Hypothermia: Field Assessment and Treatment

Filed under: cold challenge, hypothermia, thermoregulation

The body has a number of mechanisms to properly maintain its optimal core temperature of 98.6°F (37°C). Above 105°F (40°C), many body enzymes become denatured and chemical reactions cannot take place, leading to death. Below 98.6°F (37°C), chemical reactions slow down, with various complications that can lead to death. Understanding thermoregulation is important to treating injuries related to heat or cold exposure.

How Your Body Regulates Core Temperature

- Vasodilation increases surface blood flow, which increases heat loss (when ambient temperature is less than body temperature).
- Vasoconstriction decreases blood flow to the periphery (arms and legs), decreasing heat loss.
- Sweating cools the body through evaporative cooling.
- Shivering generates heat through increase in chemical reactions required for muscle activity. Visible shivering can maximally increase surface heat production by 500 percent. However, this is limited to a few hours because of depletion of muscle glucose and the onset of fatigue. Active exercise is much more efficient at heating than shivering.
- Increasing or decreasing activity will cause corresponding increases in heat production and decreases in heat production.
- Behavioral responses, such as putting on or taking off layers of clothing.

Cold Challenge

Whenever you go into an environment that is colder than your body temperature, you are exposed to a cold challenge. As long as your levels of heat production and heat retention (the positive factors) are greater than the cold challenge (the negative factors), then you will be thermoregulating properly. If the cold challenge is greater than your combined heat production and heat retention, then you are susceptible to a cold illness such as hypothermia or frostbite.

Cold Challenge—Negative Factors

- Temperature
- Body wetness from rain, sweat, water
- Wind (see Windchill Index)

Heat Retention—Positive Factors

- Body size/shape—your surface-to-volume ratio affects how quickly you lose heat. Children will lose heat faster than adults.
- Insulation—type of clothing layers affects how well you retain heat
- Body fat—amount of body fat affects how quickly you lose heat

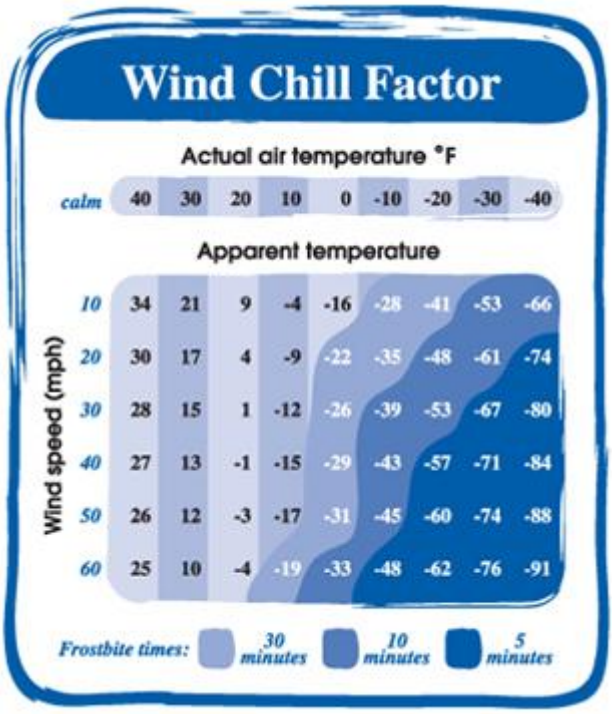
- Shell/core response—allows the body shell to act as a thermal barrier (see Shell/Core Response)

Heat Production—Positive Factors

- Exercise
- Shivering

Windchill

Windchill can have a major impact on heat loss through convection. As air heated by your body is replaced with cooler air pushed by the wind, the amount of heat you can lose in a given period of time increases. This increase is comparable to the amount of heat you would lose at a colder temperature with no wind. The windchill factor takes that rate of heat loss into account and gives a comparable temperature. (see Windchill Index, below).



Wind Chill Chart - Adopted from National Weather Service (NWS) Chart - Courtesy of the CDC

Note: Frostbite occurs in 15 minutes or less at wind chill values of -18° F (° C) or lower

Cold - Weather Injuries

Hypothermia

Hypothermia is a decrease in body core temperature to the point where normal body functions are impaired (see Shell/Core Response, page 000). The key to combating hypothermia is prevention.

Although the risks are highest during cold winter conditions, hypothermia can happen at any time of the year.

The classic example of hypothermia is the summer hiker on Mount Washington in New Hampshire dressed in cotton shorts and a T-shirt. The weather changes rapidly. A sudden thunderstorm drops the temperature from 80°F (27°C) to 60°F (16°C) with strong wind and rain. In these conditions, hypothermia can start to occur almost immediately and become severe in less than an hour.

