

## Etiology

Hypothermia (HT) is defined as a core body temperature of less than 35° Celsius. It can be caused by excessive cold stress, inadequate body heat production, or both such as with a history of cold exposure and a disease that predisposes the patient to hypothermia.

**Primary hypothermia** is caused by excessive exposure to cold temperatures.

**Secondary hypothermia** is caused either by underlying health conditions that impair thermoregulation such as old age, low body fat or disease. Secondary hypothermia can also be caused by decreased heat production or increased heat loss resulting from burns and multisystem trauma or shock.

In early hypothermia, the body attempts to raise its temperature by shivering, increasing muscle tone, peripheral vasoconstriction, and increases in respiratory rate and cardiac output. When these mechanisms can no longer compensate for heat loss, body temperature falls.

When treating a victim of hypothermia, don't forget to protect yourself from the factors that have caused your patient's condition. However, causes may not always be obvious. Prolonged exposure to temperatures that are cool, but not cold, can still cause hypothermia if someone is unable to generate enough heat to compensate. The very young, elderly and those with medical conditions may be at risk for hypothermia in settings where others are not.


It is extremely difficult to accurately measure a true core temperature in the out of hospital environment; tympanic, oral, and temporal thermometers are not accurate at extremes of temperature. Whenever core temperatures cannot be readily or accurately measured, in such cases, hypothermia can be staged clinically on the basis of vital signs with the use of the Swiss Staging System of Hypothermia.

## Swiss Staging System

The Swiss Staging System is the most accurate non-thermometer based hypothermic assessment system and is favored over traditional staging (mild, moderate, severe and profound hypothermia) whenever core temperature cannot be readily measured. Survival depends on getting the appropriate treatment, and the Swiss Staging System will help determine the appropriate treatment and transport decisions.

Swiss System	LOC	Shivering	Vitals	Temperature Degrees Celsius
HT – 1 (mild)	conscious	shivering	present	35 – 32
HT – 2 (moderate)	LOC impaired	not shivering	present	32 - 28
HT – 3 (severe)	unconscious	not shivering	present	28 - 24
HT – 4 (profound)	unconscious	not shivering	absent	less than 24
HT – 5 (dead)	unconscious	chest not compressible	absent	less than 10

(HT) Comparison Chart Developed by Peter Symons EMT-P

Hypothermia = HT Temp (Noted under number) <small>Normal= 37C/98.6F</small>	Swiss Staging System	AHA - ACLS-EP Based on actual Temp	ERC Based on actual Temp	Cold Water Boot Camp	Wilderness Medical Society	Alaska State Guidelines
36				Normal	Cold Stressed	Not Hypothermic
35		Mild				
34	HT-1 Conscious /c Shivering		HT-1/Mild	Mild	Mild	Mild
33		Moderate				
32 Shivering almost stopped						Shivering Stopped
31 Shivering - rare cases	HT-2 Consciousness impaired /s Shivering		HT-2 Moderate	Moderate	Moderate	Moderate
30 Increased Risk of VF						
29						
28						
27	HT-3 Unconscious /c s/s of Life		HT-3 Severe		Severe	Severe
26						
25		Severe				
24 VF risk very high						
23						
22						
21						
20 Asystole risk high				Severe		
19					Severe	
18				Term Profound not used but noted if < 25	NB: Term Profound if < 24 advocated by some	Severe (term used twice)
17	HT-4 Unconscious no s/s of Life		HT-4			Severe (term used twice)
16						
15 lowest intact survival Infant		Profound				
14 13.7 lowest survival-Adult		Based on actual Temp < 20				
13						
12						
11						
10						
9 lowest survival-Therapeutic	HT-5 - DOA		DOA			DOA if K+ >12

## Interventions

### HT – 1

- Warm environment and clothing (remove any wet clothing).
- Consider sweet drinks or oral glucose, which can help initiate shivering.
- Active movement if possible.

## HT – 2

- Cardiac monitoring.
- Cautious, gentle movements to avoid causing cardiac dysrhythmias. Any exertion or rough handling may cause mobilization of cold and acidic blood to the heart, resulting in dysrhythmias or arrest.
- Horizontal position and immobilization.
- Full body insulation.
- Active external and minimally invasive rewarming techniques (warm environment or blankets).
- Closely monitor BGL and administer glucose as required.
- Transport to the closest facility.

## HT – 3

- Risk of cardiac instability increased below 28 degrees Celsius.
- HT – 2 interventions, plus airway management as required.

## HT – 4

- HT – 2 and HT – 3 interventions as well as CPR with hypothermic modifications.
- Active external and internal rewarming with warmed IV fluids when possible.

## HT – 5

- Patient frozen solid.
- DOA, no resuscitation attempts.

### **CPR for the hypothermic patient**

Detecting a pulse in a patient with hypothermia may be difficult so signs of life and pulse should be checked carefully for 60 seconds before initiating CPR. When performing CPR for the hypothermic patient, defibrillation is limited to three occurrences, even if the AED continues to prompt for defibrillation.

