-blooded animal, domestic or wild.

The majority of rabies cases in Canada are associated with bat transmission.

Once in its host, the virus travels from the peripheral nerves to the central nervous system. Sooner or later it reaches the brain, where it causes acute encephalitis, or inflammation of brain tissue. From inoculation of the virus until the first symptoms appear, the incubation period usually ranges from 20 to 60 days. In some cases, depending on the severity of the injury and the proximity of the injury to the nerve pathways and brain, among other factors, it may take years for symptoms to develop. Symptoms do not appear until the virus has reached the central nervous system. Headache, fatigue, malaise, irritability and fever are among the first symptoms. Late symptoms include acute pain, seizures, hallucinations, paralysis and coma. Death usually occurs within days of the onset of symptoms. If not treated before the virus reaches the central nervous system, rabies is always fatal.

Rabies is rare in North America and Europe where strict controls have been in place.

In Canada, there have been 24 deaths from rabies since 1925, 12 of which were in Quebec. However, worldwide, rabies kills approximately 60,000 people per year. These are mostly related to dog bites in Asia and Africa.

Vaccination is recommended, however, for people with a high risk of contact with potentially rabid animals. These include veterinarians, animal control and wildlife workers, people hunting and trapping in high-risk areas, cave explorers and travellers to rabies-endemic areas and countries where there is limited access to adequate and safe post-exposure prophylaxis. Two vaccines against rabies are currently approved for use in Canada: Imovax® Rabies and RabAvert®. The vaccines are very effective and provide immunity to rabies when administered for protection either before or after exposure.

The patient receives almost complete protection from the virus if the wound is appropriately cleaned within the first 3 hours of the bite. Mortality rates increase rapidly in cases where the wound is not cleaned within the first 24 hours.

Management

- Gently irrigate and swab the wound with clean water and hand soap.
- Do not use alcohol-based or antiseptic agents as these destroy tissue and increase the risk of tissue infection.
- Scrub to the depths of the puncture wounds, being careful to limit tissue damage.
- Vigorously scrub around the wound and nearby scratches with an antiseptic solution.
- Evacuate to a medical facility.
- Do not touch or handle a rabid animal with your bare hands.
- Report the incident to the police, local veterinarians, local district office of the Canadian Food Inspection Agency or municipal animal control officials.

10.4.2 Snake Bites

The most commonly encountered venomous snakes belong to one of two categories. Crotalidae (or Crotalinae) are pit vipers found primarily in Asia and the Americas. Elapidae mainly inhabit tropical and subtropical regions. They include coral snakes, thamnophis (snakes), flat-tailed snakes and cobras.

Crotalidae or Pit Vipers

The only venomous snakes in Canada are rattlesnakes.

Crotalidae (or Crotalinae) are pit vipers found primarily in Asia and the Americas. Elapidae mainly inhabit tropical and subtropical regions. They include coral snakes, thamnophis (snakes), flat-tailed snakes and cobras.

They belong to the Crotalid subfamily and include the massasauga rattlesnake and the western rattlesnake. Rattlesnakes feed mainly on small warm-blooded animals (birds and rodents). They locate the exact location of their prey, even in the dark, thanks to a sensory dimple, placed under the eye, which detects heat. They rarely bite humans, unless provoked or accidentally stepped on. Their bites can be either venomous or "dry" (containing no venom). The venom is primarily a hemotoxin, affecting blood tissues. Within 15 minutes most envenoming bites are recognizable by the development of discolouration, local swelling and pain at the bite site. Once it spreads through the blood, the venom can cause painful swelling, muscular paralysis and tissue death. Rattlesnake bites rarely kill adults, but may kill small children.

Elapidae

The most venomous snakes in the world tend to belong to the Elapid family. Elapid venom is primarily a neurotoxin, affecting the central nervous system. The bite produces little or no pain and minimal local swelling or tissue death. Once the venom spreads, however, it causes profound systemic reactions, such as neuromuscular paralysis.

When travelling internationally, research the area to know more about the types of snakes and other hazardous wildlife you may encounter.

Management of Snakebites

Management of all snake bites is largely the same. Anything that reduces circulation and the absorption of the snake venom will be helpful.

Management

- Keep the patient calm and quiet. Stop all activity. Movement increases blood flow and the spread of the venom through the body.
- Remove any constricting jewelry near the bite (there will be swelling).
- Wash the area well with soap and water.
- Apply pressure immobilization technique: Tightly wrap a bandage around the entire length of the bitten extremity to immobilize the limb and slow lymph flow and the dissemination of the venom.
- Keep the affected extremity below the level of the heart.
- Treat as a soft tissue injury.
- Evacuate ASAP.
- If swelling appears around the wound, trace the outline of the swelling every 15 minutes to monitor its progression.
- Systemic reaction may be delayed several hours.

- Unless symptoms are severe, the patient can walk out (generally much faster than a carry), although it is recommended to walk as little as possible so as not to increase circulation too much.
- Do NOT attempt to capture or kill the snake. However, if you are able to take a picture of the snake, it can help with treatment in a hospital setting.
- Do NOT use a tourniquet.
- Do NOT use ASA.
- DO NOT apply ice to the wound. Do not immerse the bite in water. Do not try to suck on it.

10.4.3 Arachnid Bites and Arachnid-Borne Diseases

Arachnids are terrestrial eight-legged invertebrate animals that include spiders, scorpions and ticks. Unlike insects, they have no antennae and no wings.

Spiders

Most spiders found in North America have fangs that are too small or too weak to puncture human skin. They also rarely bite unless cornered or tangled in clothes.

Spider Bite Assessment

Although often painless at first, spider bites can become very painful within hours of the bite.

Two spiders that are considered a health risk in Canada and the United States are the brown recluse and the black widow.

The brown recluse

Is light brown in colour and has a violin-shaped marking on the upper mid-portion of its body. It tends to be active at night rather than during the day.

Assessment

- The bite of the brown recluse can cause necrosis of the skin and soft tissue around the bite site in 40% of cases. These wounds can take months to heal and leave significant scarring in 13% of cases. Systemic reaction to venom is rare. If it occurs, symptoms may include nausea, vomiting and muscle cramps.

The black widow

has a shiny black body with a red hourglass-shaped marking on its abdomen. Only the female black widow is poisonous.

Assessment

- The venom from the black widow, on the other hand, is neurotoxic and can cause muscle cramps, fatigue, dizziness, headaches, nausea, vomiting and heavy sweating. The site of the bite can become mildly inflamed, red and itchy. Muscle pain and spasms may occur within the first hour after the bite and may mimic a myocardial infarction.
- Symptoms usually subside within 48 to 72 hours.
- In extremely rare cases, particularly in young children, the elderly or people with weakened immune systems, black widow spider bites can be fatal.

Scorpions

Scorpions are easy recognizable by their characteristic pincers and long segmented tail with a stinger. They live in all sorts of habitats, rainforests and deserts, beaches and mountaintops. In North America, they can be found throughout Mexico, the western United States and in south-western Canada, especially southern Alberta. They are nocturnal creatures and their prey is primarily insects. Scorpions watch for their prey rather than chase it away. Most scorpion bites occur when they are accidentally crushed.

In the United States, the most dangerous scorpion species is the Centruroides sculpturatus (in English Arizona Bark Scorpion). This species is found in Arizona and parts of Texas, New Mexico, California, Nevada and northern Mexico. The bite of this scorpion causes mainly neuromuscular effects, which can even be accompanied in the most severe cases by respiratory distress. The "tap test" can confirm a bite of this scorpion. This test consists of gently tapping the bite site while the person is distracted. If this simple touch greatly exacerbates the pain, the test is positive.

Scorpion Bite Assessment

North American scorpion bites are almost never fatal. Most stings to humans occur on the hands and feet. The sensation of a scorpion bite is reminiscent of a bee sting. These bites can cause mild inflammation, redness and itching.

Management and prevention of spider and scorpion bites

The treatment is basically the same for all spider and scorpion bites.

Management

- Clean and disinfect scorpion and spider bites.
- Apply a cold compress to relieve pain.
- Make sure the victim is well hydrated and receiving pain medication as needed.
- Ask the patient if he or she has been immunized against tetanus within the last ten years. If not, recommend the patient receive an inoculation as soon as possible.
- If systemic symptoms develop, monitor ABCs and evacuate.

Prevention when in an environment known to have harmful arachnids

- Shake out boots, shoes and clothes before putting them on.
- Keep tents zipped up at night.
- Wear gloves when handling firewood and rocks or removing items stored in unused corners or closets.

Ticks and Lyme Disease

Lyme disease is a serious illness that can develop into debilitating arthritis and nervous system abnormalities. It is caused by Borrelia burgdorferi, a spirochete bacteria that is carried by ticks of the genus Ixodes. In Europe and Asia, it can be caused by other Borrelia species.

The tick looks like a small spider. It has four pairs of legs, no wings and no antennae. It can remain attached to the skin for more than 24 hours.

In central and eastern Canada and the United States, it is the blacklegged tick Ixodes scapularis, also known as the deer tick, that transmits Borrelia bacteria to humans. On the west coast of Canada and the United States, it is the Ixodes pacificus tick. The most affected provinces in Canada are Ontario, Nova Scotia and Quebec. The Eastern Townships is the most affected region in the province of Quebec. In the United States, the most affected states are in the northeast and midwest. Since 2011, the number of cases of Lyme disease has increased significantly in Quebec. This can be partly explained by the warmer winters, which lead to a lower mortality in the tick population. Between 5 and 25 percent of these ticks are infected with the disease according to a 2015 study.According to UpToDate, the risk of contracting Lyme disease after a bite

from a tick with unknown infection status is between 1.2 and 1.4%.

Ticks invade their animal host by climbing on grasses and shrubs. From there they then reach humans and animals that graze this vegetation. Ticks may be carried by pets. However, there is no evidence that pet owners are at a higher risk of infection.

Most often, ticks transmit Lyme disease to humans when they are in the nymph stage. Because they are still relatively small (less than 2 mm, or the size of the dot at the end of this sentence), they often go unnoticed. Ticks usually have to feed for 2 days in order to transmit the disease. Adult ticks can also infect humans with Lyme disease. However, due to their larger size they are likely to be spotted and removed within a few hours.

To transmit infection, the carrier tick must remain attached to the host for at least 24-36 hours. It should be removed as soon as it is detected.

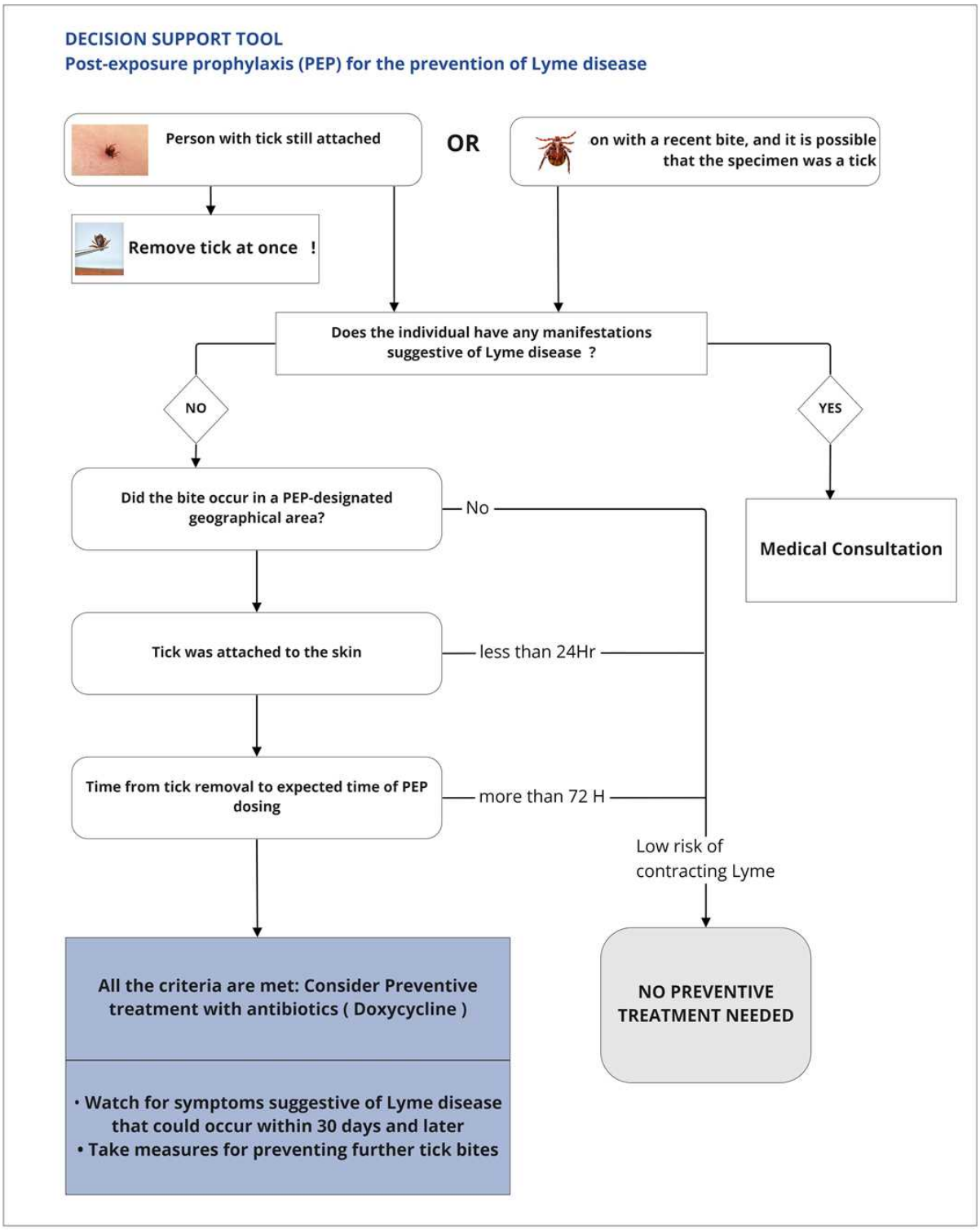
Assessment

- Fatigue
- Chills and fever
- Headache
- Muscle and joint pain
- Swollen lymph nodes
- A distinctive red circular rash, known as erythema migrans, appearing between one day and one month after the bite The plate can be isolated or there can be several. This is often the first sign of Lyme disease and is present in 70 to 80% of people with Lyme disease.
- Neurological problems (up to six months after the sting): facial paralysis, numbness in the face, deafness, double vision, weakness, loss of sensation, loss of certain reflexes, photophobia, nuchal stiffness, nausea and vomiting, etc.
- Heart problems (up to six months after the injection): chest pain, palpitations, dyspnea, syncope, dizziness.
- Arthritis (up to one year after the injection): especially in the knee.

Tick Removal and Wound Management

- Inspect body thoroughly.
- Grab the tick as close to the skin as possible with tweezers or a tick puller. Avoid using your fingers or nails. Also avoid squeezing the tick's abdomen.
- Gently pull straight back with constant pressure to avoid crushing.
- If the head of the tick remains implanted in the skin, you can remove it in a second step.
- Place the tick in a container and record the date and location of the bite.
- Disinfect the bite site with soap and water.
- Call your local public health unit or call center as preventive treatment may be recommended depending on where you were bitten, how long the tick stayed on the skin and how long it took from the bite to when you were supposed to take preventive treatment.
- Watch for signs of infection in 30 days or more. If you have symptoms of Lyme disease, see your doctor, a walk-in clinic or a public health clinic.

Decision support if preventive treatment is needed (Post Exposure Prophylaxis/PPE):



Prevention

- Avoid tick-infested areas, especially in May, June and July.
- Wear light-coloured clothing so that ticks can be readily spotted. Tuck and tape pant legs into socks.

- Apply insect repellent containing DEET to exposed skin, and treat clothing with permethrin. Permethrin kills ticks on contact with treated clothing.
- Walk in the centre of trails to avoid overhanging grass and brush.
- At the end of the outing, remove clothing, wash and dry in high heat.

Children aged 5-9 years are the age group (along with 55-59 years) with the highest incidence of Lyme disease cases, likely due to the amount of time spent playing outdoors. It is therefore especially important to dress them in long clothing, teach them to stay on the trails and check their skin for ticks at least once a day if they are in a high risk area.

10.4.4 Insect-Borne Diseases

West Nile Virus

West Nile virus is a virus transmitted to people principally through the bite of an infected mosquito. The mosquitoes themselves become infected by feeding on the blood of birds carrying the virus. Symptoms of infection include flu-like symptoms such as headache, muscle aches and fever. Mild redness and swelling of the lymph glands may also occur. The virus may also cause severe illness, such as meningitis (inflammation of the lining of the brain and spinal cord), encephalitis (inflammation of the brain itself) or acute flaccid paralysis (a polio-like syndrome with loss of function of one or more limbs).

West Nile virus has been encountered on every continent and since 1999 in much of North America as well. West Nile virus season occurs between May and October. Symptoms usually appear between 2 days and 2 weeks after infection and generally have a rapid onset. People with weakened immune systems, chronic illnesses (such as diabetes, cancer or heart disease) or who are elderly are more likely to have the most severe symptoms.

Assessment Signs and Symptoms

- Severe headache
- High fever
- Stiff neck
- Nausea and/or vomiting
- Difficulty swallowing
- Drowsiness
- Confusion
- Loss of consciousness
- Lack of coordination and muscle weakness
- Paralysis
- Movement disorders
- Muscle degeneration

Management

Anyone who has a sudden onset of these symptoms should seek immediate medical attention. The most accurate way to diagnose West Nile virus infection is through a blood test. Most cases resolve with appropriate hospital care.

10.4.5 Insect Repellents

Insect bites are extremely common in the wilderness in North America, and there are many types of protection available. Once applied, insect repellents surround the application site with a vapour that deters insects. Because wind, rain, time and perspiration reduce the size of the vapour barrier, reapplication is necessary.

Topical Repellents

The most effective topical insect repellents contain DEET (N,N-Diethyl-meta-Toluamide). DEET-based insect repellents are effective against mosquitoes, ticks, chiggers, fleas and flies. Traditionally, it was thought that the greater the concentration of DEET, the longer its repellent properties lasted. However, newer formulations have been produced that are as effective in lower concentrations and have a decreased risk of adverse effects.

DEET is absorbed slowly through the skin. Studies have shown that up to 10 to 15 percent of each dose is eliminated in the urine. Toxic and allergic reactions have been reported to cause hives, contact dermatitis and, in rare cases, damage to the nervous system.

Children should not be exposed to concentrations of DEET greater than 10 percent no more than once a day for those under two years of age and no more than three times a day for those under 12 years of age, and DEET should not be used on infants under six months of age.

If DEET is to be applied with sunscreen, apply the sunscreen first and then the DEET so as not to interfere with the effectiveness of the sunscreen. Avoid products that combine sunscreen and DEET.

Icaridine (e.g. Skin So Soft products) has a similar efficacy to DEET and has the advantage of not interfering with the sunscreen. Icaridine should also not be used in children under six months of age. Other products recommended by Health Canada include permethrin, soybean oil, metofluthrin, hydrated and clyclized lemon eucalyptus oil and insect repellents containing a mixture of lemon, eucalyptus, pine needle, geranium and camphor essential oils.

Natural products such as citronella may repel mosquitoes, but are not very effective as protection against insect bites. In addition, they have a short duration of action. For these reasons, they are not recommended by Health Canada.

Clothing Repellents

Impregnating clothing and sleeping materials with an insecticide is an effective insect repellent strategy. Permethrin, the active ingredient in most flee sprays used for pets and livestock, is now commercially available. It is also possible to buy clothes already inhibited with permethrin. 1aThe effect of the insecticide applied directly to the fabric lasts up to one year even after repeated washing. Permethrin is toxic to insects but is poorly absorbed by mammals. Adverse reactions are rare. Permethrin-inhibited garments are not recommended for children 16 years of age and younger.

Extreme Conditions

The most effective bug protection is a combination of topical repellents and permethrin-impregnated clothing. Long-sleeved shirts with a hood in combination with “quick-dry” pants make a very effective bug barrier.

Special bug clothing is another alternative to chemical deterrents. Jackets and pants, however, should be made of mesh material fine enough to prevent burns from penetrating. For better protection, fabrics and net fabrics can be treated with permethrin. A sleeping net is crucial protection in some tropical regions.

10.5 Submersion Accidents

Submersion accidents are accidents in the water, where the risk of asphyxiation and drowning is high. Drowning involves an irreversible sequence of events.

- Asphyxia – inadequate intake of oxygen into the lungs
- Hypoxia – insufficient oxygen levels in body tissues
- Respiratory arrest
- Cardiac arrest
- Biological death

The drowning process begins with the victim's airway being submerged below the surface of the water. While victims initially attempt to hold their breath and may reflexively swallow large amounts of water, relatively little water aspiration occurs in the initial phase of a drowning.

It was long believed that a significant percentage of drowning victims suffered from prolonged laryngospasm, resulting in the proverbial "dry drowning," but a number of studies have disproved this notion. A study of 598 autopsied drowning victims found water in the lungs of 98.6% of the victims. The few victims found without significant amounts of water in their lungs were considered dead, and therefore without respiratory effort, at the time of immersion.

The progressive decrease of the oxygen level as well as the progressive increase of the CO2 level eventually leads to a reflex breathing by the respiratory control centers which results in the aspiration of water into the lungs.

Water that enters the lungs, whether salty or not, disrupts pulmonary ventilation by altering the function of the alveoli through various mechanisms. Contact with fresh water is more irritating and causes the alveoli to collapse, while salt water causes fluid to accumulate in the alveoli. The result in both cases is an inability to oxygenate the blood.

10.5.1 Types of Drowning

According to the World Health Organization (WHO):

- Drowning is the third leading cause of unintentional injury death worldwide and accounts for 7% of all injury deaths.
- Children, males and people who are in frequent contact with water are at the greatest risk of drowning.
- Drowning is defined as the process of impaired respiratory function resulting from submersion/immersion in a liquid.

In the past, drowning was classified as aspiration, non-aspiration, near-drowning or secondary drowning.

We now speak of non-fatal drowning WITHOUT sequelae, non-fatal drowning WITH sequelae, or fatal drowning. It may take several hours or even days to definitively classify the type of drowning, as complications may arise later.

Drowning can also be classified as hot water (>20°C) or cold water (<20°C). Although the sequelae and management of each may vary somewhat depending on the salinity level of the water at the time of drowning, the presence of saltwater versus freshwater makes little difference in the prehospital management of the drowning victim.

Submergence is defined as when the victim's entire body, including the respiratory tract, is completely covered by water, while during immersion, only part of the body is underwater.

Dry Drowning

A dry drowning is a fatal submersion accident in which the victim died of asphyxiation, but no water was found to have entered the lungs. This can be due to the body’s position in the water or laryngospasm. Laryngospasm is a reflex closure of the larynx (reflex breath-holding) that frequently occurs when a person involuntarily aspirates water.