Prevention and Assessment Be aware of the causes of hypothermia, which are usually cool to cold temperatures combined with wetness and wind. Constantly evaluate the environmental conditions and the conditions of your group. Here are some guidelines to staying warm and avoiding hypothermia:

- Wear proper clothing. Adjust your clothing frequently so that you are neither too hot nor too cold. Choose materials that keep you warm even when wet.
- Stay Dry. Prevent your clothing from getting wet either from sweat or from rain or snow. Wet clothing will rob you of heat 25 times faster than dry clothing. Adjust your clothing layers to prevent overheating and too much sweat from saturated your inner layers. Have proper rain gear to protect your outer layers. If you are too hot and you begin to sweat, the
- Be aware of the impact of windchill on increasing the rate of heat loss (see Windchill Index, page 000).
- Eat small amounts of food at frequent intervals to maintain the body's energy reserves. Carry carbohydrates to snack on, because they provide quick energy, and protein and fat to eat before bed, because they burn slowly, providing energy overnight. Try not to push yourself to your physical limits in cold weather. Always leave your body with energy in reserve.
- Stay well hydrated. Dehydration quickens hypothermia and hyperthermia, so drink enough fluids (see Fluid Balance page 000)
- Avoid caffeine. It is a vasoconstrictor that increases the chances of peripheral frostbite.
- Avoid alcohol. It is a vasodilator and increases heat loss.
- Be alert to sudden weather changes, make a quick evaluation of your group's condition, and take active steps to reduce the risk of exposure.

How to Assess if Someone Is Hypothermic

- Ask the person a question that requires higher reasoning in the brain (to count backward from 100 by nines). If the person is hypothermic, she won't be able to do it. (Other conditions besides hypothermia could be the cause see Assessing Mental Status page 000; Seizures page 000).
- If shivering can be stopped voluntarily, it is mild hypothermia. If shivering cannot be stopped voluntarily, it is moderate to severe hypothermia.
- If you can't get a radial pulse at the wrist, it indicates a core temperature below about 90°F (32°C). Check pulse and respirations *carefully.* Even after a full minute, you may not be able to detect a pulse or respirations and yet the person may still be alive. The body may be using a massive shell/core response to maintain basic life functions.
- A severely hypothermic person may appear dead. The person may be rigid, blue, and curled up in a fetal position. Try to open her arm up from the fetal position; if it curls back up, the person is alive. Dead muscles won't contract—only live muscles.

Stages of Hypothermia

Stage	Core Temperature	Signs and Symptoms

Mild	97–95°F (36–35°C)	Shivering begins—can be mild to severe Unable to perform complex tasks with hands Hands numb
Moderate	95–90°F (35–32°C)	Shivering becomes uncontrollable and violentChanges in mental status, mild confusion, higher reasoning becomes impaired; eventually becomes withdrawn, may show "paradoxical undressing"—person imagines they are warm and takes off clothing Muscle incoordination becomes apparent, movements slow and labored, stumbling pace
Severe	90–85°F (32–29°C)	Shivering stops Skin blue or puffy Unable to walk, confusion, muscles become rigid Incoherent/irrational behavior, becomes semiconscious Pulse rate decreases Respiration rate decreases
	85–80°F (29–27°C)	Unconscious Heartbeat and respiration erratic Pulse may not be palpable Cardiac and respiratory failure

Treatment - Mild to Moderate Hypothermia

1. **Reduce Heat Loss** Remove patient from wind and cold if possible. Remove all wet clothing. Make sure the person is properly clothed (dry wicking layer, fleece, and outer shell). **Provide shelter** If a person is still shivering, she has the ability to rewarm herself at a rate of 4°F (2°C) per hour *if* you can stop all further heat loss.

2. **Add Fuel and Fluids** It is essential to keep a hypothermic person adequately hydrated and fueled. Food intake should include hot liquids, sugars, GORP. One of the best fuels is hot Jello® which contains both protein and sugars (see Food Sources). Avoid alcohol, caffeine, or nicotine.

3. **Add Heat** Put the hypothermic person in dry clothing, in a sleeping bag. In cases of mild hypothermia you can put another warm, dry person in the bag with her. In cases of moderate hypothermia use chemical heat packs or hot water bottles (see below).

