

Cold related illness and injury

For the unprepared the wilderness environment can be unforgiving. Most environmental emergencies are avoidable and can be prevented with proper knowledge, planning and preparation.

Cold related problems occur when our **ability to produce and retain heat, is overwhelmed by the cold challenge that we are facing.**

Mechanisms of Heat Production

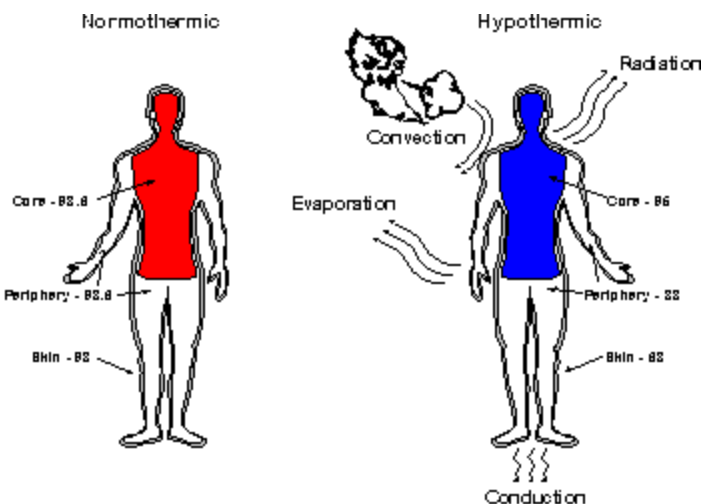
- **Basal Metabolic Rate** – Heat is produced as a by-product of cell metabolism and by our bodies metabolizing the food we eat.
- **Exercise** – Activity is a very effective means of staying warm because approximately 70% of muscle energy is released as heat.
- **Shivering** – Heat is produced at a rate approximately 5 times greater than our resting basal metabolic rate. Shivering however, is a very inefficient means of generation heat, consuming more energy than it develops.

All three of the above mechanisms require **adequate food intake** to sustain them, and **proper hydration** which is necessary for metabolism and heat transport. Good **physical conditioning** is also extremely important because exhaustion quickly leads to an inability to produce heat.

A second component necessary for maintaining core temperature when faced with a cold challenge is **heat retention**. Heat produced by metabolism, exercise and shivering must be trapped so that it is not lost to the environment faster than it can be produced.

Mechanisms of Heat Loss

- **Radiation** – Heat is transferred by electromagnetic waves from a warmer to a cooler object.
- **Convection** – Heat is transferred by molecules of air or fluid moving between areas of unequal temperature.
- **Conduction** – Heat is exchanged between objects in contact with each other.
- **Evaporation** – Heat is lost by water molecules diffusing from the body surface. When water changes from a liquid to a gas, it must absorb a large amount of heat in order to do so. This energy is called the latent heat of vaporization.
- **Respiration** – A significant amount of heat is lost through the process of breathing.



Prevention of Cold Injury and Illness

Maximize heat production

- Adequate food and fluid intake
- Good physical conditioning (know your limits).
- Observe other group members – stop, rest, eat, drink before anyone becomes exhausted.

Minimize heat loss

- Proper clothing to retain heat – dress in layers. Avoid cotton; wool or synthetics are better. Carry extra warm clothing, a warm hat and rainwear.
- Stay dry – remove layers before you begin to sweat during heavy activity.
- Have a means of providing shelter from rain, wind etc.

Frostbite

Frostbite is localized tissue damage caused by cold. Severity of frostbite depends on how cold the tissue becomes and how long it is exposed to the cold. Factors that contribute to becoming frostbitten include: Environment, hydration and nutrition, physical health, restrictive clothing, drugs (caffeine, nicotine).

Frostbite can be categorized as either **superficial** or **deep** frostbite.

Superficial Frostbite

Superficial frostbite occurs when tissue is damaged by cold but does not freeze solid.

Problem

- Decreased peripheral circulation.

Assessment

- Pale, blanched skin.
- Dulled sensation, numbness.
- Skin may feel waxy but still pliable.

Management

- Prevent further exposure to the cold.
- Loosen restrictive clothing or equipment.
- Skin to skin rewarming in field.
- Increase general circulation (activity).
- Pain medication if required and available.

Deep Frostbite

Deep frostbite occurs when ice crystals form in the skin and underlying tissue.

Problem

- Decreased peripheral circulation.
- Tissue freezing.

Assessment

- Firm or hard tissue.
- Skin white or grey-blue in colour.
- Loss of circulation, sensation and movement (CSM).

Management

- Prevent further freezing.
- Evacuate.