Wet Drowning

The term wet drowning is used when water was found to have entered the lungs of the drowning victim.

10.5.2 Factors Influencing the chance of Surviving a Drowning

The chance of surviving a drowning incident depends upon many factors.

Duration of the flooding

The shorter the submergence, the better the chances of survival. In exceptional circumstances, some patients have survived episodes of prolonged submersion.

Water Temperature

The colder the water, the better the chances of recovery. Cold water slows the speed of metabolism and reduces the body's oxygen consumption. Hypothermia has been isolated as the prime factor contributing to recovery after long periods of submersion.

Condition of Patient

The younger and fitter the patient, the better are the chances of survival.

Quality of the Water

The chance of developing pneumonia and pulmonary edema (secondary drowning) increases with the aspiration of contaminated water. There is no significant physiological difference or difference in the rate of mortality in patients who have drowned in fresh or salt water.

Quality of Care

The most important element in managing a drowning patient is the quality of the first aid and medical care provided.

10.5.3 Management of a Patient in an Aquatic Emergency

Management of aquatic emergencies follows the same basic principles applied to any medical emergency. An important variable to the rescuer, however, is the hazardous aquatic environment. Remove the victim from the water as soon as possible. Once the environment is stabilized, the basic principles of emergency care are followed.

Management

- Remove the patient from the water and place on a firm flat surface.
- Open the airway and check respiration. If the patient is not breathing, give 2 rescue breaths that make the chest visibly rise.
- After 2 effective breaths, begin chest thrusts (chest compressions) according to the cycles recommended in the guidelines for immediate resuscitation care (see Adult CPR (p. 240)).
- Do not attempt to remove water from the airway or perform abdominal thrusts.
- Hypothermia may increase the patient's chance of survival by lowering metabolic activity and the demand for oxygen. Pulse and respiration may need to be assessed for as long as one minute in severe hypothermic patients.
- Once the patient is breathing and has a pulse, treat for shock.
- Handle with care. Unnecessary movement of the patient may precipitate a fatal arrhythmia.
- Oxygen should be administered as soon as it is available.
- Obtain a history, if possible, that might indicate other injuries.

- Monitor patients closely for complications and signs of developing pneumonia or pulmonary edema long after they are breathing again.
- Evacuate.

10.5.4 Water Rescue

Safe access to a drowning patient is often the most significant challenge facing rescuers. Primary consideration must be given to the safety of the rescuers at all times. Environments that include strong winds or moving water will make the rescue efforts more dangerous and increase the time required to get the patient to a stable environment where resuscitation efforts may be started.

Rescuer's Personal Safety Checklist

The Ladder Approach has long been used by aquatic rescuers as a means to judge personal risk in a rescue situation. Under this approach, the rescuer always applies the least risky rescue technique first. Only when it becomes absolutely necessary do they move on to the next technique, which is more dangerous than the previous one.

- Talk – Try talking to the person to see if he can help himself.
- Throw – Throw an aid to the person.
- Reach – Reach out to the person with an aid.
- Wade – Wade into the water to provide the person with an aid.
- Row – Row out to the person and help her into your boat or provide her with an aid.
- Swim – Swim to the person and provide him with an aid.
- Tow – Swim out to the person and tow her back to safety using an aid.
- Carry – Physically carry the person from danger.

Priorities of water rescue safety

Call out to patient to attract his attention. Reach out with an aid or throw a rope.

Use direct contact only as a last resort.

10.6 Water Disinfection

All wilderness surface water carries the risk of illness. Water-borne enteric (or gastroenterological) pathogens exist in various microorganic forms.

Bacterial	Escherichia coli Salmonella Shigella
Viral	Hepatitis A, Hepatitis E
Protozoan	Giardia Lamblia Entamoeba histolytica Cryptosporidium
Parasitic	Taenia (Tapeworms) Ancylostoma duodenale (Hookworms)

Many water-borne bacteria and viruses can cause serious illness. In North America, the protozoan parasite Giardia Lamblia, the cause of giardiasis, is the most common contaminant in wilderness water.

There are currently many systems and techniques available for rendering water safe for drinking. Each has advantages and disadvantages. The choice of water-treatment technique will depend on the number of people in the group, space and weight accommodations, the quality of the source water, personal taste preferences and fuel availability. Optimal protection may require combining two or more techniques.

10.6.1 Water Disinfection Techniques

Clarification or pre-treatment techniques prepare water for purification or disinfection.

Purification removes chemicals, metals and biological contaminants from water, but not the tiniest pathogens, such as viruses.

Disinfection removes or destroys all water-borne pathogens.

Post-treatment techniques make chemically treated water more palatable.

10.6.2 Clarification Techniques

Clarification, or pre-treatment techniques, refers to the preparation of water for disinfection. The purpose of this step is to remove any sediment from the water that may later interfere with the disinfection process itself. The following techniques work well in remote settings.

Sedimentation

Sedimentation is the separation of suspended particles that are large enough to settle rapidly by gravity (such as sand and silt). Water must be allowed to sit undisturbed for approximately 1 hour or until the sediment has formed on the bottom of the container. The non-turbid water can then be decanted, i.e. separated from the sediment at the top of the container, and then purified or disinfected. Microorganisms also eventually settle, but the process takes much longer.

Coagulation-Flocculation

Coagulation-flocculation is a two-step process that can remove very fine suspended particles that are too small to settle by gravity. The first step, coagulation, is achieved by adding alum (aluminum potassium sulfate) or lime (calcium hydroxide), which neutralizes the electrostatic charge of very fine particles. The second step, flocculation, causes these particles to clump together into flocs or larger heavier particles so they can either settle to the bottom or be filtered off the top. Add 1/8 to 1/4-teaspoon alum or lime per gallon of water and mix. Gently agitate for 5 minutes and let stand for an hour. Then filter flocced particles from water or decant clear water from the top of the container and proceed to purification or disinfection.

Pre-Treatment Filtration

The water can be filtered before being disinfected or purified. Filter the water through a fine cheesecloth or paper filter (e.g. coffee filter) to remove larger particles.

10.6.3 Purification and Disinfection Techniques

Heat Disinfection

Boiling disinfects water by destroying potentially harmful pathogens. Water is safe to drink as soon as it comes to a rolling boil (100 degrees Celsius). This technique does not require pre-treatment of the water. Although the boiling point of water decreases as altitude increases (at 18,000 feet water boils at 80 degrees Celsius), effective thermal death occurs at 60 degrees Celsius, which means that any boiled water is safe to drink. The disadvantage of heat disinfection is that the water must cool before consumption and this technique is both fuel- and time-intensive.

Filtration

Filtration removes a range of impurities from water by means of a fine physical barrier. Filter sizes range from 0.1 to 5 micrometers. Filters with the smallest pores, 0.1 to 0.5 microns, can remove bacteria, protozoa and most parasites. However, they are ineffective for viruses, which can be less than 0.004 micrometres in size. Some filters incorporate iodine resin to kill viruses and activated charcoal to absorb chemical contaminants. The disadvantages of this filtration technique are that the devices are often expensive and they operate mechanically, which is time-consuming. Besides, they can break.

Microorganism	Microorganism Size in Micrometers
Protozoa (Giardia Lambia, Cryptosporidium)	1 – 5
Enteric Bacteria (E. Coli, Salmonella)	0.1 – 0.2
Viral	0.004-0.01

Ultra-Violet (UV) Disinfection

Ultraviolet (UV) treatment refers to the disinfection process that exposes water to ultraviolet radiation to inactivate harmful microorganisms in the water. UV radiation alters the deoxyribonucleic acid (DNA) of pathogens, making them harmless. Affordable portable UV (point-of-use) water units are now widely available in various formats (e.g. SteriPen®).

UV purifiers are only effective in treating non-turbid water. The large particles suspended in turbid water form a screen between the UV rays and the pathogens, allowing the pathogens to survive. Ideally, a UV system should be used only after the water is clarified or filtered. Some UV kits come with a pre-filter.

Important Considerations

UV treatment does not remove dirt and particles, metals such as lead or iron, or hard minerals such as calcium, although some UV units come with pre-filters for this purpose. As well, inactivated microorganisms are not removed from the water. In addition, microorganisms rendered harmless by UV radiation are not removed from the water. If treated water is stored and the neutralized microorganisms are exposed to a light source for an extended period of time, they can be reactivated by a process called photorestauration.

Finally, certain water characteristics can affect UV effectiveness, including water hardness, alkalinity, pH and iron concentrations. In ideal circumstances, the water should be tested before UV treatment to see if it needs additional treatment.

Chemical Disinfection

Chlorine and iodine are two simple bodies that belong to the family of halogens, or non-metallic chemical elements. Chlorine and iodine are effective water disinfectants. They eliminate viruses, bacteria, protozoa and parasites. Both iodine and chlorine are readily available in many commercial forms. All commercial brands of bleach (without softener) contain chlorine. However, at high concentrations, most people prefer the taste of iodine to that of chlorine.

Water disinfection systems that use the chemical compound chlorine dioxide (Pristine®) are stable and easy to use. The user combines the two supplied chemicals to form the required amount of buffered compound before adding the mixture to the water.

All halogen disinfection techniques operate on the following principles.

10.6.4 Solution Concentration

A greater concentration of halogen will increase the solution's potency, thus increasing its effectiveness. This is useful for wound cleaning, when water disinfection is achieved more rapidly simply by using more disinfectant. On the other hand, the greater the potency, the less palatable the treated water becomes. When taste is a factor, the water can be filtered first so that only small amounts of chlorine or iodine are needed to kill the remaining pathogens. These concentrations are almost tasteless.

Contact Time

The longer the halogen is left in the water the more effective it becomes. An increase in contact time therefore allows for the use of a lesser concentration.

Water Clarity

Organic particles suspended in the water will bind to the halogen, essentially decreasing the amount of free halogen available to kill organic pathogens. Appropriate pre-treatment of the water should alleviate this situation.

Water Temperature

Cold water decreases the action of halogens. In cold water the contact time or the concentration must be increased.

Special Considerations Caution is advised when using iodine with pregnant women or people with thyroid dysfunction or who have allergies to iodine.

> **IMPORTANT**
>
> In cloudy water that does not settle out with pre-treatment techniques, the dose of halogen should be at least 8 drops/l for iodine and 4 drops/l for chlorine to account for greater halogen demand from the organic material.

Halogen Disinfection			
Drops/Litre	**5 ^{0}C**	**5 ^{0}C**	**30 ^{0}C**
Tincture of Iodine – 2.5 percent			
2	4 hours	2 hours	1 hour
5	2 hours	1 hour	45 min
10	1 hour	30 min	15 min
Chlorine Bleach – 5 percent			
1	4 hours	2 hours	1 hour
2	2 hours	1 hour	45 min
4	1 hour	30 min	15 min

10.6.5 Post-Treatment Techniques

These techniques make chemically disinfected water more palatable. Ascorbic acid (vitamin C) can be added to water treated with halogen to remove the iodine or chlorine odour after the treatment is complete. Some commercial filters have activated charcoal incorporated into the system to achieve a similar result.

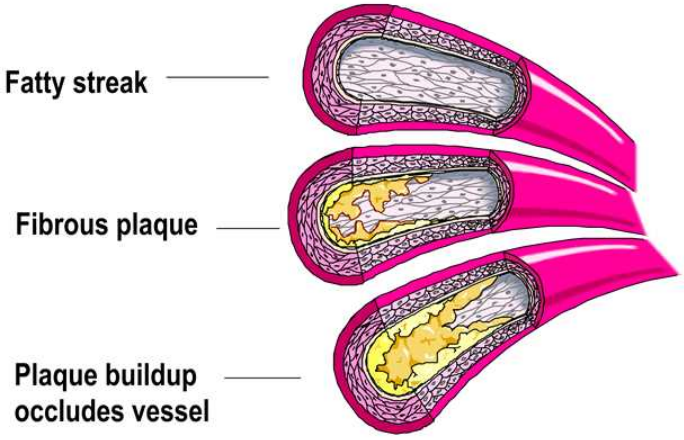
11. Medical emergencies

11.1 Cardiovascular diseases

Cardiovascular disease is the leading cause of death in adult Canadians. It refers to a broad spectrum of diseases that affect the circulatory system, specifically the heart (cardio) and blood vessels (vascular). Cardiovascular diseases are generally the result of a poor lifestyle, including poor diet, smoking and insufficient physical activity.

11.1.1 Coronary Artery Disease

The most common cardiovascular diseases are those affecting the coronary arteries. These diseases are called coronopathies. They result from the accumulation of fatty deposits, or plaques, in the walls of arteries. The deposits narrow the vessels and reduce the flow of oxygenated blood throughout the body. Because there is a decrease in blood flow, the heart is forced to pump harder to be able to maintain this flow. This overwork often leads to high blood pressure. If untreated this disease has a high risk of several possible medical emergencies:



Angina

Often a precursor to a heart attack, angina is chest pain caused by an insufficient supply of oxygenated blood to the heart, usually due to blocked coronary arteries.

It is often triggered by factors such as exercise or emotional stressors.

Signs and Symptoms

- Fullness, pressure or squeezing of the chest lasting from 2 to 15 minutes.
- Nausea.
- Sweating.
- Weakness.
- Denial.
- Shortness of breath.

Heart attack

A failure of the heart to contract properly

Signs and Symptoms

- Chest pain.
- Discomfort in other parts of the body.
- Nausea.

- Sweating.
- Weakness.
- Denial.
- Shortness of breath.

Acute myocardial infarction

Death of or damage to heart muscle tissue caused by an insufficient supply of oxygenated blood, usually due to coronary occlusion.

Signs and Symptoms

- Presentation can include (but is not limited to):
- Chest pain.
- Discomfort in other parts of the body.
- Nausea.
- Sweating.
- Weakness.
- Denial.
- Shortness of breath.

Cardiac arrest

A failure of the heart to contract effectively and thereby to circulate blood throughout the body.

Signs and Symptoms

- Loss of consciousness.
- Absence of respiration.
- Absence of pulse.

11.1.2 Management of Angina and Heart Attack

- CALL 9-1-1 or have someone else activate EMS immediately.
- Have the patient stop all activity.
- Place the patient in a comfortable position, lying or sitting down.
- If the patient has nitroglycerin in his or her possession, assist the patient in taking it. Follow the dosage and administration instructions as written on the prescription label. If the symptoms of chest pain do not subside or if they return within 5 minutes have the patient take a second dose. The dose may be taken a total of 3 times at 5 minute intervals.
- If the patient has taken a vasodilator medication such as Viagra®, Levitra®, or Cialis® within the last 48 hours do not administer nitroglycerin.
- For a patient with chest pain and with no history of allergy to aspirin or recent gastrointestinal bleeding, have the patient chew and swallow 1 regular strength 325 mg ASA tablet (acetylsalicylic acid, commonly known as Aspirin®) or 2 low-dose 81 mg tablets. ASA and nitroglycerin can be taken at the same time.
- Administer oxygen if available.
- Stay with the patient until EMS arrives.

Early recognition can save a life. Be prepared to perform CPR (see Adult CPR (p. 240)).

The Role of ASA and Nitroglycerin

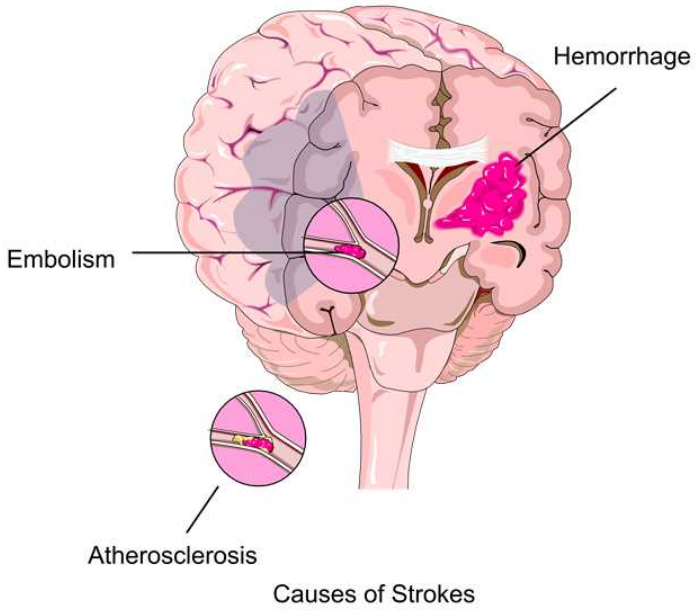
- Nitroglycerin is a nitrate drug that causes dilation of the blood vessels, therefore permitting greater circulation to the heart tissue.
- ASA is an over-the-counter medication with properties that inhibit the aggregation of platelets in the blood and therefore prevent the formation of blood clots in the arteries of the heart. Do not use other analgesics such as Tylenol or Advil which do not have the same effect as ASA on inhibiting blood clotting.

11.2 Cerebrovascular Diseases

Cerebrovascular disease involves the death or injury of brain tissue as a result of oxygen deprivation. It includes strokes and transient ischemic attacks. Like coronary disease, cerebrovascular disease can be and often is caused by disease of the arteries.

Cerebrovascular Accident (CVA)

A cerebrovascular accident, commonly known as a stroke, is caused by an interruption of blood flow to the brain. This may result from a blockage of a blood vessel supplying the brain (ischemic stroke) or from a blood vessel rupture (hemorrhagic stroke). A stroke involves a sudden reduction in or loss of consciousness, sensation and voluntary motion. This may be noticed as weakness or numbness in the arms, numbness in the face, difficulty speaking and changes in level of consciousness. A headache and dizziness may also accompany a stroke.



Causes of Strokes

Transient Ischemic Attack (TIA)

Transient ischemic attack (TIA) is often referred to as a "mini stroke" since it is caused by the temporary disturbance of the blood supply to a restricted area of the brain. The symptoms usually resolve within several hours. A TIA, however, requires careful monitoring since it is often a precursor to a full stroke.

11.2.1 Assessment of a Stroke or TIA

Vascular accidents are treatable conditions. This is why it is essential to know how to recognize the warning signs and to respond quickly.

Signs and Symptoms

- SUDDEN weakness
- SUDDEN numbness
- SUDDEN trouble speaking

- SUDDEN vision problems
- SUDDEN loss of balance
- SUDDEN headaches

Management of a Stroke or a TIA

- If the person is experiencing any of the above warning signs, early action is key!
- Call 9-1-1 or have someone else activate EMS immediately.
- Place the patient in a comfortable position.
- Be prepared to support ventilation, if needed.
- Administer oxygen if available.
- Do not administer ASA. While most strokes are caused by blood clots, some are caused by ruptured blood vessels. Taking ASA could potentially make these bleeding strokes more severe.
- Remember the adage "Time lost is brain lost!" »

Risk Factors for Cardiovascular and Cerebrovascular Diseases

Uncontrollable	Controllable
Age	High Blood Pressure
Gender	High Blood Cholesterol
Family History	Diabetes
Ethnicity	Being Overweight
Past Medical History of Stroke or TIA	Being Physically Inactive
	Poor Diet
	Smoking
	Consuming Excessive Amounts of Alcohol
	Stress

Hypertension (High Blood Pressure)

People with hypertension have an increased risk of heart attack and strokes. More than a third of Canadians with high blood pressure are unaware that they have the condition and are therefore at greater risk. While any stressful situation may temporarily cause an increase in otherwise normal blood pressure, recurring high blood pressure readings require definitive medical assessment and care. BPs are considered to be high and are regularly above 140/90 mm Hg (see The Circulatory System (p. 37)).

11.3 Seizures

Seizures are caused by sudden, excessive neural discharges in the brain. The condition resulting from the discharges depends on the origin and the number of neurons affected. Epilepsy is a condition in which an individual experiences recurring seizures. The symptoms can vary from a brief loss of consciousness to convulsions that affect the entire body. Anyone can experience a seizure if the nervous system is sufficiently irritated.

11.3.1 Conditions Known to Cause Seizures

- Cerebral trauma
- Brain tumours, lesions, injuries or congenital brain defects

- Severe allergic reactions (anaphylaxis)
- Major infections (encephalitis, meningitis)
- Body temperature in excess of 40 degrees Celsius (hyperthermia)
- Metabolic disorders
- Hypoxia
- Withdrawal symptoms
- Convulsive or toxic drugs

11.3.2 Types of Seizures

Partial

Partial seizures originate in one area of the brain only and usually affect a specific motor, sensory or psychological function. Simple partial seizures do not affect consciousness. On the other hand, a complex partial seizure is usually accompanied by an altered consciousness state. The victim appears confused, makes unintelligible sounds and seems dissociated from her surroundings.

Generalized

Generalized tonic-clonic seizures can be quite alarming. In the tonic phase, muscles become rigid and stiff. This is followed by the clonic phase characterized by uncontrolled muscle jerking in the legs, arms and trunk. During the seizure, the patient may become incontinent and/or stop breathing due to paralysis of the diaphragm and secondary breathing muscles. Seizures usually last less than 2 minutes. When they regain consciousness, the victim usually feels very tired and confused.

Status Epilepticus

The epileptic condition puts the victim's vital prognosis at risk. It is defined as a seizure that is abnormally prolonged (more than 5 minutes), or a series of recurrent seizures that are too close together to maintain an adequate supply of oxygen to the brain cells. This is a medical emergency and the patient requires immediate medical care.

Non-Epileptic Seizures

Non-epileptic seizures resemble epileptic seizures but do not involve the electrical discharges associated with epilepsy. They are caused by physiological or psychological conditions.

Febrile Seizure

A febrile seizure is a set of convulsions caused by a very high fever. It occurs most frequently in children and infants between the ages of 6 months and 6 years. Management includes monitoring airway, breathing and circulation and reducing the fever.

11.3.3 Assessment of Seizure Disorders

Wilderness leaders and rescuers, whenever possible, should be aware of anyone with a history of seizure disorders within their group. An interview with the individual prior to the trip will reveal important information about specific seizure patterns, triggering factors and the frequency of occurrence. The leader should make note of any drugs used to control the condition and of experienced side effects.

Symptoms of Seizure Disorders

- Staring spells
- Altered behaviour and confusion
- Unexpected collapse due to loss of consciousness
- Convulsions
- Incontinence
- Salivation

Management of Seizures

A seizure cannot be stopped once it has begun. Management is aimed at preventing injury during the episode.

- Protect the patient from harm but do not restrain.
- Support the head or cushion it with clothing or soft items.
- Remove sharp, hard or hot objects from the vicinity.
- Initiate Basic Life Support for unconscious patients, as needed.
- Stay with the patient until he/she is fully recovered.
- Ensure privacy for the patient.
- Check for any other injuries.
- Patient may be confused and may need to rest after the seizure.
- Patients previously undiagnosed as having seizure disorders should be referred to definitive medical care.
- Treat the cause of the seizure if it is evident.