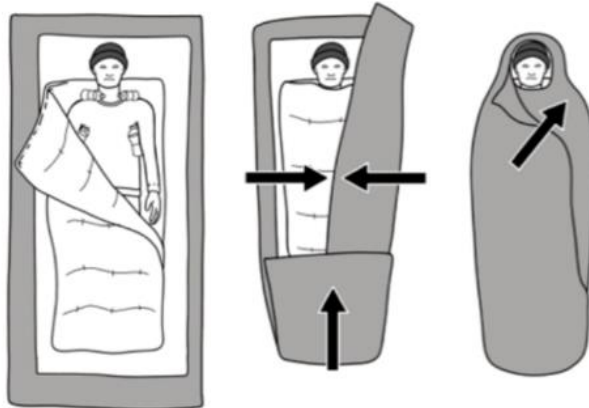
The duration of CPR is not a predictor of outcome. CPR should be started immediately and continued without interruption if possible. Short interruptions in CPR for patient extrication are better tolerated in the hypothermic patient than in the normothermic patient.

### **Rewarming**

#### **1. Passive rewarming**

- a. Gently remove any wet clothing, cutting is the preferred method of clothing removal. Wrap in vapour barrier, which may include a reflective blanket, garbage bag or sheet of plastic.

- b. Protect against further heat loss and wind chill.
- c. Cover with blankets and a second layer of vapour barrier outside the blankets. Wrap burrito style as pictured below.
- d. Turn on any heat source available to you in the patient's environment.
- e. Keep head and neck covered with blanket or toque.



File:Hypothermia-wrap.png. (2020, October 24). Wikimedia Commons, the free media repository. Retrieved 15:47, April 8, 2021 from <https://commons.wikimedia.org/w/index.php?title=File:Hypothermia-wrap.png&oldid=499022399>

## 2. Active external rewarming

- a. Apply radiant heat warm blankets (if available) to core.
- b. Use warmed IV fluids (where available) for fluid resuscitation, do not fluid overload - IV fluids must be heated to 40 – 44 degrees Celsius because rapid IV infusion of room temperature solutions will cause further cooling and may precipitate ventricular fibrillation or asystole. Heating of IV fluids is vital to prevent further heat loss, but this method alone cannot transmit enough heat to achieve rewarming.
- c. The application of external heat although often considered, should be avoided when circulation is impaired.

### Patient Safety Considerations

- Ensure that underlying and treatable medical conditions (e.g. overdose, hypoglycemia, seizure) and/or trauma) are not present.
- Avoid administration of cool or room temperature IV fluids.

## Frostbite

Cold exposure can injure the skin, causing tissue damage known as frostbite. These injuries to the skin and underlying tissues can vary in degree from superficial to deep. Superficial injuries are observed as skin that appears pale and does not return to normal colour with palpation although the underlying structures are soft. Deep injuries involve freezing of the underlying tissues with permanent cell damage. The skin appears white and waxy and the part feels firm when gently palpated. There may be blisters or swelling. When thawed or partially thawed, the skin may appear red with areas of purple or white.

## 1. Superficial

- a. Initial symptoms are coldness and numbness in affected area.
- b. Extreme pain (throbbing and tingling) occurs during rewarming.
- c. Edema may appear within three hours of rewarming followed by the formation of vesicles within 3 to 24 hours.

## 2. Deep

- a. Disrupted capillary flow never returns to the affected area.
- b. Area remains cold, mottled, and blue or gray after rewarming.
- c. Area forms a black, hard eschar 9 to 15 days after injury.
- d. Eventually, non-viable tissue mummifies and sloughs off.

### Treatment of frostbite

1. Rapid rewarming of acute frostbite is impractical in the prehospital setting therefore, rapid transport with wrapping of the affected parts in a blanket is the appropriate treatment.
2. Remove any constrictive jewelry or clothing from the affected site.
3. Do not break blisters or apply direct heat to frostbitten tissue.
4. Cover the frostbitten tissue with dry, clean dressings.
5. Refreezing a thawed extremity significantly increases tissue damage and subsequent need for amputation.
6. When rewarming frozen limbs or body parts, hot packs are not to be used.
7. Consider pain management.

### Backcountry and extrication considerations

If you're in an outdoor environment or the patient is in a backcountry rescue situation, active heating will be difficult. Passive heating will be more feasible, primarily by removing wet clothing and protecting from further cold injury.

1. The ambient temperature will be much higher in direct sun, even in the winter. If the patient is stationary, select the warmest spot you can. South-facing exposures will likely be warmer and may have less snow cover.
2. Wind chill can be a major contributing factor to hypothermia. When the temperature is less than 10 C and there is wind, those conditions combine to remove the warm layer of heat that surrounds the body. Once that protective heat is removed, the body's internal temperature begins to drop. It is important to try and reduce the patient's wind exposure as much as possible, whether the patient is stationary or in the process of extrication. This can be done with tarps, or even the strategic placement of rescuers to break that wind.
3. While the goal is to handle a hypothermic patient as gently as possible, the reality is that in backcountry rescue situations, this may not be possible. Extrication should not be delayed to

### Medical First Response

keep the patient still as ultimately, hypothermic patients need to be out of the elements and transported to definitive care.

4. If extricating a patient from the backcountry, try to pad the rescue wheel or basket stretcher to reduce the movement of the patient.
5. Draping the patient in a darker top layer will help retain heat if there is direct sunlight available.
6. Try to choose a route that maximizes sun exposure.
7. Assign a member to assess the patient frequently while transporting. Don't stop extrication to retake vital signs but monitor the patient for any change in LOC. Ensure the AED is available in the event the patient experiences dysrhythmia or arrest during extrication.

### What to expect when EMS arrives

EMS will likely want to know how long the patient was exposed, and if there were any changes in baseline vital signs. The priority for a severely hypothermic patient is to determine with OLMC if the patient is a good candidate for extracorporeal membrane oxygenation (ECMO) which is only available in Calgary and Edmonton.