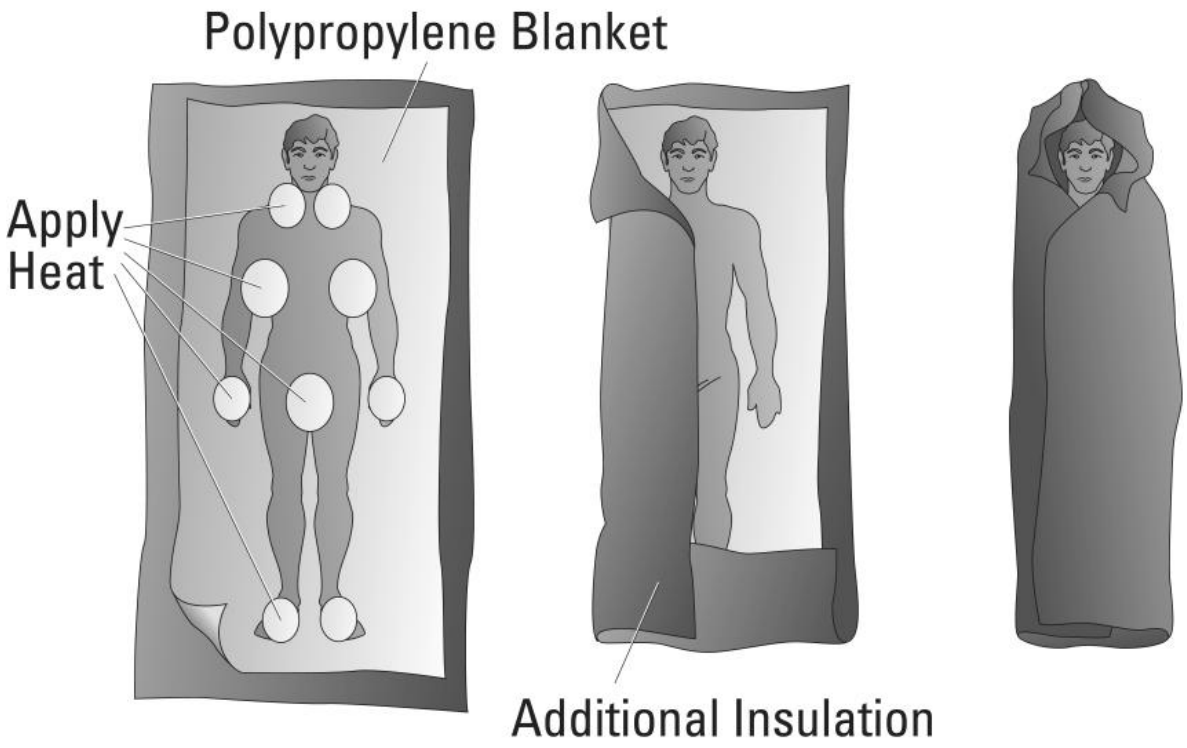
4. **Activity** Increasing physical activity will help rewarm the victim. Violent shivering is the body's way of generating hear from muscle contraction so don't suppress shivering, instead have the person be more active. A mildly hypothermic person can do jumping jacks or run in place which will generate more heat than shivering will. A moderately hypothermic person is best in a sleeping bag to better trap the heat they produce. The person can increase heat production by moving arms and legs or doing isometric exercises inside the sleeping bag.

If the patient's condition improves, evacuation may not be necessary; but if her condition worsens or does not improve, prepare to evacuate your patient when she is able, or send for help.

Treatment - Moderate to Severe Hypothermia

In addition to the treatment methods outlines above, a severely hypothermia person whousl be treated with the following.

1. **Create a Hypothermia Wrap around the Victim.** No matter how cold if you provide a shell of total insulation aroung the patient, the victim can still internally rewarm themselves more efficiently than any external field rewarming (hospitals can obviously do a better job). Make sure the patient is dry and has a wicking inner layer next to the skin to minimize sweating. Use a plastic garbage bag as a diaper to prevent urine from soaking the insulation layers. The person must be protected from any moisture in the environment. Use multiple sleeping bags, blankets, clothing, foam pads, etc. to create a minimum of 4 inches (10 centimeters) of insulation all the way around the patient, especially between the patient and the ground. Use foam pads to insulate the person from the ground. Include an aluminum space blanket to help prevent radiant heat loss if you have one. Wrap the entire ensemble in something waterproof like a tarp of tent rainfly to protect from wind and water. Your patient will look like she is in a giant burrito with only her face exposed.



2. **Add Fuel and Fluids.** At this stage of hypothermia, the stomach has shut down and will not digest solid food but can absorb water and dilute sugars. Give a dilute mixture of warm water with sugar every 15 minutes. Dilute hot Jello® works best, since it is part sugar and part protein and will be absorbed directly into the bloodstream, providing the necessary calories to allow the person to rewarm herself. Do *not* give full - strength Jell-O, even in liquid form—it is too concentrated and won't be absorbed.