If a seizure lasts for more than 5 minutes or if several seizures recur without a break, contact EMS immediately.

11.4 Diabetes

Diabetes is the condition that results from the body's failure either to produce insulin or to use insulin. Insulin is the hormone that facilitates the uptake and use of glucose by most body tissues.

11.4.1 Physiology of the Pancreas

Insulin and Glucagon

The pancreas is a gland organ that produces two hormones used to regulate sugar levels in the blood stream. When the concentration of blood glucose (blood sugar) increases, for example, at the end of a meal, the pancreas releases insulin into the bloodstream to allow cells to absorb glucose and convert it into fuel. Glucose can also be stored in the liver, muscles and fat tissue for later use. When blood sugar levels are low, on the other hand, the pancreas will produce glucagon to help release stored glucose from body tissue back into the blood stream for immediate use by cells.

Hyperglycemia and Hypoglycemia

Any failure in insulin production or glucose uptake has the effect of dangerously increasing the concentration of sugar in the blood. This condition is called hyperglycemia. Conversely, prolonged low blood sugar levels or hypoglycemia can also become a life-threatening condition.

11.4.2 Types of Diabetes

Although there are many types of diabetes, most fall into one of three principal categories, Type I, Type II and Gestational Diabetes.

Type I Diabetes

Type I diabetes results from an insufficient production of insulin by the pancreas. Type I diabetes is most often diagnosed in childhood. It requires insulin therapy to aid carbohydrate metabolism and maintain carbohydrate homeostasis. As a result this type is also often referred to as insulin-dependent diabetes or juvenile-onset diabetes.

Type II Diabetes

With type II diabetes the body's cells develop a resistance to insulin. Type II diabetes is also sometimes associated with a moderate decline in insulin production. It usually develops in adulthood. People with type 2 diabetes can control their disease primarily through diet, physical activity and medication. Consequently this type of diabetes is also referred to as adult-onset diabetes or non-insulin-dependent diabetes.

Gestational Diabetes

Pregnancy-induced diabetes, or gestational diabetes, occurs during pregnancy in less than five per cent of pregnant women. It can disappear after childbirth. Much like Type II diabetes, gestational diabetes involves insulin resistance and sometimes a moderate decline in insulin production. It can be regulated through diet and exercise, and sometimes medication. If not monitored and treated it can endanger the life and health of both mother and fetus.

11.4.3 Management of Diabetes

Each diabetic is unique. The goal of management is to keep blood sugar levels as close to normal as possible. The diabetic person must be aware of the close interaction between diet, exercise, metabolism and the role that insulin plays in regulating blood glucose levels.

Diet

Glucose is a cell's primary fuel and the main nutritional source of glucose is carbohydrates. In a diabetic person, carbohydrate intake must be controlled and regulated. In order to keep glucose levels constant, meals must be regular, frequent and relatively small. A diabetic person generally monitors his or her blood glucose regularly through blood or urine tests.

Metabolism

Metabolism refers to the complex chemical reactions occurring in living cells that produce or use energy. Factors such as exercise, frequency and size of meals, the body's reaction to changes in temperature, as well as overall health all have an impact on metabolism and therefore affect the body's requirement for glucose.

- Moderate but regular exercise burns off excess glucose to allow the muscles to work. This keeps blood glucose levels low and reduces the need for insulin. Diabetics generally require food intake prior to activity. Food and insulin are also required following activity to replenish glucose stores.
- Too much exercise can lead to dramatic and dangerous drops in glucose levels (see Hypoglycemia).

- Intense or excessive exercise can also have the opposite effect in a person with diabetes. It can stimulate the release of stress hormones into the bloodstream, which tells the body to release glucose into the bloodstream. These tell the body to release glucose into the blood stream and result in an increased demand for insulin.
- Shivering will increase glucose requirements.
- Diabetics generally need to eat smaller meals and more frequently throughout the day. Especially if exercising, they often need to eat a snack before going to sleep to maintain glucose stores throughout the night.

Insulin Production and Administration

An insulin-dependent diabetic will require administration of insulin by injection at regular intervals. Fast-acting insulin is usually used in conjunction with longer-acting insulin. Fast-acting insulin is most effective in emergency situations. Longer-acting insulin is effective over a period of 12 – 14 hours. Non-insulin-dependent diabetics may take medication that stimulates the pancreas to produce more insulin.

Most diabetics are aware of their condition and manage it appropriately. Diabetics may participate in all activities. However, caution should be used regarding sudden changes is exercise, stress levels and meal frequency or content.

11.4.4 Emergency Complications of Diabetes

Hypoglycemia

Hypoglycemia is a condition is which blood glucose levels are very low and insulin levels are very high. It is the complication of diabetes most likely to be encountered in a wilderness setting. It is a medical emergency and can quickly lead to unconsciousness, coma and death if not treated immediately. The symptoms tend to have a rapid onset.

Causes

- Too much exercise
- Inadequate food intake
- Too much insulin (rare)

Symptoms

- Fatigue
- Headache
- Hunger
- Dizziness
- Muscular weakness
- Blurred vision

Signs

- Slurred Speech
- Confusion
- Restlessness
- Irritability
- Pale, sweaty skin
- Rapid pulse

- Unconsciousness
- Tremors

Management

If the Patient is Conscious

- At the first sign of abnormality, administer simple sugars (sweet liquids, fruit juice, syrup).
- If the patient responds to oral sugar, this can be followed by a meal to increase blood glucose levels.
- If the patient does not improve, arrange for medical attention immediately.

If the Patient is Unconscious

- Monitor ABCs.
- Place the patient in recovery position and place glucose syrup or gel inside the cheek. Rub syrup into the cheek to aid absorption. If the patient does not respond, arrange for medical attention immediately.
- Unit doses of glucose gel are easily absorbed through the lining of the mouth. They are easy to obtain and quick to use. They should be included in first aid supplies at the outset when a person with diabetes is participating in a remote program.

Hyperglycemia

Hyperglycemia refers to an abnormally high concentration of glucose in the blood. It results from lack of insulin, lack of exercise or overeating. It is a medical emergency and leads to a number of complications. Among other things, the lack of insulin in the bloodstream prevents glucose from being absorbed by most of the body's cells and will trigger the body to break down its fatty acids into ketoacids for energy. The body then begins to break down the fatty acids into ketonic acids to meet its energy needs. Without an adequate supply of insulin, the body also loses the ability to regulate the production of ketoacids, the excessive accumulation of which causes a type of metabolic acidosis called ketoacidosis. The body's response is to flush out excess glucose and ketoacids in the urine, which in turn results in dehydration and electrolyte loss. The combined effect of dehydration, ketoacidosis and electrolyte imbalance eventually impairs brain function and can lead to unconsciousness, coma and eventually death.

Breakdown of Steps in Hyperglycemia

- Abnormally high glucose levels.
- Ketoacidosis – the cells begin to metabolize proteins and fatty acids producing amino acids and ketoacids.
- Dehydration — the kidneys produce increased amounts of urine (diuresis) causing dehydration over time.
- Electrolyte imbalance - Glucose and ketonic acids bind to solutes in the urine and cause a process called osmotic diuresis, an increase in water in the urine. This process aggravates dehydration and electrolyte loss.
- Drop in blood pH.
- Kussmaul Respiration – respiration deepens to expel carbon dioxide. In extreme cases these deep breaths are known as Kussmaul respirations.
- Diminished level of consciousness and coma – if untreated, hyperglycemia will lead to death.

Assessment

Most people with diabetes are almost constantly in a state of mild hyperglycemia. They tend to be thirsty and urinate often. Usually they will be aware of any increase in these symptoms. Life-threatening hyperglycemia has a fairly slow onset and is rare in active people. Hyperglycemia is recognized by the following signs and symptoms.

Symptoms

- Headache
- Nausea
- Intense thirst
- Abdominal pain
- Dry mouth and tongue

Signs

- Restlessness
- Acetone or fruity breath odour
- Flushed dry skin
- Fast heart rate
- Deep, rapid respiration
- Frequent urination
- Diminished LOC or unconsciousness

Management

- The management of hyperglycemia requires insulin therapy, which should be fast-acting to correct the imbalance as soon as possible.
- A urine or blood test is required to definitively confirm hyperglycemia.
- If the patient is unable to self-administer the insulin, do not do it.
- Seek medical care ASAP.

Comparative Hypoglycemia / Hyperglycemia

Comparative Hypoglycemia / Hyperglycemia Table		
	Hypoglycemia	**Hyperglycemia**
History		
Food intake	Not enough	Excessive
Insulin or medications	Too much relative to food intake	Not enough
Onset of symptoms	Rapid	Gradual
Symptoms		
Thirst		Present
Hunger	Present	–
Vomiting	–	Common
Urination	Normal	Excessive
Physical Signs		
Breath odour	–	Acetone - Fruity
Rate of breathing	Normal	Rapid
Pulse	Normal to slightly strong	Weak and rapid

Comparative Hypoglycemia / Hyperglycemia Table		
	Hypoglycemia	**Hyperglycemia**
Skin	Pale and clammy	Warm and dry
Seizures	Common	–
Response to Glucose Treatment	**Rapid improvement**	**No change**

If you are unsure whether the diabetic patient is experiencing hypoglycemia or hyperglycemia, administer any of the simple sugars used in hypoglycemia management. A small dose of sugar will provide immediate benefit to a patient with hypoglycemia whereas it does little to worsen a hyperglycemic's immediate condition.

11.5 Non-Traumatic Abdominal Emergencies

Acute Abdomen

Acute abdomen is a term used to describe the sudden onset of severe abdominal pain and discomfort. It can result from a variety of abdominal disorders and generally indicates a serious problem. Causes of acute abdomen include:

- Ruptured organs or vessels from blunt trauma causing internal bleeding.
- Perforation of the stomach or intestines due to penetrating trauma.
- Infections of any the structures in the abdominal cavity (appendicitis, pancreatitis, peritonitis, gastroenteritis).
- Obstructions of any of the hollow organs or tubular structures (constipation, gall stones, kidney stones, blockage of the bile ducts).

Assessment

- The following signs and symptoms suggest the presence of an acute abdomen. All cases of acute abdomen should be evacuated immediately. Watch carefully for these red flags.

Signs and Symptoms

- Signs of internal bleeding (blood in vomit, stool, urine; extensive bruising)
- Signs of advanced shock
- Local pain and pain that is slow in its onset
- Pain accompanied by vomiting and fever
- Lack of intestinal sounds
- Tenderness, distension, guarding or rigidity of abdominal wall
- Inability to move
- Presence of a hernia

Management

- Treat for shock.
- Maintain in a position of comfort. Patient may need to be transported in a supine position, with knees flexed and supported to relieve stress on the abdominal structures.
- Do not give anything by mouth.
- Manage gently. Do not allow patient to walk.
- Evacuate as quickly as possible.
- For long evacuations, give water as tolerated.

Gastroenteritis

Gastroenteritis is frequently encountered in the backcountry and in foreign travel. Gastroenteritis is an infection of the stomach and intestines caused by bacteria, viruses, parasites or protozoa. These organisms are often transmitted through fecal contamination of water or food. As the infection develops, by-products excreted by the organisms reach levels that are toxic to the body. When this toxic threshold is reached the body implements several mechanisms in an attempt to flush the pathogens and the toxic by-products from the system. Infection of the upper gastrointestinal (GI) system will usually result in cramping and vomiting. A low-grade fever is common. Most cases are self-limiting and are resolved in eight to twelve hours. Infection of the lower GI system will result in diarrhea and lower abdominal cramping. Lengthy bouts of vomiting or diarrhea will rapidly deplete the body of fluids as well as essential electrolytes.

Assessment

- Carefully assess all recent food and water sources.

Signs and Symptoms

- Nausea and vomiting.
- Diarrhea, pain associated with diarrhea.
- Headache.
- Abdominal cramps.
- Possibility of fever.
- Rapid onset and short duration.
- Excessive stomach sounds.
- Others in the group with similar symptoms.

Management

The principal goal of managing gastroenteritis is to prevent dehydration. Most cases of gastroenteritis are self-limiting and will be resolved with time.

- Assess the volume of fluid being lost through vomiting and/or diarrhea. Taking fluid by mouth does not stimulate vomiting or diarrhea in a victim suffering from gastroenteritis. However, it limits the volume of fluids lost through intestinal and gastric evacuation.
- Prevent dehydration.
- Replace electrolytes lost in stool or vomit.
- Reduce activity.
- Monitor both patient and other group members.
- Administer antibiotics for severe cases.

11.6 Non-Traumatic Respiratory Emergencies

The function of the respiratory system is to supply the body's cells with a constant supply of oxygen (O_2) and to remove excess carbon dioxide (CO_2). Problems arising with any component of the respiratory system may result in respiratory emergencies.

Signs of Ineffective Breathing

Ineffective breathing is breathing that does not meet the body's need for oxygen. It is characterized by any of the following:

- Abnormal breathing rates – breathing that is either too slow or too rapid
- Difficulty in breathing or shortness of breath (dyspnea)

- Noisy or raspy breathing
- Abnormal chest movement during inhalation or exhalation
- Bluish tinge to the lips and skin (cyanosis)
- Feeling fatigued from the effort of breathing

Common Terms in Respiratory Distress

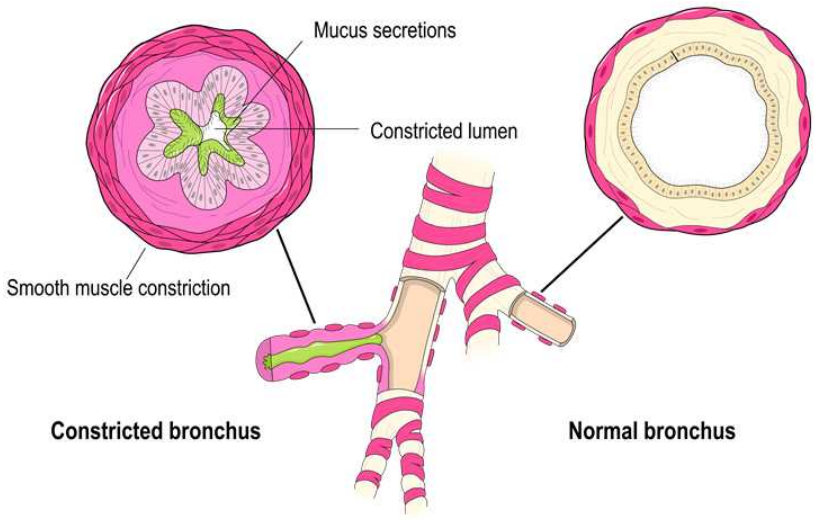
Hypoxia
Insufficient levels of oxygen in the blood and body tissues.

Anoxia
Absence of oxygen from a part of the body.

Asphyxia
Inadequate intake of oxygen into the respiratory system, brought on by choking, drowning or inhalation of toxic gases or chemicals. If not reversed, asphyxia very quickly results in hypoxia and increasing carbon dioxide levels.

11.6.1 Asthma

Asthma is a common chronic respiratory disease in Canada. It affects about one-sixth of all children under the age of 12 and about one-tenth of the adult population. The cause of asthma is generally ascribed to a hypersensitive reaction of the lower respiratory system.



Asthma is an inflammation of the bronchial walls that causes excessive mucus secretion in the lower airways and/or spasm of the bronchial muscles. The inflammation of the bronchi causes air to become "trapped" in the lungs, making it difficult to breathe, especially during exhalation. The resulting airway obstruction generally leads to persistent coughing, wheezing and shortness of breath.

Factors Precipitating Asthma Attacks

- Allergic reactions
- Respiratory infections
- Exercise
- Cold air
- Chemical irritants such as smoke
- ASA and anti-inflammatory medications
- Emotional stress

Assessment of Asthma

Signs and Symptoms

- Various stages of respiratory distress
- Air hunger
- Panic or anxiety
- Pursed lip breathing
- Elevated pulse rate
- Accessory respiratory muscle use
- Over-inflated chest with prolonged expiration
- Cyanosis.

Management

- Reassure and calm the patient.
- Assist in establishing slow efficient breathing.
- Help the patient take appropriate medication – several doses may be required.
- Treat for shock.
- Administer oxygen, if available, at a flow of 10 L/min.
- Prolonged attacks necessitate patient evacuation.

Medications

Asthma sufferers may use inhaled medications to combat the effects of their condition. These are divided into two categories.

Steroid Medications

Steroid drugs are designed to reduce inflammation in the lungs. These medications can be either inhaled through the mouth or nose or swallowed orally. Examples of some of the products available to treat asthma:

- Inhaled – Beclovent®, Beclofotre®, Vanceril®, Pulmicort®, Flovent®.
- Oral – Prednisone, including Apo-Prednisone®, Novo-Prednisone®, Winpred®.

Bronchodilators

Bronchodilators open the airways by relaxing the smooth muscles that encircle the bronchial tubes. Some of the products available to treat the acute symptoms of asthma include: Ventoline®, Alupent®, Berotec®, Bricanyl®.

The bronchial tissue in an asthmatic's lungs is sensitive to a variety of stimuli, any of which could trigger an asthmatic attack. The "triggers" can affect people differently.

11.6.2 Allergic Reactions

The body's immune system normally protects the body from harmful agents such as bacteria and toxins. Its overreaction to a relatively harmless substance is called an allergic reaction. The substance that triggers an allergic reaction is called an allergen. A severe allergic reaction can be life-threatening.

Anything can be an allergen. Common allergens include plant oils and pollens, mould spores, foods and food additives, insect and animal venoms, animal dander, medications, metals and chemicals.

Portals through which Allergens May Be Absorbed

- Contact with the skin
- Injected through the skin
- Inhaled through the respiratory system
- Ingested through the gastrointestinal system

Mechanism of an Allergic Reaction

Effects of Histamine on the Body

- Inflammation of soft tissue and mucosal linings
- Increased mucus production
- Increased circulation to the affected area
- Constriction of smooth muscles of the respiratory and gastrointestinal systems
- Increased capillary permeability to allow the release of white blood cells to combat the allergen
- Vasodilation of blood vessels

Symptoms of an Allergic Reaction Can Include

- Local or extensive inflammation of the skin, itchiness or hives
- Gastrointestinal problems (such as nausea, vomiting, diarrhea)
- Seizures
- Respiratory distress or arrest
- Circulatory failure

The most common life-threatening allergic reaction is respiratory distress. Anaphylaxis, or anaphylactic shock, is an acute and sudden multisystemic allergic reaction that can affect several systems (see Anaphylaxis (p. 217)).

The process of sensitization

- We cannot develop allergies to anything we have not previously been exposed to.
- The process of sensitization to an allergen is almost always asymptomatic, meaning the process goes undetected until the body encounters the allergen a subsequent time.
- It may take repeated exposures to an allergen before a person has a noticeable allergic reaction.
- Some people, on the other hand, become sensitized very quickly, and some develop allergies after exposure to only minute quantities of an allergen.

Types of allergic reactions

Allergic rhinitis

Allergic rhinitis is a local allergic reaction to dust, dander, mould spores or plant pollen (from ragweed, trees and grass). It affects the sensitive mucosal lining of the nose, throat, eyes and sinus cavities. When the allergen is pollen, allergic rhinitis is commonly known as hay fever (although hay itself is not generally the trigger).

Signs and Symptoms

- Nasal discharge – clear, watery and frequent
- Weeping, red and itchy eyes
- Sneezing
- Headache
- Dark circles under the eyes
- Fatigue
- Allergic rhinitis may be confused with infectious rhinitis or sinusitis, which is caused by a bacterial or viral infection of the nasal area. The nasal discharge in cases of infectious rhinitis is usually thick, cloudy and greenish.

Management

- Administer antihistamines to inhibit the effects of inflammation.
- Administer decongestants to combat nasal and sinus congestion.
- Clean the nostril with sinus rinse
- As a preventative measure, include an assessment for hay fever in pre-trip medical histories.

Allergic Contact Dermatitis

Allergic contact dermatitis is caused by direct skin exposure to an allergen. Common allergens include poison ivy, poison oak, poison sumac, topical medications (benzocaine®), various metals (e.g. nickel used in jewelry), rubber or latex gloves or adhesives, cosmetics, detergents and fragrances. The allergic reaction is often delayed. The rash appears 24 to 48 hours after exposure. The skin inflammation varies from mild irritation and redness to open sores, depending on the type of irritant, the body part affected and the person's sensitivity.

Poison Ivy, Poison Oak, Poison Sumac

The reaction to poison ivy, oak and sumac is the most common form of contact dermatitis or local allergic reaction. More than 80 percent of the population is allergic to poison ivy (see photo). The allergen responsible for the allergic reaction is urushiol, the resin found in the leaves and stem of the plant. Urushiol is present in the plant year round.

Poison ivy is found throughout Canada, and poison ivy in eastern Canada. Western sumac is more common west of the Rockies.

The resin may be transmitted through contact with skin, clothing or pets that have themselves come into contact with the plant. When the plant is burned, inhaling the smoke can also cause inflammation of the lining of the lungs leading to respiratory difficulty.

In most cases, the allergic reaction is limited to small areas of the skin at and near the point of contact. The resin can generally be washed off the skin within 1 to 4 hours without reaction. In some sensitive individuals, the allergic reaction is more widespread and may develop into a systemic allergic reaction requiring hospitalization and systemic drug therapy. Repeated exposures may elicit increasingly severe reactions.

Assessment

- The clear liquid oozing from the skin lesions is plasma. It doesn't spread the rash.

Signs and Symptoms

- Hives, redness, blisters at site of contact 8 - 48 hours after contact with the resin
- Itching
- Occasionally, large blisters
- Systemic reactions may occur causing extensive tissue swelling

Management

- Remove resin immediately after contact using cold water and soap.
- Wash any clothing that may contain the resin.
- Avoid scratching, as it will introduce infection.
- Do not drain blisters.
- Manage areas of open skin carefully to prevent infection.
- Extensive reactions may require medical care.
- Antihistamine administration will help alleviate the swelling and itching.

Urticaria (Hives)

Hives appear as red blisters or papules on the skin and are itchy. It is often triggered by allergens. Hives can also develop from emotional stress, extreme cold, sun exposure or excessive perspiration.

Assessment

- The onset is generally rapid following contact with the allergen.
- The reaction may be localized or widespread.
- The welts may get bigger, spread and join together to form larger areas of flat, raised skin.
- The cause of the allergic reaction may not be obvious.

Signs and Symptoms

- Raised welts on the skin
- Skin is red and itchy

Management

- Assess the cause of the reaction and avoid contact with it.
- Avoid scratching.
- Antihistamines are effective in relieving symptoms.

11.6.3 Anaphylaxis

Anaphylaxis is an acute allergic reaction in which histamine is massively released throughout the body. The effects of the histamine are rapid and life-threatening because of their profound effect on the respiratory and vascular systems.