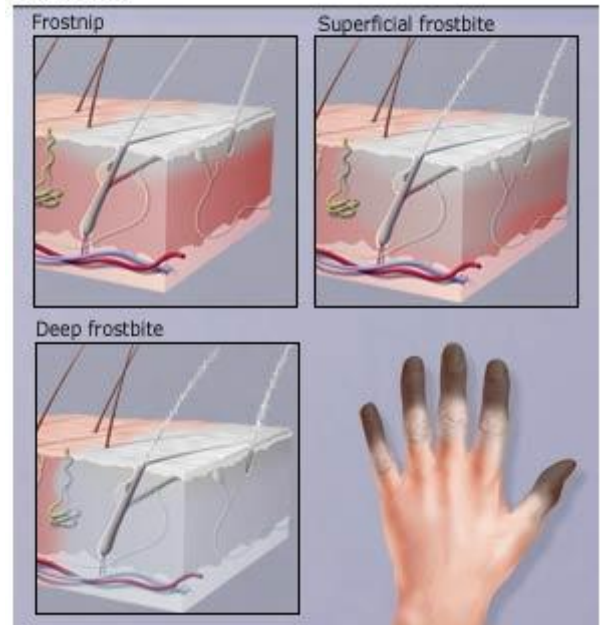
Consider rapid re-warming if:

- More than 24 hours from definitive care.
- Casualty will not be required to use frozen part(s).
- Appropriate equipment for re-warming is available.
- Re-freezing can be prevented.

Rapid re-warming

- Immerse frozen part in 40° C water for 30 minutes. Water temperature must be maintained while re-warming.
- Strong pain medication if available.
- Do not debride or drain blisters or blebs.
- Cover with dry, sterile dressings.
- No use of affected area.
- Do not allow to re-freeze.

Frostbite



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Hypothermia

Hypothermia occurs when the body loses heat faster than it produces it resulting in a lowering of the core temperature. Normal body temperature is 37 C; the temperature at which the brain functions optimally. If we are unable to compensate for heat lost to the environment, our core temperature falls and various brain functions begin to fail. The first functions to fail are our perception of danger, our problem solving ability and our judgement. Technically, a person can be classified as hypothermic when core temperature drops to 35° C.

A casualty who is severely hypothermic (core temperature below 32° C) is in an extremely “brittle” condition. At this point, blood outside the core has virtually ceased to circulate causing it to be extremely cold and toxic. Complications that can result from re-warming require advanced life support techniques not available in the backcountry. These complications include:

- **Ventricular Fibrillation** – if acidotic blood is returned to the heart it can send the heart into V-Fib.
- **Afterdrop** – caused by heat loss through conduction between cold peripheral tissues and warmer core tissues, and re-circulation of cold blood and body fluids back to the core.
- **Blood pressure drop** – warming of the extremities causes vasodilation of vessels formerly constricted. The amount of circulating blood is not enough to fill this increased vascular bed and blood pressure drops.

Assessment

Mild to Moderate Hypothermia (35° to 32° C)

- Cold sensation, goose bumps, shivering
- Changes in Level of consciousness (LOC) – irritable, withdrawn.
- Loss of manual dexterity.
- Intense shivering, lack of muscle coordination, mild confusion but may appear alert.
- Violent shivering, difficulty speaking, sluggish thinking, poor gross motor coordination, lethargy, irrational behavior.

Severe Hypothermia (Below 32° C)

- **Shivering stops**, inability to walk, incoherent speech, exposed skin may appear blue or puffy.
- Muscles rigid, decreased pulse and respiration, may lose consciousness.
- Muscle reflexes cease, pulse and respiration may not be detectable.

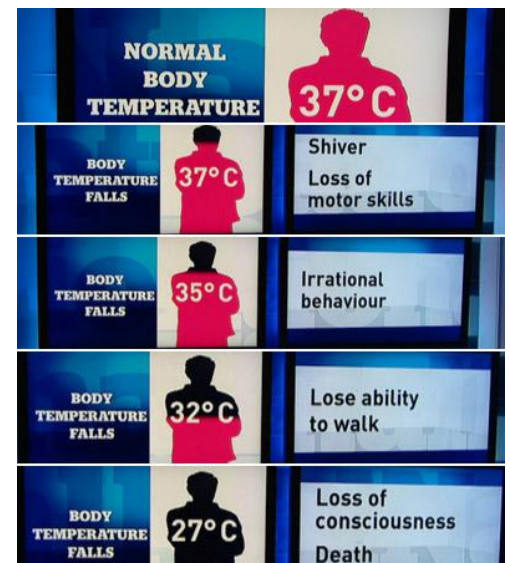
Management

Mild to Moderate Hypothermia

- Remove casualty from cold environment – shelter from wind, rain, snow etc.
- Increase heat production – food, warm sweet fluids, exercise.
- Increase heat retention – remove wet clothing and replace with dry insulating layers.
- Aggressive external re-warming – fire, hot water bottles etc.

Severe Hypothermia

- Remove casualty from cold environment – shelter from wind, rain, snow etc.
- Prevent further heat loss.
- Monitor/maintain ABCs, vital signs.
- Evacuate – handle casualty very gently to prevent re-circulation of acidotic blood (V. Fib.)
- No aggressive external re-warming. Do not attempt to re-warm the casualty in the field.



References:

The School of Wilderness Arts and Technology. "Chapter 15 - Environmental Emergencies." *SWAT Wilderness First Aid Manual TOC*. 2007. Print.