3. **Encourage Urination.** The hypothermic person will have to urinate from cold diuresis. Cold Diuresis is a condition where the surface blood vessels constrict in response to cold. This constriction causes greater volume pressure in the circulatory system. The kidneys will "pull off" the excess fluid to reduce the pressure. The kidneys then excrete the fluid, causing the bladder to fill. This is one way in which the body protects the amount of heat lost at the surface. The garbage bag diaper is to allow the person to urinate inside the wrap. Remember that water or urine against the skin will cause faster heat loss. The garbage bag diaper serves as a vapor barrier and minimizes the chilling effect.

4. **Add Heat.** Heat can be applied to the skin where the major arteries are near the surface—the best places are at the palms of the hands and the soles of the feet. You can also use heat packs at the neck for the carotid, at the armpits for the brachial, and at the groin for the femoral artery. Chemical heat packs such as the Heat Wave provide 110°F (43°C) for 6 to 10 hours. You can also use hot water bottles, warm rocks, towels, and compresses. Wrap these in cloth so as not to have the heat source directly against the skin.

5. **Rescue Breathing.** For a severely hypothermic person, rescue breathing (see Basic Life Support) timed with the victim's breathing can provide supplemental oxygen and more importantly heated air going directly into the person's body core (rather then the cold environmental air).

After-Drop

After-drop is a situation in which the core temperature actually decreases during rewarming. As the shell (the arms and legs) are rewarmed, the peripheral vessels in the arms and legs dilate. This dilation sends very cold blood filled with metabolic waste products from the shell into the core, further decreasing the core temperature. It is not possible to *prevent* after-drop, but *slow* controlled rewarming, the kind the person's body is doing on it's own in a hypothermia wrap, minimizes the negative effect.

After-drop is why you don't try to apply direct heat sources like chemical heat packs to the person's arms and legs. This would cause major vasodilation, which would push lots of cold blood back into the core which could cause death. Avoid after - drop by applying heat to the core *only!*

Evacuation Guidelines

You should not attempt to evacuate someone in a state of severe hypothermia. Moving the person can cause the heart to stop. Send for advanced medical care or wait until the condition stabilizes. If evacuation is delayed it is recommended to put two warm rescuers inside the hypothermia wrap, one on either side of the person.

Hypothermia and CPR

When a person is in severe hypothermia, she may *appear* to be dead: cold, blue skin; fixed and dilated pupils; no discernible pulse or breathing; comatose and unresponsive to any stimuli; rigid muscles. As a rescuer, you may not be sure, so your job is to rewarm the person and do CPR if indicated. Treatment follows the saying "a hypothermic patient is never cold and dead, only warm and dead."

1. Make sure you do a complete assessment of heart rate before beginning CPR. Remember, the heart rate may be 2 to 3 per minute and the breathing rate one per thirty seconds. During severe hypothermia, the heart is hyperexcitable, and mechanical stimulation (including CPR, moving the patient, or after-drop, see page 299) may result in ventricular fibrillation, leading to death. As a result CPR itself may be contraindicated for some hypothermia situations. Also, instituting cardiac compressions while the heart is still beating on its own may lead to life - threatening arrhythmias. Check the carotid pulse for a longer time period (up to a full minute) to ascertain if there is some slow heartbeat. Even though the heart is beating very slowly, it is filling completely and distributing blood fairly effectively. External cardiac compressions are only 20 to 30 percent effective. Thus, the body may be able to satisfy its reduced circulatory needs with only 2 to 3 beats per minute. *Be sure the pulse is absent before beginning CPR.* Once you start doing CPR you will need to continue as you rewarm the person.

2. Ventilation (air being moved in and out of the lungs) may have stopped but respiration (oxygen and carbon dioxide exchange in the blood) may continue. The oxygen demands for the body have been so diminished with hypothermia that the body may be able to survive for some time using only the oxygen that is already in the body. If ventilation has stopped, artificial ventilation (rescue breathing) may be

started to increase available oxygen. In addition, blowing warm air into the person's lungs may assist in internal rewarming.

3. Perform CPR procedures (see Basic Life Support):

- Check radial pulse; between 91° and 86°F (33° and 30°C) this pulse disappears.
- Check for carotid pulse; wait at least a full minute to check for very slow heartbeat.
- If there is a pulse but no breathing or slow breathing, give rescue breathing (also adds heat).
- If there is no discernible heartbeat, begin CPR and be prepared to continue—persons with hypothermia have been given CPR for up to 3.5 hours and have recovered with *no* neurological damage.
- Begin active rewarming as described above.