Common Allergens Responsible for Anaphylactic Reactions

- Bee stings (hymenoptera family: wasps, honey bees, yellow jackets, bumble bees)
- Certain foods (seafood, peanuts, dairy, berries, food additives)
- Specific drugs (such as penicillin and other antibiotics, Aspirin® and many of the "caine" drugs)
- Snake venom (also the antivenin)

Assessment and Management of Anaphylaxis

Anaphylaxis affects several body systems – the skin, respiratory, cardiovascular, nervous and gastrointestinal systems. Although all the symptoms are serious, the majority of anaphylaxis-related fatalities result from respiratory complications. Signs usually develop rapidly (within seconds or minutes) but may be delayed for as long as an hour. The rapidity of the onset of symptoms is generally an indicator of the severity.

Assessment

Assessment of Anaphylaxis	
Skin	Hives. Swelling at site of sting. Cyanosis. Pale and/or red skin. Inflammation and swelling of soft tissues. Increased production of mucus.
Respiratory	Respiratory distress. Bronchospasm. Wheezing.
Circulatory	Rapid pulse. Arrhythmia. Vasodilation. Decreased blood pressure.
Gastrointestinal	Nausea and vomiting. Diarrhea.
Neurological	Altered LOC. Restlessness, anxiety. Unconsciousness.
Other	Pelvic cramping in women. Weeping and irritation of the eyes.

Management

The initial management of an anaphylactic reaction is the administration of epinephrine within 4 hours of contact with an allergen under the following conditions (see Epinephrine (p. 218)).

Administer epinephrine if :

- Signs and symptoms of respiratory distress or circulatory failure (signs of shock) are present:

Respiratory distress associated with one or more of the following signs and symptoms:	**Circulatory failure associated with two or more of the following signs and symptoms:**
• Increase in respiratory rate • Difficulty breathing • Wheezing/stridor • Use of accessory muscles • Decrease level of consciousness • Cyanosis • Unable to speak in complete sentences	• Increase heart rate • Increase in respiratory rate • Agitated/anxious • Light/cold/milky skin • Absence of radial pulse • Decrease level of consciousness • Decrease in blood pressure

Or

- The presence of at least 2 out of the 4 next criteria:
  - Hives or angioedema
  - Breathing difficulty (admitted dyspnea without signs required)
  - Confessed circulatory failure as great weakness / dizziness
  - Gastric symptoms: nausea, vomiting, abdominal cramps or diarrhea

Backcountry management also requires the administration of antihistamines and treatment for shock. The patient should be monitored carefully for 24 hours and allowed to rest. If possible, immediate evacuation to a medical centre is advised.

- If the patient is able to swallow, administer an antihistamine such as Diphenhydramine (Benadryl®) as soon as possible after the administration of epinephrine.
- Do not use slow-release antihistamine preparations!

Epinephrine

Epinephrine is a medication administered via intramuscular injection. It works by relaxing the muscles in the airway and constricting the blood vessels.

Epinephrine is available in the form of auto-injectors, under the trade names EpiPen® and EpiPen® Jr. It is also available in vials and can be administered by syringe.

There are no absolute contraindications to the use of epinephrine in a life-threatening situation. Adverse reactions to epinephrine may include palpitations, rapid heart rate, sweating, nausea and vomiting, dizziness, tremor, headache, nervousness and anxiety.

EpiPen®

The EpiPen® is a single-dose injector containing 2.0 ml of epinephrine at 1:1000 dilution. One injection delivers 0.3 ml of fluid that contains 0.3 mg of epinephrine. This is designed for adults and children weighing more than 30 kg (66lb).

EpiPen® Jr is also a single-dose auto-injector. It contains 2.0 ml of epinephrine at a dilution of 1:2000. One injection delivers 0.3ml of fluid, which contains 0.15 mg of epinephrine. This is used for young children weighing between 15 and 30 kg (33 – 66 lbs).

When administered intramuscularly, epinephrine has a rapid onset and a short duration. Its effects usually last around 20 minutes, so a second dose should be on hand.

Important to note :

- Epinephrine is sensitive to light. It should therefore be stored in its original container at room temperature (15 - 30 degrees Celsius). Do not refrigerate, freeze or store in an area that will be exposed to extreme temperatures.
- Inspect the solution regularly and replace if the expiration date has lapsed or if the solution has turned brown or has become cloudy.
- Read all instructions and information that accompanies the EpiPen® and highlight information regarding directions for use.
- On long expeditions carry multiple kits in separate locations.

Directions for EpiPen® Use

1. Grasp unit in fist with orange tip pointing downwards.
2. The needle comes out of the orange tip. Do not place your finger or thumb over the tip.
3. Remove the blue safety cap.
4. Swing the orange tip towards the fleshy outer portion of the thigh and push firmly against the thigh until it clicks. This can be done through regular clothes if necessary, but not heavy protective clothing such as chainsaw pants.
5. Apply moderate pressure and hold for 10 seconds.
6. If symptoms return administer a second injection if available.
7. Treat for shock.
8. Monitor for respiratory and cardiac distress for 24 hours.
9. Evacuate to medical facility.
10. Store used syringe in kit and take it to a pharmacy for disposal and replacement.

1. Remove the safety cap.
2. Push the auto injector firmly against the fleshy part of the outer thigh until it clicks.
3. Hold for 10 seconds.

For more information on the EpiPen®: www.epipen.ca.

11.7 Poisons and Toxins

A poison is any substance that disrupts an organism. Virtually anything can be poisonous if taken in large enough quantities. Poison can be:

- Ingested through the gastrointestinal tract – such as poisonous mushrooms
- Inhaled through the respiratory system – such as carbon monoxide
- Injected into the skin - by animal bites, arachnid bites or insect stings (see Bites and Stings (p. 184)).
- Absorbed through the skin – exposure to strong chemicals (this is rare in wilderness settings)

The effect of the poison depends on the quantity and strength of the toxin as well as the patient's general health, body weight, sex and age. The management of toxins and poisons will therefore vary widely depending on all these variables. If possible, consult the poison control centre before treatment. Where relevant, keep a sample or the container of the poison for reference.

Always research any toxic substances you may be taking on a trip (including medications) in the event of accidental ingestion. As well, research the area you will be travelling in and become familiar with any poisonous insects, arachnids, plants or animals. In the event of accidental poisoning evacuate the patient as soon as possible and contact the nearest poison control centre.

11.7.1 Ingested Poisons

When treating ingested poisons, the primary goal is to limit the body's exposure to the poison by countering its absorption in the gastrointestinal system. When there is no adequate antidote available, activated charcoal is recommended.

Binding Ingested Poisons with Activated Charcoal

Activated charcoal absorbs the toxic substance before it is absorbed. Therefore, it should be administered within one hour of poisoning. Both the poison and the charcoal are eliminated when the patient has a bowel movement. Do not administer activated charcoal for the ingestion of strong acids and bases, metals, alcohol or hydrocarbons because these do not bind as well to charcoal.

Activated charcoal is readily available from most pharmacies in tablet form or as a powder. Mix with water and administer as a single-dose liquid preparation. An adult dose is 50 – 100 grams; a child dose is 20 – 50 grams.

11.7.2 Inhaled Poisons

Carbon Monoxide Poisoning

Carbon monoxide is a colourless, odourless and tasteless gas. It's a by-product of hydrocarbon combustion. If untreated, inhaled carbon monoxide can lead to coma and death.

Assessment Sign and Symptoms

- Headache
- Difficulty breathing
- Red or pink skin colour
- Nausea and vomiting

- Dizziness and weakness
- Altered level of consciousness

Management

- Remove patient from source of poison to a well-ventilated area.
- Maintain airway and administer oxygen if possible.
- Evacuate as soon as possible.

11.8 Genito-Urinary Emergencies

11.8.1 Anatomy and Physiology of the Urinary and Reproductive Systems

The Urinary System

The urinary system serves to produce, store and eliminate urine. It is made up of the kidneys, the ureters, the bladder and the urethra.

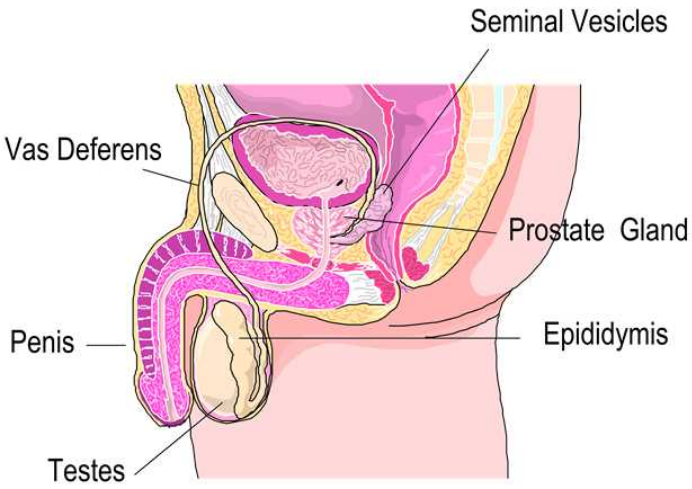
The two kidneys rid the blood of its toxic waste and control the balance of water and salts in the blood stream. Urine is made up of a combination of water and waste material.

Urine is carried from the kidneys to the bladder via the small muscular hollow tubes called the ureters. Seated at the floor of the pelvic area, the bladder is a balloon-shaped organ that stores urine before it is removed through urination. Urine leaves the body via the urethra, which is controlled by a sphincter under voluntary control.

The Reproductive System

Male Reproductive System

The male reproductive system is made up of the testes, the epididymis, the vas deferens, the seminal vesicles, the prostate gland and the penis.

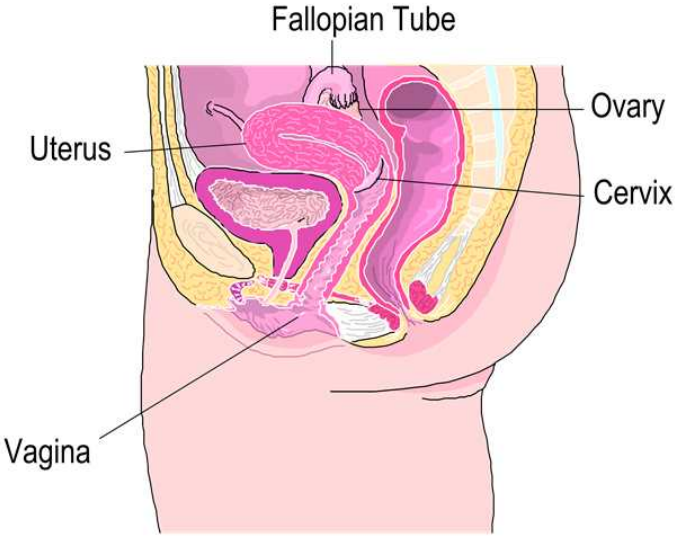


The male reproductive cells, called spermatozoa or sperm, are produced in the testes. Maturation of these cells takes place in the epididymis. The sperm travel via the vas deferens to the seminal vesicles and then to the prostate gland before exiting the body through the penis. Along the way, the sperm are bathed in nutritive and protective fluid, produced and secreted by various glands. Semen is the liquid that contains sperm and glandular secretions. It's the sperm that's ejected from the body.

Female Reproductive System

The female reproduction system is made up of the ovaries, the fallopian tubes, the uterus, the cervix (or neck of the uterus) and the vagina.

Reproduction begins in the ovaries where the ova or female reproductive cells are produced. Once a month, an ovum passes from one of the ovaries into its adjoining fallopian tube. This is called ovulation. The wall of the uterus (or endometrium) then prepares for the possible implantation of an embryo by producing an extra lining. The ovum has a lifespan of approximately 24 – 36 hours. If male sperm enter the fallopian tube or have been lying in wait, one sperm may successfully penetrate the ovum. This is called fertilization.



12. Special considerations

12.1 Medical Kits and Supplies

First Aid Kit – General Considerations

What is brought into the backcountry can often be the limiting factor in the rescuer's ability to provide an appropriate standard of care. A well-constructed kit is essential to travel and work in remote settings. The following considerations should be addressed when designing a first aid kit.

Activity/Environment

Consider the nature of the activity, the environment and the season. A kit suitable for a weekend hike is not suitable for a week-long kayak trip or a month-long field reconnaissance in the Far North. The duration and geographical framework of these three expeditions are completely different. Sprains and strains require athletic tape, ace bandages and closed cell foam, for instance, while the treatment of kayaking injuries may require technical dressings to effectively deal with the water environment.

Group Members

The number of people in the group, their skill level, first aid training and experience will dictate the quantity and nature of items to be carried by the leader. Those inexperienced in wilderness excursions are more likely to require care for overuse injuries, for instance.

Type

It is often useful to set up a basic kit and then modify it to meet specific trip needs. In some circumstances, carrying more than one kit is useful. The basic kit stays at the bottom of the pack while a secondary kit can be readily available at the top of the pack. Some items must be kept close to the body to prevent freezing. In large groups, additional material can be split among group members rather than carried exclusively by the group leader.

Kit Container

The best kit containers meet the following criteria:

- Contain compartments to keep things organized
- Fold out to provide access to contents and provide a "work" area
- Protect contents from moisture and dirt
- Be malleable and able to fit in both a dry bag and a pack

Kit Size

The larger and more bulky the kit, the more cumbersome it becomes and the less likely it will be packed on light-weight trips. Manufactured containers are available in a variety of shapes and sizes and can be modified to suit specific needs.

Versatility of Items

Select items with which you are familiar. Weight and space limitations make items that have multiple uses more valuable. You must know where various items are located, their expiry dates and what they are used for.

Leader's Responsibility

The first aid kit must include the items necessary for appropriate care in emergency situations. Group members must undertake some responsibility for their own care and should communicate any health issues to the leader. The leader, on the other hand, must make every attempt to be aware of individual health problems before the trip begins.

12.1.1 First Aid Supplies

Universal Precautions

Gloves

For use anytime contact with body fluids is a possibility. Ensure gloves are not damaged and that an adequate supply is available.

Face Shield

Many are available. The best ones have a one-way valve and readily contour the face of the patient. Some models allow the addition of oxygen (see Universal Health Precautions (p. 14)).

Eye Protection

Clear protective eyewear must be worn if there is any chance that fluid may be splashed (i.e. during wound cleaning).

Face Mask

A surgical mask will protect the rescuer and patient from air-borne disease.

Biohazard Bag

This is a container for medical waste. It is impermeable to viruses, bacteria and other microorganisms.

"Sharps" Container

A plastic container for contaminated instruments, needles etc.

Instruments

Oropharyngeal Airways and Portable Suction Unit

Practical only for large expeditions.

Sphygmomanometer

Blood pressure cuff for accurate assessment of blood pressure. May be used as a tourniquet or to apply direct pressure for persistent bleeding.

Stethoscope
Lightweight inexpensive models are suitable for expedition work. Essential at altitude where early indication of pulmonary edema is essential.

EMT Shears
Durable stainless steel shears capable of cutting layers of athletic tape, clothing, zippers, straps, metal, kevlar.

Bandage Scissors
4.5" stainless scissors with angulated cutting blade and safety tip. Ideal for removing bandages and tape.

Iris Scissors
4.5" stainless scissors with straight blades and pointed tips. Useful for tissue debridement, suture removal, and cutting tape, gauze and bandaging material.

Oral Thermometer
Digital thermometer for fever assessment (35 – 42 degrees Celsius).

Hypothermia Thermometer
Digital thermometer with lower temperature reading for hypothermia assessment (26 – 40 degrees Celsius).

Pen Light
Useful for mouth, ear and eye examination, and assessment of pupil reaction. Also useful as emergency light.

Irrigation Syringe 40-60 cc.
For irrigating wounds with water or antiseptic. Tip can be removed for low-pressure eye and ear irrigation.

Tweezers
Stainless steel tweezers coming to a fine point – useful for wound cleaning, splinter and tick removal.

Forceps
Locking tweezers useful for holding gauze while wound cleaning.

Large Safety Pins
For multiple uses: bandaging, securing dressings, etc.

Scalpel blade No· 11
Surgical stainless steel blade that tapers to a fine point – useful for lancing blisters, removing splinters or reopening wounds that need to be re-cleaned.

Sterile Needle
Injection needle with tapered point for lancing blisters.

Dental Mirror
Small mirror on elongated handle – aids with oral examination.

Disposable Razor
Shaving razor useful for topical preparation prior to applying adhesive.

Surgical Scrub Brush
Latex plastic brush (sometimes soaked in antiseptic solution) for abrasion cleaning.

Dressing Materials

Triangular Bandage
Useful for bandaging and improvised compression bandage.

Abdominal Pad
Very absorbent and useful for large bleeds.

Sterile Gauze Pad
2”X2”, 4”X4” sizes for bleeding control and dressing.

Non-Stick Gauze Pad (Telfa®)
Will not debride wound when removed. Various sizes.

Non-Sterile Gauze
Useful for wound cleaning and to be applied on top of sterile gauze for heavy bleeding.

Sterile Gauze Roll
High quality cotton useful for securing dressings.

Elastoplast Strip
Adhesive tape with gauze for dressing small scrapes and cuts. Cut to size.

Cotton Tip Applicators
Sterile cotton tip applicator for removal of foreign bodies from eyes, ears and wounds.

Non-sterile Cotton Applicators
Useful for applying tincture of bezoin, etc.

Trainer’s Tape
1.5” quality cotton athletic tape for taping joints, bandages and splints.

Surgical Hypoallergenic Tape
1/2” tape with non-zinc-based adhesive.

Technical Dressings

Sterile Wound Closures (Steri-Strips®)
Non-elastic adhesive topical wound closures.

Spenco Second Skin®
Sterile water-based gel on semi-permeable film, used in burn management, wound dressing and blister care. It is placed directly on open wounds.

Occlusive Dressing (Biopore®, Tegaderm®, Opsite®)
Oxygen-permeable sterile dressing creates a transparent barrier to bacteria and water. Excellent for long-term management of burns and wounds.

Opsite® Spray
A water impermeable film that is sprayed over an abrasion. Has the same qualities as an occlusive dressing. Useful in a camp environment where bulky medical supplies can be stored.

Moleskin
A tough adhesive dressing useful for the displacement of pressure and friction associated with blisters. Caution must be used due to its bacteria-harbouring nature.

Compeed®
A blister care product. Adhesive skin-like covering for treating both open and closed blisters.

Spenco Adhesive Knit®
Thin durable dressing with water-resistant adhesive. Ideal for prevention of blisters and securing blister care products to hands and feet.

Miscellaneous Items

Oral Rehydration Solutions
Useful for treatment of heat-related illness and other forms of severe dehydration.

Glucose Gel
For treatment of hypoglycemia, the gel is a concentrated glucose dose that is absorbed directly through the mucus lining of the mouth.

Sam Splint
Made of lightweight aluminum, this splint lends itself to multiple uses. It provides rigid support and is padded for comfort.

Wire Splint
Similar to Sam Splint but without the padding.

Compressor Bandage (Tensor®)
Used for providing compression in musculoskeletal injuries. Excellent for holding ice packs in place. Used in conjunction with trainer's tape to provide support for injured joints.

Cold Compress (instant cold pack)
Portable, disposable cold compress. Activated as required by cold chemical reaction.

Sunscreen
The active ingredients titanium dioxide and zinc oxide are considered among the most effective full-spectrum blocks available.

Dental Paste (Cavit G®)
For temporary dental repair. Used for replacing detached dental work and broken teeth. The paste hardens in place on the damaged tooth.

Dental Wax
Good alternative to Cavit G® for covering sharp broken teeth or lost fillings.

Rescue Blanket
Useful as a temporary shelter. Blocks wind and reflects radiated heat.

Surveyor's Tape
Useful for identifying accident area.

Waterproof Plastic Containers
For storing medications, small items, etc.

Ziploc Bags
Waterproof storage for kit materials. Also useful for irrigating wounds, storing avulsed tissue, occlusive barrier for open chest wounds, waste disposal, etc.

Sanitary Napkins
The unfamiliar wilderness environment can cause undue stress and disrupt the regular menstrual cycle. Highly appreciated by unprepared participants. They also provide additional absorbent material for bleeding wounds.

Antiseptic Wipes
Benzalkonium chloride wipes, povidone-iodine wipes and applicators are items that make wound care (especially minor wounds) easier to manage.

Antiseptic Solution
Non-alcohol-based antiseptics for wound irrigation. Transfer antiseptic into a sturdy and durable container (eg. Nalgene bottle) to avoid spillage during travel.

Eye Irrigation Solution (Murine®, Tears®)
Non-medicated solution for irritated eyes, removal of foreign bodies, etc.

Analgesic Pads
Lidocaine 2.5 percent for wound cleaning.

Antibiotic Ointment (Polysporin®)
Or stronger prescription topical antibiotics.

Analgesic Ointment (Xylocaine®)
For topical application and wound cleaning.

Tincture of Iodine - 2.5 percent
Highly effective as a water disinfectant and as a wound irrigation solution when diluted in water.

Tincture of Benzoin
Applied to skin to help bandages adhere more effectively.

Alcohol 70 percent
Disinfectant for instruments and antiseptic for skin.

12.1.2 Leader's Essentials

Leaders should always carry the following items, regardless of trip duration or site location. Together these constitute the minimal amount of gear required to deal with environmental emergencies in all seasons.

Shelter
12'x12' guide tarp constructed of ripstop nylon with reinforced grommets. This material compacts into a small lightweight stuff sac that is easily carried in a daypack. The tarp can also double as the base for an improvised litter.

Heat Source
Small portable stove with pot and lighting mechanism, lighter and matches. It is essential to have an external heat source and the capacity to heat water for decontamination purposes.

Water
It is necessary to have appropriate containers as well as a means of purifying contaminated water.

Food
Extra high-energy food. Simple carbohydrates (glucose, fructose, sucrose) offer immediate fuel for depleted energy stores. Complex carbohydrates (starch), lipids (fats) and proteins offer a longer-term supply of energy.

Extra Clothing
Each participant must have appropriate clothing for the activity. This includes insulating layers and protection from the elements.

Map and Compass
An appropriate map of the area in which you are traveling or working is invaluable in emergency situations. Planning is greatly facilitated by having a visual reference in front of you. Do not rely exclusively on GPS.

Knife
A small compact, multi-tool knife is ideal.

Rope
50 ft (15 meters) of lightweight, high tensile cord can be useful for emergency shelter construction.

Whistle and Signalling Mirror
These provide simple but highly effective means of signalling your location in emergency situations.

Sleeping Bags
A lightweight sleeping bag is a must. It is invaluable in wilderness emergency situations and essential to the "hypothermia wrap."

Insulating Pad
Inflatable mattresses offer great thermal protection. However, if they are damaged they become almost useless. The closed cell foam pad tends to be more durable and can be used for multiple purposes in emergency situations.

Paper and Pencil
Pens should be avoided in wilderness settings, as ink freezes in sub-zero temperatures. All-weather writing paper (Rite in the Rain®) is useful.

Headlamp
Some form of hands-free lighting is crucial. Headlamps using longer lasting lithium batteries and light-emitting diodes (LED lights) are ideal.

First Aid Kit
A first aid kit designed for the activity.

12.2 Medication

The terms "medication" and "drugs" are often used loosely and interchangeably. Here we use the term "drug" to refer to any substance used in the management or prevention of medical problems in a wilderness environment. These include drugs that are readily available at pharmacies and topical preparations such as sunscreens and insect repellents. Essentially any active ingredient that is put in or on the body and that has some designated effect could be considered a drug

Great care must be exercised in administering any drugs in the backcountry. Even the most common and widely used drugs may have serious side effects under certain conditions. Before administering a medication all the potential risks and benefits must be weighed.

Leaders and rescuers must have a thorough understanding of any drugs they carry in their first aid kits as well as any drugs that group members may be taking during the trip. The best source of information about drugs is a physician or pharmacist. Other sources of information include drug reference books, available at your local library, bookstore or on internet sources.

An excellent reference for outdoor operators and guides is the New Guide to Prescription and Over-the-Counter Drugs published by the Canadian Medical Association. Most bookstores and libraries have copies. In addition to information on all drugs sold in Canada, there is general information on diseases and medications.

Drug Considerations Drug Names

Most drugs in use have three different names. When a drug is first discovered or synthesized, it is given a chemical name to describe its molecular structure. When the drug is approved by a government agency for use in the general population, it is given a common or generic name since the chemical name is usually too cumbersome for general use. Finally, the drug's brand name is the name chosen by the manufacturer for marketing purposes. For example, "Tylenol" is a brand name. "Acetaminophen" is the same drug's generic name, while its chemical name is "N-acetyl-para-aminophenol."

Classification

Drugs are sometimes grouped according to chemical similarity. Most often they are grouped according to their use or biological effect. Acetaminophen and Ibuprofen, for instance, are both used as analgesics (pain relievers) and antipyretics (reducing fever). However, they belong to different chemical classes. Acetaminophen is what is known as an aniline analgesic, whereas ibuprofen is a non-steroidal anti-inflammatory drug (NSAID) and indeed also has important anti-inflammatory properties.

Ingredients

Know what the active ingredients in a medication are and how they affect the body. Each ingredient may produce adverse reactions and side effects in some people. Some medications, known as combination drugs, are preparations comprised of two or more drugs. Many medications designed to relieve flu symptoms fall into this category.

Action

The action of a drug refers to the effect that the drug has on the body. The action of most drugs will have an effect on many tissues and organs in the body. Some drugs remain active in the body for weeks following the last dose. While some of these effects are beneficial or therapeutic, other effects may be less desirable. These are known as side effects.

Reaction Time

The reaction time or rate of onset refers to the length of time before the drug begins to have the desired effect.

Therapeutic Effect

This is the desired effect that the drug is supposed to have. Some drugs may have several therapeutic effects.

Side Effects

Side effects are the expected and frequently experienced additional reactions of a given drug. Side effects may not be present in everybody and may gradually diminish as the body becomes accustomed to the drug.

Adverse Reactions

Adverse reactions are unexpected and undesirable reactions that are not related to the usual effects of a normal dose of a drug. Adverse reactions include allergic reactions and interactions with other drugs.

Precautions

These include allergic reactions, pregnancy, potential for abuse, age-related and special conditions, actions with other drugs, sensitivity to sunlight, etc.

Drug Interactions

When drugs are taken in combination with certain foods, alcohol or other drugs, they may produce different effects than when the drug is taken alone. In some cases drug interaction is beneficial. In other cases the interaction produces effects that are not desirable or may even be harmful. Some types of interactions include:

- Altered Absorption – the rate at which the drug is absorbed from the stomach and intestines.
- Altered Excretion – the rate at which the drug is excreted or removed from the body.
- Decreased Potency – rendering it less effective.
- Increased Potency – increasing its effectiveness in the body.
- Similar Effects -- drugs can have the same effect on the body via different mechanisms. This is because they have a different chemical structure and will stimulate different receptors in the body to produce the same effect.
- Additional side effects or adverse reactions.

Indications

Indications are the conditions in which the drug should be used.

Contraindications

Contraindications are the conditions under which the drug should not be used.

Patient Medication History

This is a patient's history with a particular drug, especially any adverse reactions or history of significant side effects. Any allergies should be noted as well as the class of drug. Patients can have allergies to several drugs in the same class – ASA (Aspirin®) and Ibuprofen (Advil®), for instance, both belong to the class of non-steroidal anti-inflammatory drugs (NSAIDS).

Route of Administration

The route of administration refers to the route a drug takes to reach the tissues where their effects are needed. The route of administration determines the speed and efficiency at which the drug begins to have an effect. There are many possible routes for a drug.

Oral

This is the most frequent route of administration. The drug is swallowed and acts on the body through the digestive system. The speed at which the drug is absorbed and the amount of drug that is available depends upon several factors: the form it is given in (tablet or liquid) and whether it is taken with food. Most tablets require at least 1/2 an hour to be effective.

Sublingual

Sublingual administration refers to medication that is placed under the tongue and absorbed through the lining of the mouth which has a rich blood supply.

Buccal (from the Latin for cheek and mouth)

Medications such as glucose gel may be rubbed into the gums and cheeks or placed between the cheek and gums.

Subcutaneous

The drug is injected under the skin.

Intramuscular

The drug is injected into a muscle, usually the thigh, upper arm or buttock.

Intravenous
The drug is injected directly into the bloodstream via the veins. Drugs administered by this route act more quickly than drugs administered by other types of injection. However it requires specialized equipment, training and practice.

Transdermal
The drug is absorbed slowly through the skin, usually from an impregnated adhesive patch.

Topical
The drug, in the form of a cream, ointment, liquid, spray or lotion, is applied directly onto the skin.

Rectal
The suppositories are inserted into the rectum, from where the drug passes into the bloodstream. The drug may also produce a local effect on tissues.

Respiratory
Drugs are inhaled to produce a systemic effect or a direct effect on the tissues of the respiratory system. Bronchodilators, which are used to treat asthma, fall into this category.

Dosage
The dosage refers to the amount of drug that is required to achieve the desired effect. Generally the dose is a function of the patient's body weight. The effect a drug will have on the body will vary among individuals. In the backcountry it is prudent to administer the smallest dose possible and wait to see if the desired effect has been achieved. Other considerations related to dosage include the maximum dosage allowed per day; the time of day the drug should be taken; what to do if a dose is missed; whether the drug should be taken before, after or during a meal, or else on an empty stomach; and finally when to stop taking the drug.

For the purposes of drug administration, anyone under the age of 12 is considered a child. Never give a child even a small portion of a medicine intended for adult use without the advice of a physician or pharmacist.

Stability
The stability refers to the "storageability" of a drug. Some drugs must be stored at low temperatures while others are kept at room temperature. Some drugs will deteriorate if they are frozen, heated or come in contact with moisture. Expiry dates should be noted and the drugs disposed of when they are due. Where possible, they should be returned to the pharmacy. Never give drugs to anyone if they have exceeded their expiry date or show signs of deterioration.

Considerations
Helping a person take or administer a medication is a serious medical procedure, usually reserved for health care professionals. However, the nature of remote areas sometimes requires us to take medications with us on a preventive basis for use in medical emergencies. However, this does not detract from the seriousness of the act, and several considerations must be taken into account before advising a drug or assisting in its administration.

First of all, in order to better understand what you can and cannot do as a first responder, you need to differentiate between three classifications of drugs :

- Non-prescription drugs
- Prescribed drugs
- Emergency medication (prescribed or not)

Non-prescription drugs are all those you can buy freely in pharmacies such as ibuprofen (Advil®) or acetaminophen (Tylenol®). These drugs are available to anyone who is old enough to make their own decisions for themselves, and since we do not have access to a pharmacy in isolated areas, the leaders' kit can be used as a group pharmacy.

Prescribed drugs, such as strong painkillers (pain killers) or antibiotics, always require a doctor's prior approval before they are administered, as misuse could have serious consequences. We still recommend having them with you in remote areas. However, if you think you need it, make sure you can contact a doctor. Some organizations or leaders of large expeditions will choose to operate under the medical direction of a person with the authority to prescribe these drugs, which will help them in such situations. In fact, SIRIUSMEDx offers telemedicine services.

Emergency medication, whether prescribed or not, can save lives. In the field, you may not always have time to call a doctor, or you may not have a satellite phone at your disposal. When someone's life is at stake, administer the medication without delay. You can always call afterwards to validate your decisions.

Before you help someone take any medication, you should always check :

- This is the RIGHT patient
- This is the RIGHT medicine
- This is the RIGHT dose
- It's the RIGHT time (some medications should be given at mealtime or before bedtime for example).
- This is the RIGHT route of administration (under the tongue, intramuscular or subcutaneous injection, inhalation, etc.).
- That's the RIGHT reason.
- You complete a GOOD documentation of your deed

Reading the directions that come with the medication will help you with these checks.

- Consult a pharmacist or doctor. Make a list of all the medicines you are taking or will be taking. Record this information in writing and keep it in your observation notebook or first aid kit.
- Obtain a prescription for all drugs carried in the leader’s first aid kit.
- Store drugs in water-proof and crush-proof containers.
- Drugs that are used in the management of serious or life-threatening conditions should not be carried by only one person or stored in only one canoe or backpack.
- Bring along an extra supply of important medications that group members may require and keep these with the group leader.
- When visiting foreign countries keep copies of prescriptions and store the drugs in their original containers. Be prepared to produce these documents at customs.
- For remote excursions take more than one type of medication for the same indication in the event that a group member develops an allergy or sensitivity to a drug. Examples include different types of analgesic, sun screen and insect repellent.
- Gather information from participants on any allergies and medications taken individually.

12.2.1 Medications Commonly Used in the Backcountry

Analgesics (Pain Medication)

Acetaminophen (Tylenol®)

Indication – Non-opioid analgesic used for mild pain relief and to reduce fever. Unlike other analgesics it does not cause stomach upset or gastrointestinal bleeding.

Precautions – Large doses can cause serious liver and kidney damage.

Acetaminophen with Codeine Phosphate (Tylenol 3®)
Only by prescription

Indication – For moderate to severe pain. Codeine is an opioid analgesic and cough suppressant.

Precautions – Codeine can cause constipation. Large doses of acetaminophen can cause serious liver and kidney damage.

Benzocaine (Orajel Maximum Strength®)
Indication – Topical oral analgesic for tooth and gum pain.

Precautions – Not to be applied to severely damaged tissue because of the risk of systemic absorption.

Lidocaine 5% (Xylocaine®)
Indication – Topical anesthetic ointment used for the temporary relief of pain associated with burns and abrasions.

Precautions – Not to be applied to severely damaged tissue because of the risk of systemic absorption.

Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)

Ibuprofen (Advil®, Motrin®)
Indication – To reduce inflammation and relieve mild to moderate pain.

Precautions – Gastric irritant.

Angina and Heart Attack

ASA Acetylsalicylic Acid (Aspirin®) (non-enteric-coated)
Indication – To treat episodes of angina and heart attack.

Precautions – Can provoke asthma attacks. With prolonged use, it can cause gastric ulcers and bleeding.

Nitroglycerin
Indication – To treat acute attacks of angina pectoris. Nitroglycerin is a potent vasodilator that relaxes the blood vessels and allows more blood to reach the heart.

Precautions – Should not be taken with phosphodiesterase inhibitors such as Viagra® or Cialis® since these amplify the effects of vasodilation and can lead to severe hypotension.

Allergic Reactions

Epinephrine (Epi-Pen®)
Indication – Auto-injected dose of epinephrine to treat severe allergic reaction and anaphylactic shock.

Precautions – There are no absolute contraindications to the use of epinephrine in an anaphylactic emergency.

Diphenhydramine Hydrochloride (Benadryl®)
Indication – Antihistamine used to prevent or reduce the symptoms of allergic reactions.

Precautions – May cause drowsiness. Should not be taken with alcohol.

Loratadine (Claritin®)
Indication – Non-sedative antihistamine used to prevent or reduce the symptoms of allergic reactions.

Precautions – May cause headaches, dry mouth, indigestion.

Hydrocortisone 0.5% or 1% (Cortoderm®)

Indication – Topical ointment used to provide temporary relief of minor skin irritation, itching and redness due to insect bites and allergic reactions.

Precautions - Do not exceed prescribed doses. Do not use for more than 7 consecutive days. Not to be used in cases of untreated bacterial or fungal skin infections.

Asthma/Bronchitis

Salbutamol Sulphate (Ventolin®)

Only by prescription

Indication – Metered-dose inhaler used for the symptomatic relief of bronchial asthma, chronic bronchitis or exercise-induced brochospasm.

Precautions – In large doses, can cause anxiety, tremors and restlessness. Should not be taken with epinephrine or sympathomimetic agents (substances that mimic the effects of the sympathetic nervous system).

Gastrointestinal Disorders

Calcium Carbonate; Simethicone (Maalox®)

Indication – Chewable tablets to relieve acid reflux, indigestion and gas.

Precautions – None known.

Dimenhydrinate (Gravol®)

Indication – Antihistamine used to treat motion sickness, relieve nausea and vomiting.

Precautions – Can cause drowsiness, dry mouth and blurred vision. Not to be taken with alcohol. Do not drive or operate heavy machinery.

Oral Rehydration Salts (Gastrolyte Regular®)

Indication – Powder mixed into solution taken orally for the management of excessive electrolyte loss due to diarrhea, vomiting and excessive perspiration.

Precautions – Each sachet should always be dissolved in water as directed on the package. A weaker solution will provide an inadequate concentration, and a stronger solution may lead to an electrolyte imbalance. Not to be administered in cases of intractable vomiting or intestinal obstruction.

Loperamide Hydrochloride (Imodium®)

Indication – Taken orally for the symptomatic control of acute non-specific diarrhea, and as an adjunct to oral rehydration therapy.

Precautions – Not to be taken for the management of gastrointestinal infection, as it may delay the expulsion of bacteria from the bowel. Should not be taken with opioid analgesics, as they may cause severe constipation.

Diabetes and Glucose Disorders

Oral Glucose Gel (Insta-Glucose®)

Indication – Concentrated glucose taken orally to raise blood sugar levels in hypoglycemic patients.

Precautions – No known side effects.

Antiseptics, Topical Antibiotics and Antifungals

Tincture of Iodine 2 %
Indication – Bactericidal and fungicidal tincture used for disinfecting backcountry surface water.

Precautions – Allergies to iodine.

Povidone-Iodine (Proviodine®)
Indication – Compound solution used for skin and wound disinfection.

Precautions – Allergies to iodine.

Benzalkonium Chloride
Indication – For minor cuts and abrasions.

Precautions – Not to be used in excessive quantities. Not to be applied to extensive or blistered wounds. Regular use can lead to resistance to the antiseptic.

Polymyxin B Sulphate; Gramicidin (Polysporin® Antibiotic Eye Drops)
Indication – Ophthalmic antibiotic treatment of superficial infections of the external eye.

Precautions – Prolonged use may result in the overgrowth of resistant organisms, including fungi.

Polymyxin B Sulphate; Bacitracin Zinc; Neomycin Sulphate (Neosporin® Antibiotic Ointment)
Indication – Topical antibiotic treatment of superficial infections.

Precautions – Not to be used in the eyes or in extensive wounds where absorption is possible. Prolonged use may result in the overgrowth of resistant organisms, including fungi.

Clotrimazole 1% (Canesten® Topical)
Indication – Topical treatment of fungal infections, including athlete's foot and jock itch.

Precautions – May cause burning, irritation, itching.

Insect Repellents

DEET (OFF®)
Adults: 24 %; children: 6 %

Indication – Spray or solution used to repel insects.

Precautions – Not for use on children under 6 months.

Other

Artificial Tears
Indication – Saline eye drops for dry and irritated eyes.

Precautions – Side effects are rare. Brands with preservatives may cause sensitivity.

12.3 Mental Health Emergencies and Stressful Events

Any unexpected event or accident can have repercussions beyond physical injury or trauma and quickly become a stressful situation. The stressful incident can be relatively minor (non-essential equipment or food that is missing) or relatively major (life-threatening accident or death). It can also be short-term (a single accident) or long-term (major alteration to a designated route or prolonged exposure to harsh weather). The participants' response to the stress will depend on a variety of factors, such as each individual's life experience, temperament, training and the type and duration of the event, among other things. The psychological and emotional trauma that results from a stressful situation may be as debilitating to the participants as a physical injury. The effectiveness of accident management and long-term care increases if leaders are aware of the psychological and emotional effects of trauma and fear and know how to deal with them.

Assessment

- Fear – This is a normal and even useful emotional response to a perception of threat or danger. A client on a backcountry trip may have a lower threshold for fear than a well-trained and experienced guide.
- Retrospective Analysis and Responsibility – It is common to experience a sense of responsibility for what happened and question how one might have done things differently: "If only I had..."
- Survival Guilt – Survivors of an accident often experience guilt that it did not happen to them.
- Depression – This is a common emotional response to stress. If left unchecked over time, however, it can lead to the inability to act or make decisions.
- Aggression – Feelings of frustration or loss of control that accompany a crisis may elicit angry or explosive behaviour.
- Oppression of Emotions – The belief that one should "get back on the horse" and behave as if nothing has happened may inhibit other appropriate responses.
- Repression or the Temporary Setting Aside of Emotions – Leaders are often in a position where it is appropriate to set aside emotions. The decision "I'm going to deal with this later" allows them to focus on the tasks at hand. Emotions should be addressed as soon as possible, however. They may surface later as irrational fears or other psychosomatic symptoms if they are not appropriately addressed.
- Physical Symptoms – Participants may suffer any of the following physical symptoms: fatigue, loss of appetite, headaches, aches and pains, shock-like symptoms, insomnia.
- Irrational Behaviour – Bouts of hyperactivity or panic attacks are possible responses to the stress of an accident.
- Emotional Hypersensitivity – Functioning in a stressful environment may elicit irritability, anxiety, numbness and increased startle reaction.
- Cognitive Problems – Inability to concentrate or make decisions, memory loss or amnesia are also common reactions.

> **NOTE**
>
> Medication may mask psychological symptoms or head injury symptoms. It may also interfere with the normal grieving period.

Management

- Stabilize the immediate environment. Provide basic needs for patients and group members. Provide shelter, protection, warmth, food, comfort and support.
- Provide accurate and objective information: “This is what has happened… This is the result…This is the next course of action…”
- Allow patients and group members to express their fears - “How do you feel about…?”
- Allow for some venting of emotions. Describing what happened can help patients get their thoughts in order. As well, letting off steam in a controlled environment can help group members move on from the incident and focus on the task at hand.
- Physically injured patients may need to be buffered from activity and curious group members, bystanders and staff.
- Let patients help each other. This establishes reassuring adult roles in place of dependent ones and relieves feelings of helplessness and loss of control.
- Keep people busy. Provide simple tasks that can be managed by patients in small groups.

Follow Up

- Expect some anger from people who were not necessarily involved in the incident. The anger or frustration is often directed at the rescuers or associated agencies.
- Organize debriefing with mental health consultants and others who were not involved in the incident.
- Reach out to people who were not primarily involved in the incident but may have been affected in some way. This includes bystanders, other group members as well as relatives who were not on the trip.
- Write a detailed report as soon as possible.

Preparation

Much of the stress of an emergency can de reduced if leaders are thoroughly prepared for the trip they are leading, have anticipated possible problems and have arranged for contingency plans.

13. Basic Life Support

Cardiac arrest is one of the leading causes of death in North America. When the heart stops beating, it no longer circulates oxygen-rich blood from the lungs to the cells of the body, and without oxygen none of the body's cells can function. Any interruption in respiration or circulation may result in the need for cardiopulmonary resuscitation.

13.1 Cardiopulmonary Resuscitation

Cardiopulmonary resuscitation (CPR) is a sequence of life-saving techniques that are integral to emergency care for victims of sudden cardiac arrest (SCA). The techniques are designed to mimic the proper functioning of a person's circulation, airway and breathing. They include manually pumping the heart by exerting external pressure on the chest, clearing the air passages to the lungs and, where necessary, providing artificial respiration.

A Note on the Presentation of CPR Material

The material in this chapter is based on guidelines established by the American Heart Association in 2010. Some of this information overlaps with the material presented in the primary examination section (see Primary Survey (p. 60)). As a result, this chapter will cover only information and specific techniques that are not already addressed elsewhere. Special Considerations for Wilderness Settings are discussed at the end of this chapter.

Lay Rescuer and Healthcare Providers

CPR protocols differ for lay rescuers with little or no training, on one hand, and healthcare providers, who have advanced medical training on the other.

This chapter covers CPR techniques for healthcare providers.

13.1.1 Definitions of Death

Clinical death

Is the term used to describe a reversible condition in which a person's heart stops beating. Within seconds, the person will lose consciousness and stop breathing. The brain can only survive for a few minutes in these conditions.

Biological death

Refers to an irreversible condition in which the brain no longer displays any electrical activity due to lack of oxygen.

Critical Timelines for the Brain

- Within 4-6 minutes of clinical death, some brain damage is possible.
- Within 6-10 minutes of clinical death, brain damage is likely.
- After 10 minutes of clinical death, irreversible brain damage is certain.

Under special circumstances, such as severe hypothermia, biological death may be delayed.

The best outcome for resuscitation occurs when CPR is initiated within the first 2 minutes of clinical death and defibrillation is administered within 5 minutes of collapse. The long-term survival rate of a patient decreases by about 4 percent for every minute without defibrillation. Without CPR, long-term survival rates fall by 7 - 10 percent for every minute of delay in administering defibrillation.

13.1.2 The Chain of Survival

The most effective intervention in a cardiac or respiratory emergency is a multi-tiered team response. The rescuer who comes upon a person lying on the ground and initiates CPR represents a single link in a larger chain of emergency response. The Heart and Stroke Foundation of Canada has developed a model, called the Chain of Survival, to help highlight the collaborative nature of emergency response and the importance of activating each link quickly and efficiently to optimize patient outcome. The Chain of Survival includes five links.

1. Immediate Recognition of an emergency and Activation of Emergency Medical Services.
2. Early CPR – When started immediately, CPR ensures that the brain, heart and lungs receive oxygen until EMS arrives on the scene. Delays in starting CPR will severely affect patient outcome.
3. Rapid Defibrillation – Rapid defibrillation is essential to restoring the electrical rhythm of the heart.
4. Effective Advanced Life Support – Advanced cardiac life support and other medical interventions by healthcare providers help stabilize the patient.
5. Integrated Post-Cardiac Arrest Care – After admission to hospital, post-cardiac arrest care optimizes and improves survival for victims of cardiac arrest.

The first 3 links in the chain can be performed by lay rescuers or healthcare providers in the field and are included in this chapter. The final 2 links require more specialized techniques and equipment and are not dealt with here.

13.2 Adult CPR

13.2.1 Basic Life Support Sequence

The emergency response priorities highlighted in the Chain of Survival are at the core of the sequence of steps rescuers should undertake to help determine the condition of a patient and how best to care for him or her. This sequence of actions is known as Basic Life Support (BLS). It corresponds to what is referred to elsewhere in this manual as Patient Assessment.

BLS Sequence

- Assessing Scene Safety
- Assessing Responsiveness
- EMS Activation/ ask for AED
- Assessing Circulation – Checking the Pulse and the breathing simultaneously
- Early CPR
  - Administering Chest Compressions
  - Opening the Airway
  - Delivering Rescue Breaths
- Rapid Defibrillation

Assessing Scene Safety

When a rescuer alone discovers an unconscious adult or witnesses a cardiopulmonary arrest, the rescuer must ensure the safety of the scene (see Scene Survey (p. 59)).

Assessing Responsiveness

After ensuring the scene is safe, the rescuer should:

He checks whether the victim is conscious or not by tapping the shoulder and talking aloud (see Primary Survey (p. 60)).

EMS Activation

If the patient is unresponsive and not breathing or only gasping the rescuer should suspect cardiac arrest.

When to Activate EMS

When you discover an unconscious person and you are accompanied, ask that person to call EMS and get an automated external defibrillator (AED). During this time, you assess the victim and, if necessary, begin CPR maneuvers.

If you are alone, assess for responsiveness, place the patient in the recovery position (see below), go to activate EMS and get an AED if available.

EMS in remote environments

In most remote environments, of course, there is no immediate access to EMS. However, because EMS is an integral part of CPR in most settings, this chapter will always make reference to immediate EMS activation.

Automated External Defibrillator (AED)

An AED is a portable electronic device used both to diagnose life-threatening cardiac arrhythmias and to treat them with defibrillation. Defibrillation is a form of electrical therapy that enables the heart to regain its regular rhythm. AEDs are now widely available and part of all CPR training.

Assessing Circulation - Checking the Pulse and assessing breathing simultaneously

Taking no more than 10 seconds, palpate the patient's carotid pulse.

If there is no pulse or if you are unsure of a pulse, suspect that the patient is in cardiac arrest. Begin chest compressions immediately.

Assessing breathing

It is essential to open the airway before assessing the patient breathing for at least 5 second to maximum 10.

In the presence of a patient in which the breathing is:

- Absent or inefficient (agonal breathing): if there is a pulse, refer to « Ventilatory support».

CPR 1) Administering Chest Compressions

For any patient who has likely experienced a cardiac arrest, chest compressions provide vital blood flow to the heart and brain and must be started as soon as possible.

Chest compressions can only be performed on a firm, flat surface. It may be necessary for you to move the patient or, if you have placed the patient in the recovery position, to roll him or her onto the back.

Chest Compressions

- To begin, kneel on the side of the victim and spread your knees shoulder-width apart. Get as close as possible to the victim by placing one knee at neck level and the other in line with the middle of the chest.
- Make sure the patient is lying on his back on a firm and flat surface.
- Quickly move or remove clothing from the chest that would get in the way of doing chest compressions and using an AED.
- Place the heel of one hand on the lower half of the breastbone (sternum)
- Put the heel of the other hand directly on top of the first.
- Lace your fingers together.
- Lock your elbows and rock forward on your knees. Your shoulders should be directly over your wrists and lined up with the middle of the patient's breast bone.
- Your arms act like pistons, pushing down perpendicularly onto the chest. The compressions are delivered by pushing down directly onto the chest to a depth of at least 2 inches.
- After each compression, release pressure on the chest to let it recoil completely, i.e. come back to its normal position.
- Remember to push hard and push fast.
- Deliver 30 compressions at a rate of at least 100 per minute, maximum 120.

How Chest Compressions Work

CPR effectiveness is measured by the blood flow delivered to the heart muscle. Called coronary perfusion pressure (CPP), adequate blood flow and pressure are only maintained when all three of the following conditions are met:

- Compressions are done deeply and quickly – push hard and fast!
- There is full chest recoil between compressions
- Compressions are done with minimal interruptions

Allowing for full chest recoil is therefore no less important than pushing hard and fast.

If the thrusts are effective

If the thrusts are effective and the patient begins to breathe normally, the patient still requires follow-up medical care to avoid any complications caused by the techniques or by the obstruction.

CPR 2) Opening the Airway

In unresponsive patients lying on their back, the tongue and throat muscles relax and may block the airway. Once the first cycle of 30 chest compressions is complete, the rescuer must open the airway to perform rescue breaths.

Head Tilt - Chin Lift

To open the patient's airway, place one hand on the forehead and 2 fingers under the bony part of the chin. Tilt the forehead back and lift the chin at the same time. It is important to avoid putting pressure on the soft tissues of the neck or under the chin.

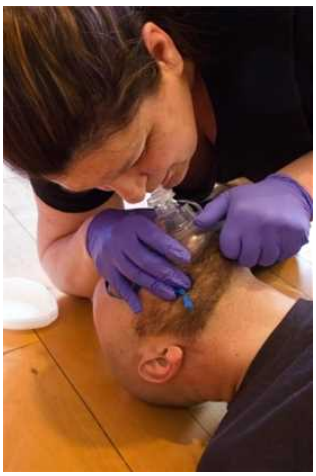
Jaw Thrust

If the mechanism of injury suggests a neck or spinal injury, open the patient's airway with a jaw thrust manoeuvre to lift the jaw without extending the neck.

Rest your elbows on the ground above the patient's head and place your hands on each side of the patient's face with yours thumps on the cheeks. Curl the fingers of both hands under the patient's lower jaw and lift the jaw forward.

CPR 3) Delivering Rescue Breaths

After opening the airway, proceed to rescue breaths.



- Deliver 2 breaths of 1 second each.
- Give enough air to see the chest visibly rise.

If the first breath does not go in

If the first breath does not go in, reposition the head with another head tilt – chin lift before giving the second breath.

- After 2 breaths, resume chest compressions.

How to Give Breaths

There are several ways to provide artificial respiration to the patient. The technique used will depend on the availability of a barrier device, the size of the patient and the presence of trauma around the face.

Mouth-to-Mouth

The rescuer takes a normal breath, seals his or her mouth over the patient's mouth and pinches the patient's nose. The rescuer then exhales into the patient's mouth while watching for the chest to visibly rise.

13.2.2 Adult CPR cycle

1-Rescuer CPR: 30 Compressions / 2 Breaths

For an adult, the rescuer should perform cycles of 30 chest compressions followed by 2 breaths at a rate of at least 100 compressions per minute, maximum 120. Keep all interruptions to an absolute minimum.

Situations Involving 2 Rescuers

For optimal results, chest compressions must be delivered quickly. Rescuer fatigue can reduce the effectiveness of the technique. Whenever possible, a second rescuer should be called upon in a relief role to minimize fatigue.

Two rescuers take turns performing CPR

- The second rescuer arrives on the scene and identifies himself as a trained CPR rescuer. He asks if he can help the first responder.
- Rescuer #1 continues to administer CPR. Rescuer #2 activates the EMS system, if not already done, and brings back an AED, if available.
- Rescuer #2 positions herself at the patient's head to maintain an open airway, using either a head tilt – chin lift or a jaw thrust.
- Rescuer #1 continues CPR until the second rescuer is ready to replace him.
- The second rescuer takes over and continues one-rescuer CPR using the same ratio of 30 compressions to 2 breaths.
- The rescuers rotate every 2 minutes (or after about 5 cycles) taking no more than five seconds to change positions.
- Rescuers can also plan to stand up during any appropriate interruption of chest compressions (e.g., when the AED delivers an electric shock).

CPR special considerations

Compressions without Ventilations

Some rescuers may be hesitant to initiate rescue breathing without using a barrier device. While CPR is best performed by combining compressions and ventilations, a trained rescuer who is concerned about contamination may choose to perform chest compressions only until a barrier device becomes available.

Mouth-to-Stoma

A tracheal stoma or tracheostomy is an artificial mouth-like device surgically inserted into the trachea from the throat. Patients must use a stoma to breathe when they have a condition that interferes with coughing or blocks the airway or when they have had part of their larynx removed because of disease or trauma. Artificial respiration is done by sealing the rescuer's mouth over the stoma and delivering enough air to see the chest visibly rise. In cases where

the patient's own trachea has not been removed or has been only partially removed, the patient will exhale through the mouth and nose. In order to provide optimal ventilation, it may be necessary for the rescuer to close the patient's mouth and nose using one hand before delivering breaths via the stoma. If possible, ventilate the stoma with a barrier device such as a bag-valve-mask or a face mask.

13.2.3 Complications of Ventilation

Gastric Distension

Gastric distension or inflation is a common complication of artificial respiration. It usually occurs when the rescuer gives the breaths too quickly or too vigorously. This forces air into the stomach rather than the lungs. Gastric distension can cause the patient to vomit. A supine patient who vomits is at risk of aspirating the vomit and suffocating.

To Minimize this Possibility

- Limit breaths to 1 second each.
- Deliver only enough air to see the chest visibly rise.

What to do if the patient vomits?

If the patient vomits during a resuscitation attempt, quickly roll the patient over onto the side and towards you. This will allow most of the vomit to drain. You may need to open the patient's mouth to sweep out some of the remaining particles, and then continue CPR.

What to do if the patient is wearing dentures?

It is best to leave the dentures in place. The sturdiness of the prostheses allows the rescuer to close his mouth tightly around the victim's mouth. If the dentures are blocking the airway, however, or are inhibit the rescuer from delivering adequate breaths, they should be removed.

What to do if the patient's face is bleeding?

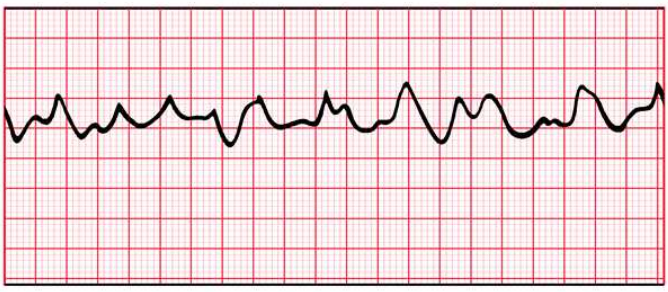
When you notice blood accumulating in the patient upper airway, roll the patient onto the side, this will help evacuating the blood, and then continue CPR.

13.2.4 Rapid Defibrillation

Most adults who are in sudden cardiac arrest are at risk of potentially fatal heart rhythms called ventricular fibrillation and ventricular tachycardia, in which the heart muscle suffers from unorganized electrical activity.

Ventricular Fibrillation (VF)

Ventricular Fibrillation (VF) is the most frequent arrhythmia, or irregular heartbeat, witnessed in the initial stages of cardiac arrest. It is characterized by a disorganization of the electrical overactivity of the heart making it « quiver » or fibrillate instead of contract. Without a contraction, the ventricles are unable to eject blood effectively, thus inhibiting vital blood circulation.

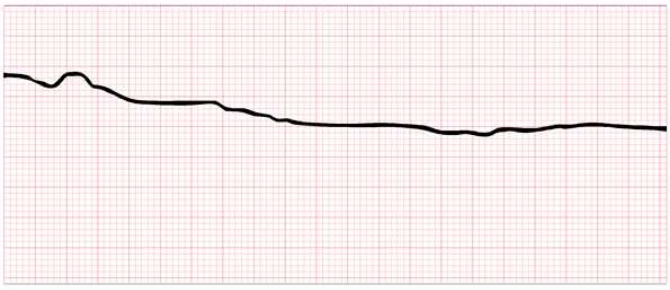


Ventricular Tachycardia (VT)

Ventricular Tachycardia (VT) is a rapid heartbeat (more than 100 beats a minute) that does not allow the heart to fill with blood, contract or create a pulse.

Asystole

With time, heart arrhythmias generally deteriorate to become asystole, which is an absence of electrical activity in the heart altogether.



Early Defibrillation

Defibrillation is the treatment of VF and some forms of VT. However, the effectiveness of defibrillation in converting the heart rhythm is rapidly decreasing. Early defibrillation is critical in cases of sudden cardiac arrest since asystole cannot be defibrillated and requires more advanced medical treatment.

13.2.5 When to Use the AED

Use the AED as soon as it becomes available even if it means interrupting the CPR cycles. If the AED is immediately available, provide electrical therapy first before beginning CPR. Rapidly administer the electrical shock when recommended by the AED. Follow the AED prompts for further CPR instructions. Effectiveness of shock delivery decreases significantly for every additional 10 seconds that elapses between the last compression and shock delivery.

How the AED Works

Over the past ten years, the technology that goes into AEDs has improved considerably. As a result, the general public can now use these devices without extensive training, with very favourable results. The AED works to depolarize the heart by delivering an electrical shock via electrodes applied to the chest wall. This may in turn enable the normal sinoatrial node or pacemaker of the heart to resume its coordinated activity.

AEDs are programmed to analyze and recognize many electrical patterns requiring defibrillation. Once the analysing is complete, two vocal messages can be heard: first one is shock advised when possible, and the second one would be to resume CPR even without giving a shock.

Operating an AED

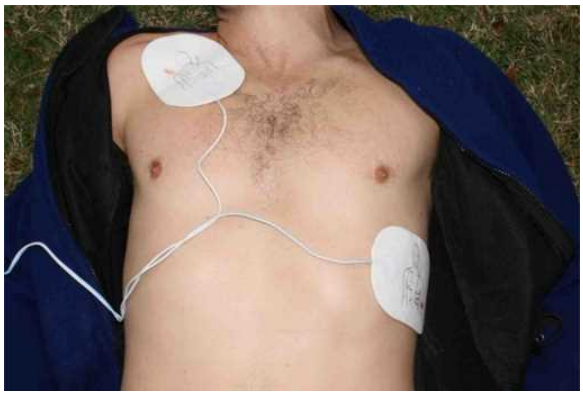
Many of the commercially available AED units have similar features and are programmed to be used in the same way.

Power Button

The AED is turned on by pressing the on/off button. Some models turn on automatically as soon as the cover is removed. An activated voice will instruct you of the following steps

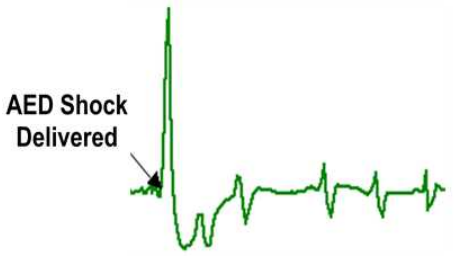
Connecting the Electrode Pads

The electrode pads are stored in pouches within the AED carrying case. Tear open the pouch and apply the pads on the patient dry, shaved and naked chest, as indicated in the illustration.



Analyzing the Heart Rhythm

Once the AED pads are connected, analysis of the heart rhythm will begin automatically. The AED will tell you to move back and not touch the patient before it starts analysing the rhythm.



Normal Electrical Activity

Clearing the Patient

Before the AED starts to analyze the heart rhythm, the patient must be "all clear." You must follow exactly the AED prompts This means:

- No one is touching the patient
- No one is moving

Clearing the patient prevents the AED machine from detecting any other electrical activity apart from that of the patient's heart. Any movement could distort or interrupt the analysing process and create additional delays.

"Shock Advised"

If a shock is advised, the rescuer presses the "Shock" button when prompted to do so. Before pressing the Shock button, a visual sweep of the patient must be done to ensure that the "all clear" condition remains.

"Shock not Advised - Resume CPR"

If a shock is not advised, the AED device will prompt the rescuer to begin or return to CPR for a period of 2 minutes before analysis takes place again automatically. Follow the prompts.

AED Maintenance

Follow the recommended manufacturer's maintenance suggestions. This includes making sure batteries are charged.

Special Considerations

Caution is required when using the AED in the following circumstances

- Medication Paste or Patches – Remove any medication paste or patches and wipe the chest before placing the AED pads.
- Oxygen Cylinders –the oxygen cylinder should be at least 1 meter away from the patient, and, when the AED instructs you to move back while analysing, you should also take away any piece of equipment used to ventilate the patient to prevent any burns or sparks during the electrical shock.
- Moving Vehicles – When transporting a patient who requires defibrillation, the vehicle should be stopped.
- Wet Surfaces – Dry off the patient's chest if wet. If lying in a pool of water, rapidly move patient to a dryer area.
- Conductive Surfaces – If you can, remove any jewelry or piercing from the neck and chest area that would impede electrode placement.
- Implanted Pacemaker or Automated Implantable Cardio-Defibrillator (AICD) – Pacemakers are generally visible, appearing as a lump under the skin of the chest. It is sometimes easier not to place pads directly over the implanted device. Defibrillation should not be delayed, however, by the need to verify exact pad placement.
- Hairy Chest Hairy Chest –Use the razor stored in the AED carrying case to remove hair from the patient chest to allow a better adhering of the electrical pads. In absence of a razor, you can proceed with following instruction: press firmly down the electrical pads on the patient chest, if the AED device prompts the rescuer to check the pads, remove some of the hair by tearing off the pads. Apply a second set of pads
- Pregnancy women- you can safely use the AED while performing CPR on pregnant women. Slide a pillow underneath the right hip to allow a better circulation.

13.3 Ventilatory support (respiratory arrest)

Ventilatory support must be started on a victim whose breathing is absent or inefficient, but the pulse is still present. You can use a pocket mask or an ambu bag to perform the technic.

In the presence of an adult victim, it is recommended to give 1 breath every 5-6 seconds for a total of 10-12 breaths per minute.

You must check the pulse every minute to make sure it's still present. You should keep the AED near you but OFF. Never install and activate an AED on a victim with a pulse, the AED will analyse the heart rate the moment the electrodes are installed regardless of the victim pulse.

13.3.1 Obstructed Airways

Dealing with choking emergencies can be frightening. A patient who is in respiratory distress is anxious and can become combative. It is important to react quickly to the following signs of airway obstruction.

The most common reaction to choking is to grasp one's throat with one or both hands. This is known as the universal choking sign. The inability to cough or speak is also a sign of a poor airway.

For a conscious choking patient, prompt intervention will enable the rescuer to clear the airway and restore breathing. The longer it takes to unblock the airway, the more likely the patient will lose consciousness.

Obstructed Airway in a Conscious Patient

Signs and Symptoms of Choking

If the patient can breathe, speak or cough, do not interfere. Encourage her to keep coughing.

A partial or complete airway obstruction, on the other hand, is characterized by weak or ineffective coughing, gasping, wheezing and the inability to talk.

The priority action to take in cases of partial or complete airway obstruction is to deliver abdominal thrusts in quick succession. These are known as the Heimlich manoeuvre.

Assessment of Obstructed Airway in Conscious Patient

- The patient cannot talk, breathe or speak.
- The patient may be grabbing her throat or indicating she cannot breathe.
- Ask the patient: "Are you choking?" ».

Management of Obstructed Airway in Conscious Patient

- Place yourself behind the patient
- Tilt the patient forward from the hip
- Give 5 back blows between the blades. If unsuccessful proceed to the next step.
- Deliver abdominal thrusts.
- Continue the thrusts until effective or the patient loses consciousness.
- If the patient becomes unconscious, gently lower her down to the ground, taking care to protect the head. Follow the manoeuvres for Obstructed Airway in an Unconscious Patient (see below).

Management maneuvers

How to deliver back blows

To deliver the back blows, place yourself behind the patient slightly to the side, hold the patient upper body with one arm and tilt it forward from the hip. Give 5 back blows with the heel of your hand between the two shoulder blades. It is recommended to alternate between the back blows and the abdominal thrusts.

How to Deliver Abdominal Thrusts

To deliver abdominal thrusts, the rescuer must stand behind the patient. The rescuer places one leg between the patient's legs for stability. The rescuer wraps his arms around the patient's waist. The rescuer then makes a fist with one hand; the thumb side of the fist is positioned at or just above the patient's navel. The other hand firmly grasps the fist and thrusts are delivered in an upward, "J"-like motion.

Chest Thrusts

If dealing with a pregnant or obese patient or a person using a wheelchair, chest thrusts are recommended and just as effective as abdominal thrusts. Place yourself behind the patient such as the abdominal thrust, position your fist with your other hand on top directly in the center of the sternum after sliding your forearm under the patient armpit. Pull toward you to create the chest thrusts.

Obstructed Airway if You Are Alone

If alone, a choking patient must find a solid chair back to drop himself upon in order to try and unblock his airway. The back of the chair should be placed just above the patient's navel. The patient lets himself drop forcefully over the chair.

Obstructed Airway in an Unresponsive Patient

Witnessed Collapse

When a conscious choking patient becomes unresponsive and the collapse is witnessed, the steps of CPR should be started rapidly by giving 30 chest compressions. After the chest compressions, it is very important to look in the patient mouth (only in unresponsive airway obstruction) before attempting the first ventilation, this will allow the

retrieval of the object, if present. Do not attempt any blind sweep, this could push the object even further down the airway. If you don't see the chest rise with your first ventilation, tilt the head again with a good chin lift and try to give a second ventilation. If the patient is still obstructed restart the sequence with the chest compressions

Unwitnessed Collapse

If an unresponsive patient is found but the collapse was not witnessed, the rescuer should start by a scene assessment and then continue with the steps of CPR with the AED

Management of an Obstructed Airway in an Unresponsive Patient

If an unresponsive patient is not breathing normally or at all, send someone to activate EMS and begin CPR. If you are alone, begin CPR immediately. Complete one sequence of 5 cycles (approximately 2 minutes) before activating EMS.

Chest Compressions

- In an unresponsive choking patient, the airway can be unblocked through the administration of chest compressions.
- The speed and depth of the compressions remain the same as for CPR.

Open Airway

- Head Tilt – Chin Lift In unresponsive patients lying on their back, the tongue and throat muscles relax and block the airway.
- Open up the airway using the head tilt - chin lift technique or the tongue-jaw lift.

Look in the Mouth

- If the patient was known to be choking and then fell unconscious, the rescuer should look for the object in the mouth.
- Remove any visible object by using your finger to sweep it out. Because the object may have shifted, it is important to look into the mouth after each series of compressions when dealing with an obstructed airway.

Deliver Rescue Breaths

- Deliver 2 breaths of one second each.
- Give enough air to see the chest visibly rise.
- If the first breath does not go in
- Reposition the head with another head tilt – chin lift and give another breath.
- Return to Chest Compressions and Continue Steps of CPR Sequence

Deliver another series of 30 compressions followed by 2 breaths. Complete 5 cycles or approximately 2 minutes.

If you are alone, activate EMS after completing the first 2-minute sequence. Place the victim in the side safety position before activating EMS. After EMS is activated, return immediately to the patient. Continue CPR until it is effective, until the arrival of EMS or until there is a change in the patient's condition.

13.4 CPR for infants and children

Infant and Child CPR follows the same guidelines as Adult CPR with several notable exceptions.

Responsiveness

When determining responsiveness in an infant, kneel at the level of the infant's head, call out and tap the infant's foot.

If a child or infant is not responsive, activate EMS, check the pulse – and breathing then begin CPR.

EMS Activation

Sudden cardiac arrest in children is most often linked to a respiratory emergency. The sequence order will depend therefore on whether the rescuer is alone or with someone when discovering the unresponsive child or infant.

If you are alone when you discover an unresponsive child or infant, shout for help and administer CPR for 2 minutes BEFORE activating the EMS system.

If you are with someone, send him or her to activate EMS immediately while you begin the steps of CPR.

Checking the Pulse and breathing simultaneously

Taking no more than 10 seconds, palpate the pulse. In a child, check the carotid or femoral pulse. In an infant, check the brachial pulse.

If there is no pulse or if you are unsure of a pulse, suspect that the child or infant is in cardiac arrest. Begin chest compressions immediately.

Check if the child / infant is breathing, it is important to clear the airway without tilting too much his head back and obstructing them. Assess breathing for at least 5 maximum 10 seconds.

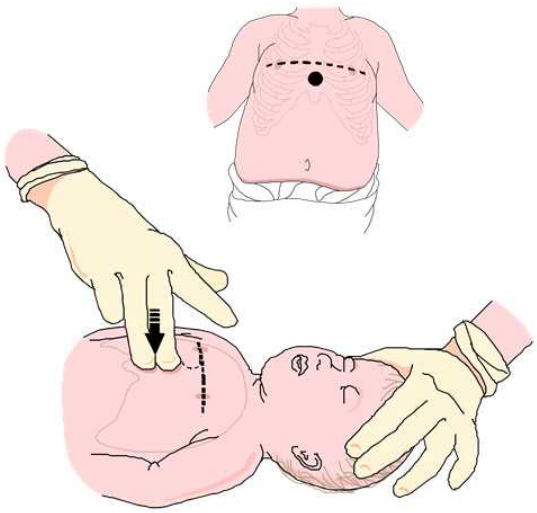
CPR 1) Administering Chest Compressions

Child Chest Compressions

- Place the heel of one hand on the lower half of the breastbone (sternum).
- Put the heel of the other hand directly on top of the first if necessary depending of the child size. Lace your fingers together.
- Lock your elbows and rock forward on your knees. Your shoulders should be directly over your wrists, lined up with the middle of the breast bone.
- Your arms act like pistons, pushing down perpendicularly over the chest. The compressions are delivered by pushing down directly over the chest to a depth of at least 1/3 of the depth of the child's chest or about 2 inches.
- Deliver 30 compressions at a rate of at least 100 per minute, maximum 120.
- Push hard and push fast.
- When performing chest compressions on children, some rescuers find it easier to use only one hand.

Infant Chest Compressions

- An infant can be placed on an elevated surface provided that it is flat and firm. A mattress is not firm enough.
- Place 2 fingers of one hand in the centre of the chest below the mammary line.
- The compression is delivered by pushing down directly over the chest with straight fingers to at least 1/3 of the depth of the infant's chest or about 1 ½ inches.
- Deliver 30 compressions at a rate of at least 100 per minute, maximum 120.
- Push hard and push fast.



CPR 2) Opening the Airway

Opening a Child's Airway

The manoeuvre to open a child's airway is no different from that for an adult. Use the head tilt – chin lift technique.

Opening an Infant's Airway

Head Tilt – Chin Lift To open an infant's airway, gently tilt the head back and lift the chin with one or 2 fingers until the neutral position is reached. Avoid over-extending the neck as the bony structures are susceptible to be compressed and can cause a narrowing of the airway.

CPR 3) Delivering Rescue Breaths

Child Breaths

Delivering breaths to a child is no different from giving breaths to an adult.

Infant Breaths

Mouth-to-Mouth-and-Nose

The rescuer takes a normal breath and seals his or her mouth over the baby's mouth AND nose. The rescuer exhales into the patient's mouth while watching for the chest to visibly rise. Deliver 2 breaths of one second each.

13.4.1 Child and Infant CPR Ratios

1-Rescuer CPR: 30 Compressions / 2 Breaths

The lone rescuer should perform a series of 30 compressions followed by 2 breaths at a rate of at least 100 compressions per minute, maximum 120.

After five cycles or about 2 minutes of CPR, the lone rescuer should activate the EMS system (if no one else has done so) and obtain an AED.

2-Rescuer CPR:

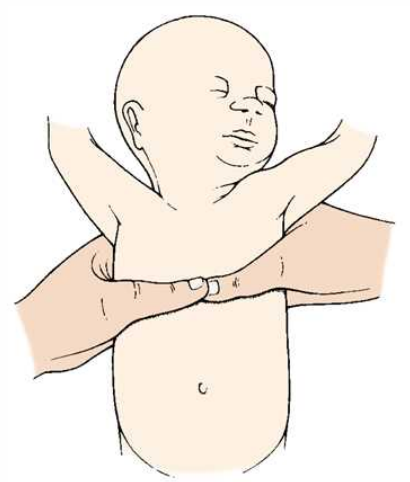
15 Compressions / 2 Breaths

After the arrival of a second rescuer, both rescuers perform a series of 15 compressions followed by 2 breaths at a rate of at least 100 compressions per minute, maximum 120.

2-Rescuer Infant Compressions

Alternative Hand Placement for Smaller Infants

- Rescuer # 1 encircles the infant's chest with both hands.
- He overlaps his thumbs on the landmark for chest compressions.
- For each compression, he pushes down directly over the sternum with his thumbs to at least 1/3 of the depth of the infant's chest or about 1 ½ inches.
- Every 15 compressions, Rescuer # 1 pauses briefly to allow Rescuer # 2 to clear the airways and give 2 breaths.



13.4.2 AEDs for Children and Infants

When to Use the AED with Children and Infants

An AED should be used as soon as it becomes available.

The lone rescuer, however, should perform the steps of CPR for 2 minutes before activating EMS and obtaining an AED. This is because most sudden cardiac arrests in children are respiratory in nature and outcome is improved by first doing CPR.

Minimize interruptions during the transition from compressions to AED use and from shock delivery to further cycles of compressions.

Pediatric AEDs

When using an AED on a child, always use the child pad package if available. The adapter on the connector delivers shocks at a dosage appropriate for children aged 0 – 8 years of age. In the absence of a child package and pads, attach the adult-size pads provided that they do not overlap on the chest and there is about one inch distance between the 2 pads. If the chest is too small, put one pad on the chest and one in the middle of the back between the blade.

13.5 Ventilatory support for children and infants

Ventilatory support must be started on a child or infant victim whose breathing is absent or inefficient but the pulse is still present and over 60 beats per minute. You can use a pocket mask or a bag-valve-mask to perform the technique.

In the presence of a child or infant victim, it is recommended to give 1 breath every 3-5 seconds for a total of 12-20 breaths per minute.

You must check the pulse every minute to make sure it's still present and over 60 heartbeat per minute. You should keep the AED near you but OFF. Never install and activate an AED on a victim with a pulse, the AED will analyse the heartbeat the moment the electrodes are installed regardless of the victim pulse.

If the child or infant heart rate is below 60 beats per minute you should do 2 minutes of CPR and check the pulse again after completing 5 cycles of 30 compressions and 2 ventilations.

13.5.1 Obstructed Airway in a Conscious Child or Infant Patient

Choking Children

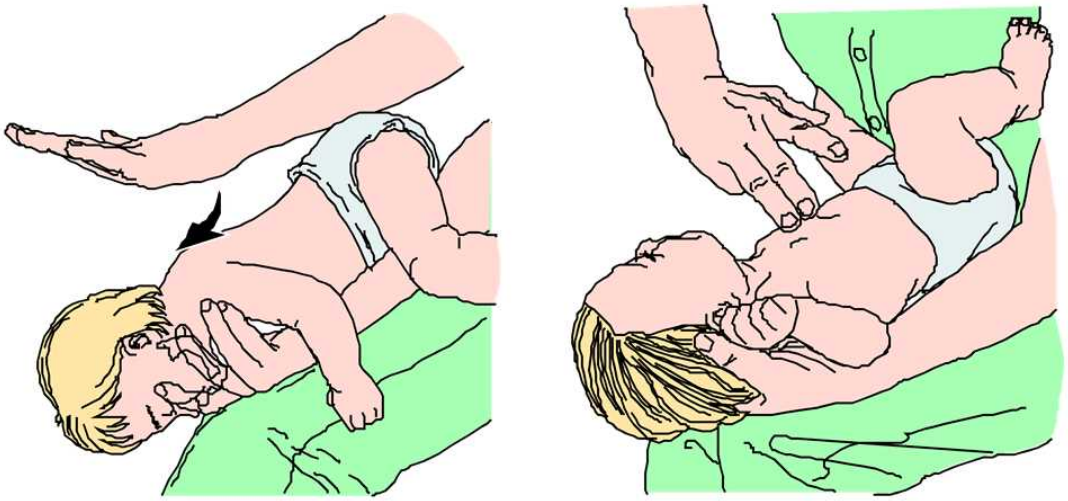
For choking children, deliver back blows or abdominal thrusts as indicated for adults. If the rescuer is much taller than the patient, she may need to kneel down on one knee or bend over to deliver the thrusts.

Choking Infants

Choking infants will often display sudden respiratory distress accompanied by high-pitched breathing sounds, weak cries and lips that become cyanotic (blue or grey). They may occasionally bury their head in a parent's arms.

For a choking infant, deliver up to 5 back blows followed by 5 chest thrusts as follows:

- Pick up the conscious and choking infant.
- Hold her firmly in your arms in a vice-like hold.
- Support the head and face by forming a "V" with your hand to cradle the cheeks and chin.
- The other hand is placed in the back supporting the neck above the shoulder blades.
- Place the infant in a position where her head is lower than her hips since gravity may improve the effectiveness of this technique. You can achieve this position by kneeling on the floor and placing the infant on your forearm, while supporting your arm with your thigh. An alternative position would be to sit on a chair with your legs extended, allowing the infant's weight to rest on your thighs.
- Deliver up to five back blows between the infant's shoulder blades in a downward glancing movement.
- Turn the infant onto his back and immediately continue the manoeuvre with 5 chest thrusts (see Infant Chest Compressions (p. 254)).
- Continue the back blows and chest thrusts until effective or the infant loses consciousness.



When the maneuver is effective.
the infant will nevertheless require follow-up medical care to avoid any complications caused by the techniques or by the obstruction.

If the infant becomes unconscious

- Administer chest compressions.
- Open the airway and look in the mouth.
- Deliver 2 rescue breaths of 1 second each.
- Return to chest compressions until effective, until the arrival of EMS or until there is a change in the infant's condition.

13.6 Special Considerations for Wilderness Settings

A wilderness environment may require special considerations when performing CPR.

When to Stop CPR

- Rescuer CPR should be continued until one of the following occurs:
- The patient starts to voluntarily move or speak.
- Definitive care is provided.
- Rescuers are exhausted.
- Rescuers are placed in danger.
- CPR has been given for more than 30 minutes without signs of recovery and you are without access to emergency medical services.

When Not to Start CPR

- In cases of a well-defined "Do not resuscitate status."
- In cases of obvious death:
  - Decapitation
  - Full body sectioning

    - Full compression of the head
    - Obvious emptying of the cranial vault
    - Advanced rotting
    - Adipocere
    - Mummification
    - Calcination
- When there are signs that the patient has been dead for some time (e.g. rigor mortis) you won't be able to open the airway and ventilate the patient.
- When there is external danger to rescuers and other members of the group.
- When an evacuation delay would endanger rescuers or other patients.
- Altering triage conditions would endanger rescuers or other patients.

Hypothermia and Avalanche Burial

(Ref. Cold-Related Injuries (p. 165))

Submersion

Because submersion accidents are primarily respiratory in nature, open the airway first and check respiration. If the patient is not breathing, give 2 rescue breaths that make the chest visibly rise.

After two effective breaths, start chest compressions. Perform 5 full cycles or 2 minutes of compressions before activating EMS, if you are alone.

Lightning Strike

It may be necessary to prolong ventilations if the patient's thoracic muscles are in spasm or the respiratory centre in the brain has been paralyzed.

Avalanche Burial

Make sure the premises are safe before proceeding.

The main causes of death from avalanche burial are asphyxiation, hypothermia and/or trauma.

Assess the Airway and immediately start artificial respiration if the victim is not breathing.

Smoke Inhalation and Burns

In cases of smoke inhalation or burns, thermal injury to the lungs or airway may complicate CPR. Assess the patient carefully and proceed with caution.

13.7 Drug administration during CPR

Certain drugs can be administered in the case of respiratory arrest or cardiorespiratory arrest, such as epinephrine and Naloxone, in order to increase resuscitation rates.

14. Adjuncts to airway management

14.1 Oxygen Administration

Indications for Oxygen Use

Oxygen is indicated for all patients suffering from cardiovascular or respiratory problems or injuries that may lead to shock.

To improve oxygenation, rescuers should provide 100 percent oxygen to any patient suffering from hypoxia or other related problems.

14.1.1 Oxygen Delivery Equipment

Oxygen Cylinder

The oxygen cylinder carries oxygen as a compressed gas. The cylinders are rigorously and regularly tested and inspected to ensure that the tanks are in good condition. Medical oxygen tanks have a series of numbers and dates stamped on them, indicating when they were last tested. In Canada, a Workplace Hazardous Material Information System (WHMIS) sticker must be affixed to the cylinder indicating that oxygen has an oxidizing potential. The cylinders are colour coded to reflect their content. The cylinders will be either green or white. In newer stainless steel cylinders only the top portion of the cylinder may be coloured.

Oxygen cylinders are available in many sizes. The larger sizes, of course, contain more gas and last much longer, while smaller sizes have the advantage of ease of transport. How long it takes to empty a cylinder will depend on the rate of flow and the size of the tank. The flow rate is the amount of oxygen gas flowing from the breathing device and is calculated in litres per minute.

The D cylinder is the most frequently used in situations where the tank must be carried to the site of an accident and is often the choice of backcountry search and rescue teams and medics. The duration of the D cylinder is approximately 20 minutes at a flow rate of 15 litres per minute.

Oxygen Capacity (in litres) of Common Cylinders	
Cylinder Size	**Volume, in litres**
M	3 000
E	625
Super D	500
D	350

Pressure Regulator

Pressurized oxygen is stored in the cylinder at a pressure of 2000 psi (pounds per square inch). A pressure regulator is required to lower the pressure of oxygen to safe levels. The reading on the regulator's gauge gives an indication of how much oxygen remains in the tank. A new cylinder holding close to 2000 psi is considered full. A gauge reading less than 250 psi of oxygen gas is considered empty since below this point there is not enough pressure in the tank to expel the oxygen. Tanks should never be allowed to empty completely. Ideally, tanks indicating a reading of less than 500 psi should be refilled.

Flow Meter

A flow meter controls the amount of oxygen flowing through the system. Most flow meters can deliver between 1 and 25 lpm (litres per minute). Integrated pressure regulator meters and flow meters are widely available and offer a simple and reliable option for most emergency applications

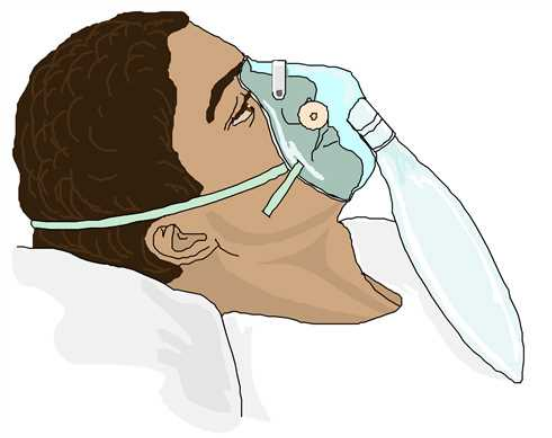
Pin Indexing System

As a safety feature, industry standards require that each different type of compressed gas have its own specific regulator and pin index. A pin-indexing system features a number of pins that are matched to the yolk of the stem of each cylinder. This safety feature makes it impossible for an oxygen regulator to be mounted onto another type of compressed gas cylinder.

14.1.2 Mask Attachments for Breathing Patients

Non-Rebreathing Mask

A non-rebreathing mask is the oxygen delivery system most commonly used by first responders in wilderness settings. The mask is attached to the regulator by a length of flexible tube and contains a bag in which the oxygen is stored. The oxygen stored in the bag has a very high concentration. As the name of the device implies, the air exhaled by the patient does not enter the bag. The reservoir must be inflated prior to use. Oxygen concentrations of 95 percent are possible when accompanied by a flow rate of 15 litres per minute.

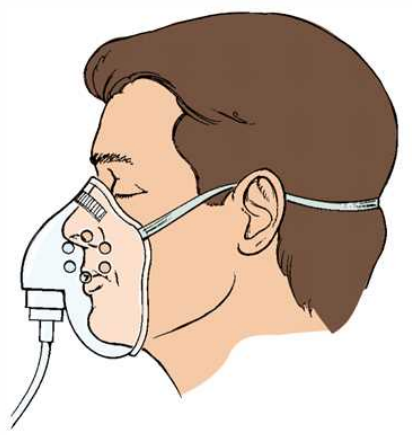


Partial Rebreathing Face Mask

The partial rebreathing mask has an attached oxygen reservoir that requires filling before use. A valve system in the mask allows for a return of the patient's exhaled air into the reservoir bag so that it can be reused. An oxygen concentration of between 35 and 60 percent is possible with a flow rate of 6 to 10 litres per minute.

Simple Face Mask

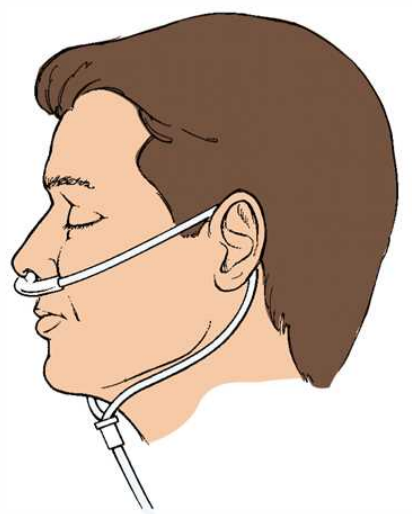
The simple face mask is a clear mask with perforation allowing for mixing of atmospheric air. It is used for patients who are already breathing. Placed over the patient's mouth and nose, oxygen is delivered to the patient in a free flowing manner. The concentration of oxygen delivered to the body will depend on the patient's ability to fully inhale, the seal of the mask and the flow rate of the oxygen. As with the partial rebreathing face mask, the oxygen flow rate of this mask is between 6 and 10 litres per minute with an oxygen concentration of between 35 and 60 percent.



Nasal Canula

A nasal canula is a device made of clear, flexible plastic tubing. Oxygen flows through the canula into the patient's nose via two small plastic prongs. The flow rate for a nasal canula is no more than six (6) litres per minute, which increases the oxygen concentration to a range of 24 to 44 percent. This rate of flow is helpful for those patients suffering from minor breathing problems or those who do not require a high concentration of oxygen.

Patients with nasal obstructions or injury or suffering from sinus congestion will find this device ineffective in supplying supplemental oxygen.



Summary of Breathing Devices Used to Administer Oxygen to a Breathing Patient

Supplemental oxygen can also be provided to the non-breathing patient.

Breathing Device	Flow Rate	O_2 percent
Non Rebreathing Mask	10 L/min +	80 - 90 percent
Partial Rebreathing Mask	6-10 L/min	35 - 60 percent
Simple Face Mask	6-10 L/min	35 - 60 percent
Nasal Canula	1-6 L/min	24 - 44 percent

Supplemental oxygen can also be provided to the non-breathing patient. Here are the possible oxygen concentrations capable of being delivered during resuscitation.

Breathing Device	O_2 percent
Pocket Mask with no O_2	16 percent
Pocket Mask with O_2	16 - 50 percent
BVM with O_2	21 - 100 percent

14.1.3 Operating Procedures of the Oxygen Delivery Device.

Verify condition of the tank.

Open tank to expel any dust that may be in the system.

Verify condition of the regulator and washer.

Fasten regulator to the tank yoke.

Tighten regulator securely to the yoke.

Open the tank valve. Regulator will indicate the pressure of oxygen in the tank.

Attach the hose to the regulator and open the regulator to the desired flow rate.

If the delivery system (mask) has a reservoir ensure that the reservoir is filled by putting your finger on the valve.

Place mask or delivery system on the patient

Monitor the patient

To Turn the Device Off

- Reduce the flow rate to zero.
- Turn the regulator to the "off" position.
- Open the regulator's flow meter to "purge" any residual oxygen within the gauge.

14.1.4 Oxygen Administration

Oxygen Administration to a Breathing Patient

As with any procedure, take the time to explain the steps of oxygen administration to a conscious breathing patient. Be aware that the face mask may cause anxiety and may need to be held away from the patient's face. A patient receiving oxygen should be monitored closely for changes in his or her vital signs.

Oxygen Removal from a Breathing Patient

If oxygen is to be removed from the patient, take the breathing device off before turning off the oxygen.

Oxygen Administration to a Non-Breathing Patient

Because the ventilation devices for a non-breathing patient are equipped with oxygen inlets, simply connect the tubing to the device.

14.1.5 Safe Handling Practices

Oxygen is an oxidant. Although not flammable it will accelerate combustion when combined with a fuelling agent. The following precautions should be used when handing oxygen delivery equipment.

The equipment should be removed from any source of open flames or sparks because of the potential for combustion. For this same reason, smoking is prohibited around oxygen devices. Grease or lubricating agents should never be used on any of the parts of the pressure regulator because this may produce a chemical reaction causing combustion.

Oxygen cylinders should be stored on their side in a soft or rigid carrying case. Because the cylinders are highly pressurized, they must be securely fastened if stored in the upright position.

Workplace Hazardous Materials Information System (WHMIS)

The transportation of oxygen is controlled by Transport Canada and other governing agencies. The Workplace Hazardous Materials Information System (WHMIS) is a comprehensive national system for the safe management of hazardous chemicals. It was developed through the combined efforts of labour, industry and government and is legislated by federal, provincial and territorial jurisdictions. Consult your local government agency for more information.

14.1.6 Special Considerations

No Contraindications to Administering O_2 in the Field

Oxygen should be administered to all persons needing it. A concern was raised that patients who use supplemental oxygen for long periods of time, such as those with severe chronic obstructive pulmonary disease (COPD), are at risk of decreased respiratory drive when receiving high concentrations of supplemental oxygen. Respiratory drive is the brain's signal to breathe more deeply when CO_2 levels in the blood increase. However, the risks of withholding emergency oxygen far outweigh the risks associated with decreased respiratory drive. Transfer from field care to definitive medical care, where the administration of oxygen can be carefully calibrated, generally occurs long before respiratory drive is dangerously affected. This is why oxygen administration is never contraindicated, the flow rate must be adjusted to obtain a minimum saturation, around 90% maximum, to avoid hypercapnia and a decrease in respiratory stimulation.

Oxygen-Powered Resuscitators

Oxygen-powered resuscitators should only be used by rescuers who trained in their use. Improperly operated devices may put patients at risk of serious injury from excess ventilation, such as gastric distension and subcutaneous emphysema.

Pulse Oximeter

A pulse oximeter measures the saturation of oxygen in the body. Most devices provide a reading of the patient's pulse as well. The battery-powered device is placed on thin tissues like the earlobe or finger. The oximeter relies on the hemoglobin's capacity to absorb light. A patient is considered hypoxic if his or her saturation is below 90 percent. The device's effectiveness may be diminished by a number of factors, such as cold tissue, nail polish, circulatory problems, and certain medications.

15. Patient Moving and Transportation

Patients suffering from any but the most minor injuries should be moved as little as possible. In remote settings, however, patients generally have to be moved at some point, in some cases to move them out of harm's way, in others to stabilize them and, of course, in many cases to evacuate them.

If there is time, both primary and secondary surveys should be completed before the patient is moved. If a patient must be moved immediately – because there is danger of further injury, for instance – reduce the potential for complicating injuries by minimizing the number of moves required.

Considerations

- Move the patient as little as possible.
- Immobilize injuries prior to movement.
- Secure a cervical collar on patients with a mechanism for head or spinal injuries.
- Prepare insulating materials prior to movement.
- Determine the best location for patients before moving them and anticipate any hazard or difficulty that may be encountered during the move.

15.0.1 Drags

The shoulder drag and blanket drag can be used by a single person who needs to move a patient from immediate danger.

Shoulder Drag

Bend the patient's arms, placing her wrists against her chest. Slide your hands under the patient's armpits and grasp the patient's wrists. Holding her wrists, pull the patient backward. The patient's head is supported by the rescuer's arms.

Blanket Drag

Position a blanket under the patient and wrap it around her. Keep her face exposed. The rescuer holds the blanket above the patient's shoulders and walks backward.

The patient's body should not twist or bend in either drag.

15.0.2 Rolls

Rolls enable rescuers to place insulation material or a spine board under the patient. Rolls can be used to put patients in a supine position so their airway can be properly managed. Maximize spine stability by maintaining the alignment between the head, neck and shoulders. Check the patient's back thoroughly before rolling.

Pulling Patient towards Rescuer - 1 Rescuer

Pulling Patient towards Rescuer – 1 Rescuer

Place mat between patient and rescuer. Position arm closest to rescuer above head.

Position the second arm above the head.

Extend the legs while supporting the hips. Cross the opposite ankle across the closer ankle.

Support the shoulders and hips and gently pull the patient towards you. Maintain alignment of the region between the top of the head and the hips.

Roll patient to the supine position and check airway and breathing.

Pushing Patient Away from Rescuer – 1 Rescuer

With your hand closest to the patient's head, reach under her closest armpit and place your palm on the back of her head.

While kneeling on both knees and keeping your centre of gravity low, hold the patient's trousers at the waist and push forward.

Rescuer supports his weight with one hand while rolling the patient with the chest. Maintain support of the patient's head.

Monitor airway and breathing.

Multiple-Person Rolls

- The leader is normally positioned at the head. He is also responsible for stabilizing the patient's head.
- Rescuers kneel on one knee, placing themselves all on the same side by the patient's shoulders, hips and knees.
- Under the leader's direction and on his command, the rescuers roll the patient towards them. One of the side rescuers adjusts the pad/board as the patient is rolled down.

Log Roll with Multiple Rescuers

Support the head while rescuers position themselves alongside the patient. The rescuer at the head should coordinate the procedure.

At the command of the rescuer at the head work together to roll the patient onto her side.

Roll patient gently to the supine position.

Monitor airway and breathing while supporting the head and neck.

15.0.3 Lifts

Lifts allow rescuers to place insulating material or a spine board underneath a patient. Lifts also enable a group to quickly move a patient out of a harmful environment.

BEAM

BEAM is an acronym for Body Elevation and Movement. This technique is used to move a patient to a secure location while maintaining the patient's body in the position in which it was found. It is best executed by several rescuers and requires their actions to be carefully coordinated.

Two-person lift

Both rescuers kneel on opposite sides of the patient.

The rescuer designated as leader reaches under the neck to support the head and grabs the opposite shoulder. The other arm reaches under the small of the back.

The second rescuer places one arm under the buttocks and the other arm under the knees.

They lift the patient together at the command of the lead rescuer.

Multiple-Person Lifts

The leader is at the patient's head, with her hands under the patient's trapezius muscles and her forearms securing the patient's head.

4 rescuers can be placed 2 a side, on one knee.

The strongest lifters should be at the shoulders and hips. The other 2 can lift the knees and feet.

Any movement should be orchestrated by the group leader.

Another rescuer should be standing by to place a pad or board underneath the patient.

15.0.4 Carries

Carries are only used to move a patient short distances, as they are exhausting for rescuers. The following four examples are one-person carries.

Fireman's Carry

Fireman's Carry is used when the patient can offer no assistance to the carrier.

- Bring the patient to a standing position and facing the rescuer.
- With the rescuer's knees bent, grasp the patient's wrist and lift him on to your shoulder.
- The patient's abdomen should rest on the rescuer's shoulder .

Backpack Carry

A backpack with an internal frame can be used to carry a patient.

- Fasten the waist belt.
- Help the patient onto your back.
- Slip on the shoulder straps bringing the backpack up and over the patient's back.

The patient's weight rests largely on the waist belt.

Back Carry

The Back Carry with nylon webbing eases the load on the rescuer, as it provides a seat for the patient and shoulder straps for the rescuer:

- The mid-point of webbing is placed across the patient's back.
- Bring webbing under the patient's arms and cross in front of their chest.
- Have patient rest against rescuer's back.
- Bring the webbing over the rescuer's shoulders and around the patient's thighs from the inside.
- The rescuer ties the webbing around her waist.

Split Coil Carry

- Divide a coiled rope into 2 loops.
- Place one of the patient's legs in each loop. The loops are then placed over the rescuer's shoulders.
- Pad the coils at weight-bearing areas.

Litters

A litter is used to carry a patient. It is not an immobilization device. Litters should be tested before being used and should protect the patient from inclement weather.

Six people make a good number for carrying a litter. Litters are most effective when used with shoulder straps or hip belts, rather than carried solely by hand. Rotate carriers before they get too tired. The strongest carrier should be placed at the back when going uphill. If possible send one person ahead to scout and mark the route, so the rescuers' route is as short and easy as possible.

Several commercial stretchers are available such as the Stokes litter, toboggans, Sked stretchers, and Furley canvas stretchers. Others can be improvised with materials at hand.

Tarp Litter

Find 2 poles 2.5 metres long. Attach them securely to 2 other smaller pieces of wood to form the litter frame.

2 poles lashed together.

Fold the tarp in 2 to form a 2 x 2 metre square. Place the litter in the centre of the tarp and fold the tarp over one of the long poles.

Fold tarp under the other pole and around both poles.

Carrying a Tarp Litter



Jacket Litter

- Find 2 poles 2.5 metres long.
- Pull the sleeves of 3 non-stretching jackets inside out.
- Secure all zippers and buttons. Place jackets front side up.
- Slide poles through body of jackets.

Internal Frame Pack Stretcher

- Find 2 poles 2.5 metres long.
- Disassemble 3 internal frame packs — they must all have side compression straps.
- Slide poles through compression straps.

External Frame Pack Stretcher

- Remove frames from at least 2 external frame packs.
- Attach 2 frames with 2 strong rigid objects (like ice axes) on either side.

Rope Stretcher

There are several types of rope stretchers. The most common one is described below.

- Starting at the centre, make seven 180 degree bends on each side of the rope. The distance between each bend should be a little more than the width of the patient. The litter should be one foot longer than the patient at each end.
- Take the rope ends adjacent to the bends and tie a series of clove hitches 15 cm apart. One bend goes through each clove hitch.
- Pull the remaining rope through all the loops and tie the ends off. Ensure the clove hitches are tight.

Improvised litters take time to construct. Practise at least one kind that is applicable to the equipment you will carry and the environment you will be in.

16. Glossary

16.1 Common Abbreviations and Acronyms

A & O x 4	Alert and Oriented X 4 – scale used to represent neurological function.
ABC	Airway, Breathing and Circulation – principal components of the Primary Survey.
AED	Automated External Defibrillator.
AVPU	Alert, Verbal, Pain, Unresponsive – scale of assessment to evaluate level of consciousness.
BEAM	Body Elevation and Movement – movement of an accident victim to a secure location while maintaining the position in which he or she was found.
BLS	Basic Life Support.
BMR	Basal metabolic rate – the amount of energy required to maintain vital functions when the body is at rest.
BP	Blood Pressure – Pressure of blood exerted against the walls of the vessels, a function of blood volume, heart rate, stroke volume and vessel diameter.
CNS	Central Nervous System.
CPR	Cardio Pulmonary Resuscitation – combined heart and lung resuscitation administered to restore and maintain respiration and circulation.
CRT	Capillary Refill Time – refers to the time it takes for normal colour to return to nail beds after depressing a finger or toe nail.
CSF	Cerebral Spinal Fluid – the fluid surrounding the brain and nerves of the spinal cord.
CSM	Circulation, Sensation, Motion.
CVA	Cerebral Vascular Accident – a stroke.
GI	Gastrointestinal.
HR	Heart Rate – Vital sign indicating quality and quantity of heart beats per minute.
ICP	Intracranial Pressure – pressure within the cranial vault.
ICS	Incident Command System.
IM	Intramuscular.
IV	Intravenous.
P	Pupils.
PAS Card	Subjective, Objective, Assessment, Plan Note – procedure for recording information during a critical assessment.
PERRLA	Pupils that are Equal, Round and Reactive to Light and Accommodation – an acronym used to assess pupil response as a vital sign. In French, it is translated as: les Pupilles Égales, Rondes, Réactives à la Lumière, normales à l'Accommodation.
PFD	Personal Flotation Device.
pH	Power or Potential of Hydrogen – scale by which acidity is measured in an organism.
PO	By mouth.

PQRST	Provoke, Quality, Region, Severity, Time – scale used to describe pain during Patient Assessment.
Pt	Patient.
RED	Rest, Elevation, Direct pressure – technique to reduce bleeding in wounds.
RICE	Rest, Ice, Compression, Elevation – protocol for management of a musculoskeletal injury.
RR	Respiratory Rate – Assessment of quantity and quality of breathing.
Rx	Medical Prescription.
S/S	Signs and Symptoms.
SAMPLE	Symptoms, Allergies, Medications, Past History, Last Meal, Events – an acronym representing the information gathered about the victim during the secondary examination. In French, it is translated as: Symptômes, Allergies, Médicaments, Passé (antécédents médicaux), Lunch (dernier repas pris), Événements.
SCTM	Skin Colour, Temperature, Moisture – assessment of the surface condition of the skin as a vital sign.
T	Body temperature.
TIA	Transient Ischemic Attack – temporary disturbance of blood supply to the brain, often referred to as a “mini stroke”.
Tx	Treatment.

16.2 Glossary of Terms

Abandonment	The termination of care before passing responsibility on to someone who is equally or more qualified
Abduction.	Movement of a limb away from the body.
Abrasion	Scratches and scrapes on the skin.
Acidosis	A decrease in blood pH below normal levels.
Adduction	Movement of a limb closer to the body.
Allergen	A non-parasitic substance that causes an allergic reaction in the body - see antigen below.
Allergy	A hypersensitivity of the body's immune system resulting in the release of histamine and related substances.
Analgesic	A medication that alleviates or reduces pain.
Anaphylactic Shock	A life-threatening allergic reaction producing a systemic release of histamine causing swelling and constriction of the airway, depressed cardiac output and loss of vasomotor tone.
Anatomical Position	A body position that is erect and facing the observer, with arms at the sides and palms facing forward.
Anterior	Towards the front (ventral).
Anti-inflammatory	A medication that reduces swelling and inflammation.
Antibiotic	A compound or substance to treat or prevent a bacterial infection that works by killing the bacteria or slowing their growth in the body (systemic antibiotic) or on the body surface (topical antibiotic).

Antigen	A substance, such as an allergen, that triggers the body's immune response.
Antiseptic	A solution that inhibits infection when applied externally to live tissue by destroying microorganisms. Often used interchangeably with disinfectant, although the latter is more accurately defined as a solution that destroys microorganisms on non-living objects.
Appendicular	An anatomical term for the limbs of the body.
Asthma	A reversible airway disease characterized by constriction of the smooth muscle of the bronchi, excessive secretion of mucus into the airway and bronchiole edema.
Ataxia	Lack of muscle coordination, usually evident in voluntary gross motor movements such as walking.
Avulsion	An open wound caused by the forcible tearing away of all layers of skin.
Axial	Anatomical division referring to the vertical midline dividing the body into right and left sides.
Bacterial infection	Any form of internal or external infection caused by bacteria.
Brachial	Anatomical term referring to the arm (i.e. brachial artery, pulse or nerve).
Brain	The part of the brain that governs higher mental functions such as reasoning, memory and cognition. It is located in the upper region of the brain and is the largest part of the brain.
Brain Stem	The portion of the brain that controls automatic functions such as breathing. It is located below the cerebrum. It's located in the back under the brain.
Capillary	The smallest blood vessels in the body. Site of oxygen, nutrient and waste exchange between blood and alveoli.
Cardiogenic Shock	A state of shock caused by the failure of the heart to pump blood adequately to all vital parts of the body.
Cardiovascular	System Body system made up of the heart (cardio) and the blood vessels (vascular).
Caregiver	The person who either administers first aid or performs some other form of emergency care.
Cartilage	Flexible connective tissue found in the ears, nose, rib cage and joints. In the joints, it serves as a cushion and joint surface for the adjacent bones.
Cell	The basic living unit of the body.
Cerebellum	Part of the brain that regulates balance, muscle tone and fine motor coordination. It's located in the back under the brain.
Cervical Spine (C-Spine)	The 7 vertebrae of the neck.
Conduction	Transfer of heat from one object, gas or liquid when it comes into contact with another object, gas or liquid. This results in heat loss for the first substance.
Congenital	A condition present at birth.
Conjunctiva	The mucous membrane lining the inside of the eyelids and the surface of the eye.
Contraindication	An indication against the advisability of a particular remedy or treatment.
Contusion	Soft tissue swelling and discoloration indicating damage to the underlying vascular bed.
Convection	Heat transfer by displacement of currents or molecules in gases or liquids (air and water).
Cornea	A clear transparent membrane that covers the eye.
Crepitus	A grating sensation or sound produced in a joint or area of damaged bones.

Cyanosis	A bluish discoloration of the skin, mucous membranes and nail beds indicating inadequate oxygen levels in the blood.
Deep	Anatomical direction which means away from the surface of the body.
Diabetes	Mellitus A disease resulting from the inadequate production or utilization of insulin.
Diarrhea	An intestinal disorder characterized by increased frequency and fluidity of fecal excretions.
Dislocation	Injury in which the end of a bone is dislodged from its normal position in a joint.
Distal	Anatomical direction, meaning away from the heart.
Electrolytes	Electrically charged elements or ions essential to metabolic function in the body. The main ions are sodium, potassium, calcium, magnesium, chlorine and phosphorus.
Embolism	An undissolved mass in a blood vessel that restricts blood circulation. It may be a solid, liquid or gas.
Epilepsy	A condition in which an individual experiences recurring seizures (see seizure).
Eversion	Anatomical term referring to the outward turning of a limb (such as the sole of the foot turned out).
Extension	Act of straightening or extending a joint.
Extracellular Fluid	Fluid and plasma found between cells.
Flexion	Act of bending a joint.
Fracture	A break or crack in bone tissue.
Frostbite	Localized tissue damage caused by freezing.
Gastroenteritis	An inflammation or infection of the stomach and intestines caused by bacteria, viruses, parasites or protozoa.
Giardia	Protozoan responsible for the contamination of natural waters.
Good Samaritan Act	A component of law that prevents any liability for emergency aid given, unless gross negligence is proven.
Halogen	A class of chemicals (iodine, chlorine) used to disinfect water.
Hematoma	A localized collection of blood in an organ or tissue.
Hyperextension	Extension of a joint beyond its normal range of motion.
Hyperglycemia	High concentration of sugar in the blood.
Hyperthermia	Condition in which the body's core temperature is above normal.
Hypoglycemia	Blood sugar concentration too low.
Hypothermia	Condition in which the body's core temperature is below normal.
Hypovolemic shock	A state of shock resulting from the loss of fluid in the circulatory system.
Hypoxia	Decreased oxygen levels in body tissues.
Inferior	Anatomical direction, meaning toward the feet.
Inferior	Anatomical direction, meaning toward the feet.
Insulin	Hormone secreted by the pancreas whose function is to regulate the metabolism of glucose and other carbohydrates. There is also commercial insulin, which is used as a medication to control

	diabetes.
Intercostal	The area between the ribs.
Intracellular fluid	The fluid inside the cells.
Inversion	Anatomical term referring to the inward turning of a limb (such as the sole of the foot turned in).
Irrigate	To flush with a liquid (usually water) in order to cleanse an affected area of the body.
Kilocalorie	Measure of unit of heat. One kilocalorie is needed to raise the temperature of one kilogram of water by one degree Celsius.
Lateral	Anatomical direction, meaning to the left or right of the body's midline.
Lateral Recumbent	Body position in which a person is lying on either side.
Liability	Legal condition, in which a person or group is considered legally responsible for their actions or lack of actions as they relate to the safety and well-being of others.
Ligament	Connective tissue attaching bone to bone.
Lumbar Spine	The 5 vertebrae of the spinal column that connect the rib cage to the pelvis.
Medial	Anatomical direction, meaning toward the midline or centre of the body.
Meninges	The three-layered membrane that encloses and helps protect the brain.
Neurological	A system in the body that regulates physiological activities and body movements through the direct control or action of hormones.
Objective Hazards	Environmental conditions that are beyond human control (e.g. lightning, avalanche, rock fall).
Palpate	To examine a patient by physically touching, feeling or probing.
Plasma	The liquid portion of the blood containing suspended elements.
Pneumothorax	Condition in which air enters the thoracic cavity from an open wound or from a damaged lung or both.
Prone	Body position in which a person is lying face down.
Respiratory	Body system whose function is to supply oxygen to, eliminate carbon dioxide from and regulate acid-base balance in body tissue.
Respiratory shock	Failure of the respiratory system to provide an adequate supply of oxygen to the blood, resulting in hypoxia of tissues and organs.
Right to assistance	In the province of Quebec, under the Quebec Charter of Rights and Freedoms, "Every human being whose life is in danger has the right to assistance. " (1975, c. 6, s. 2)
Seizure	An episode in which uncoordinated electrical activity in the brain causes altered levels of consciousness, or involuntary movements and muscular spasms.
Shock	A state of inadequate oxygen perfusion of the body's cells, resulting in tissue and organ hypoxia.
Sign	An indication of a disease or injury that is observed and measured.
Spine or Spinal Column	Series of 33 connected vertebrae encasing and protecting the spinal cord.
Sprain	Trauma to a joint causing injury to the ligaments.

Standard of Care	The standard to which an individual (leader/rescuer) should be able to perform at all times.
Strain	Injury from trauma or overuse involving muscle, tendons and connective tissue.
Subjective Hazards	Hazards resulting from human behaviour or errors in judgement (e.g. improper clothing, lack of experience, fatigue).
Superficial	Anatomical direction, meaning toward or on the surface of the body.
Superior	Anatomical direction, meaning toward the head.
Supine	Body position in which a person is lying face up.
Symptom	Indicator of an abnormal condition felt by a patient, such as pain, discomfort or other abnormalities.
Synovial Capsule	The sac surrounding a joint and containing synovial fluid.
Tendon	Connective tissue that attaches the muscle to the bone.
Tendonitis	An inflammation of a tendon.
Tension Pneumothorax	A progressive condition of increasing air pressure in the thoracic cavity.
Thoracic Spine	The 12 vertebrae of the spine at the level of the rib cage. Each thoracic vertebra is connected to a rib. Each of these vertebrae is attached to a rib.
Trauma	Any bodily injury caused by some extrinsic force or condition, usually in a violent manner.
Vasoconstriction	Narrowing or constriction of blood vessels.
Vasogenic Shock	State of shock due to the systemic dilation of the blood vessels and causing decreased arterial pressure.
Ventricular	Referring to the two ventricles, the lower pumping chambers of the heart.
Virus	A microscopic, parasitic and infectious agent that requires the living cells of other organisms to survive.
Vital Signs	An accurate and objective measure of physiological status used to assess the state of the body's vital functions. They include level of consciousness, respiration, pulse, skin, blood pressure, pupils and temperature.

17. Recommended Reading

17.0.1 Wilderness First Aid and Medicine

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18. SIRIUSMEDx First Aid Kits

18.1 First Aid Kit contents

	KITS	
CONTENTS	**SIRIUS 20**	**SIRIUS 40**
Organizer Bag 17x13x6cm (closed)	1	
Organizer Bag 27x14x8cm (closed)		1
EMT Shears 5.5”- Stainless	1	1
Splinter Forceps 4.5”- Stainless	1	1
Thermometer	1	1
Pen Light		1
Syringe for Wound Irrigation 10 cc		1
Rescue Blanket		1
Examination Gloves	1	2
Triangular Bandage	1	2
Safety Pins	3	6
Plastic Container	2	2
Abdominal Pad 5”x9”	1	1
Sterile Gauze Roll 3”	1	2
Dressing Strips 3”	10	12
Knuckle Bandages	5	5
Elastoplast® Strip 3”x4”		1
Non-Stick Pads 2”x3”	5	5
Gauze Pads 4”x4”		6
Gauze Pads 3”x3”	5	6
Gauze Pads 2”x2”	5	6
Butterfly Closures	5	
Non-Surgical Wound Closures (pkg of 5)		1
Trainer’s Tape 1”		1
Tape ½”	1	1
Spenco Second Skin® 2”x3”	1	1
Elastic Bandage 3”		1

	KITS	
CONTENTS	**SIRIUS 20**	**SIRIUS 40**
Elastic Bandage 2”	1	
Cotton Tip Applicators (Sterile)	6	10
Antiseptic Pads	10	12
Antibiotic Ointment – 1g	2	5
Tincture of Iodine 25ml		1
Disposable Razor		1
Pencil	1	1
Tegaderm® Waterproof Dressing		2
Mole Skin – Blister Care 3”x6”	1	2
Accident Report Form	1	2
Wilderness First Aid Booklet		1

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