

Cold-Related Emergencies

17



Cold-Related Emergencies

Heat flows from an area with a higher temperature to an area with a lower temperature. When a person is surrounded by air or water cooler than body temperature, the body loses heat. If heat escapes faster than the body produces heat, the body temperature falls. Normal body temperature is 98.6°F, and if the body temperature falls much below that, cold injuries can result.

► Freezing Cold Injuries

Freezing cold injuries can occur whenever the air temperature is below freezing (32°F). Freezing limited to the skin surface is **frostnip**. Freezing that extends deeper through the skin and into the flesh is **frostbite**.

Frostbite is prevalent during military campaigns and is a known hazard for outdoor workers, the homeless, mountain climbers, and explorers. As more people pursue cross-country skiing, snowmobiling, and other outdoor winter sports, the number of frostbite cases probably will increase. However, it is still thought to be rare in nonmilitary situations.

Frostnip

Frostnip is caused when water on the skin surface freezes. Frostnip should be taken seriously because it could be the first sign of impending frostbite.

chapter *at a glance*

► Cold-Related Emergencies

► Freezing Cold Injuries

► Hypothermia

Recognizing Frostnip

It is difficult to tell the difference between frostnip and frostbite. Signs of frostnip include:

- Skin appears red and sometimes swollen.
- Painful, but usually no further damage after rewarming.
- Repeated frostnip in the same spot can dry the skin, causing it to crack and become sensitive.

Care for a Frostnip Victim

To care for a frostnip victim:

1. Gently warm the affected area by placing it against a warm body part (for example, put bare hands under the armpits or on the stomach) or by blowing warm air on the area. After rewarming, the affected area can be red and tingling.
2. Do not rub the affected area.

Frostbite

Frostbite happens only in below-freezing temperatures.

Frostbite affects mainly the feet, hands, ears, and nose **Figure 1**. These areas do not contain large heat-producing muscles and are some distance from the body's heat-generation sources. The most severe consequences of frostbite occur when tissue dies (gangrene), and the affected part might have to be amputated. The longer the tissue stays frozen, the worse the injury. Check for hypothermia in any frostbitten victim.

Recognizing Frostbite

The severity and extent of frostbite are difficult to judge until hours after thawing. Frostbite can be classified as superficial or deep before thawing.

The signs and symptoms of superficial frostbite are as follows:

- The skin is white, waxy, or grayish yellow.
- The affected part feels very cold and numb. There might be tingling, stinging, or an aching sensation.
- The skin surface feels stiff or crusty and the underlying tissue soft when depressed gently and firmly.

The following signs and symptoms indicate deep frostbite:

- The affected part feels cold, hard, and solid and cannot be depressed—it feels like a piece of wood or frozen meat.



Figure 1

Frostbitten fingers 6 hours after rewarming in 108°F water.

- Blisters might appear after rewarming.
- The affected part is cold, with pale, waxy skin.
- A painfully cold part suddenly stops hurting.

After a part has thawed, frostbite can be categorized by degrees, similar to the classification of burns. First-degree frostbite is superficial, and second-, third-, and fourth-degree frostbite are deeper.

- First-degree frostbite: The affected part is warm, swollen, and tender.
- Second-degree frostbite: Blisters form minutes to hours after thawing and enlarge over several days **Figure 2** and **Figure 3**.
- Third-degree frostbite: Blisters are small and contain reddish blue or purplish fluid. The



Figure 2

Second-degree frostbite.

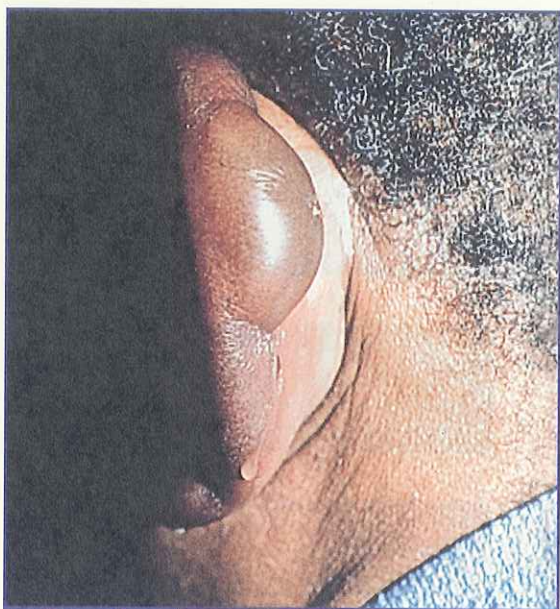


Figure 3

Frostbitten ear.

surrounding skin can be red or blue and might not blanch when pressure is applied.

- Fourth-degree frostbite: No blisters or swelling occur. The part remains numb, cold, and white to dark purple.

Care for a Frostbite Victim

All frostbite injuries require the same first aid treatment. Seek medical care immediately. Rewarming of frostbite should seldom be attempted outside a medical facility.

1. Get the victim out of the cold and to a warm place.
2. Remove any wet clothing or constricting items, such as rings, that could impair blood circulation.
3. Seek immediate medical care.
4. If the affected part is partially thawed, and you have warm water, use the following wet, rapid rewarming method. If there is risk of refreezing, do not rewarm. Place the frostbitten part in warm (100°F to 104°F) water. If you do not have a thermometer, pour some of the water over the inside of your arm or put your elbow into it to test that it is warm, not hot. Maintain water temperature by

CAUTION

DO NOT use water hotter than 104°F—burns can result.

DO NOT use water cooler than 100°F—it will not thaw frostbite rapidly enough.

DO NOT break any blisters.

DO NOT rub or massage the affected part—ice crystals can be pushed into body cells, rupturing them.

DO NOT rub the affected part with ice or snow.

DO NOT rewarm the part with a heating pad, hot-water bottle, stove, sunlamp, radiator, or exhaust pipe or over a fire. Excessive temperatures cannot be controlled, and burns can result.

DO NOT allow the victim to drink alcoholic beverages. Alcohol dilates blood vessels and causes loss of body heat.

DO NOT allow the victim to smoke. Smoking constricts blood vessels, thus impairing circulation.

DO NOT rewarm if there is any possibility of refreezing.

DO NOT allow the thawed part to refreeze because the ice crystals formed will be larger and more damaging. If refreezing is likely or even possible, it is better to leave the affected part frozen.

DO NOT use the dry rewarming technique (putting the victim's hands in your armpits) because that takes three to four times longer than the wet, rapid method to thaw frozen tissue. Slow rewarming results in greater tissue damage than rapid rewarming.

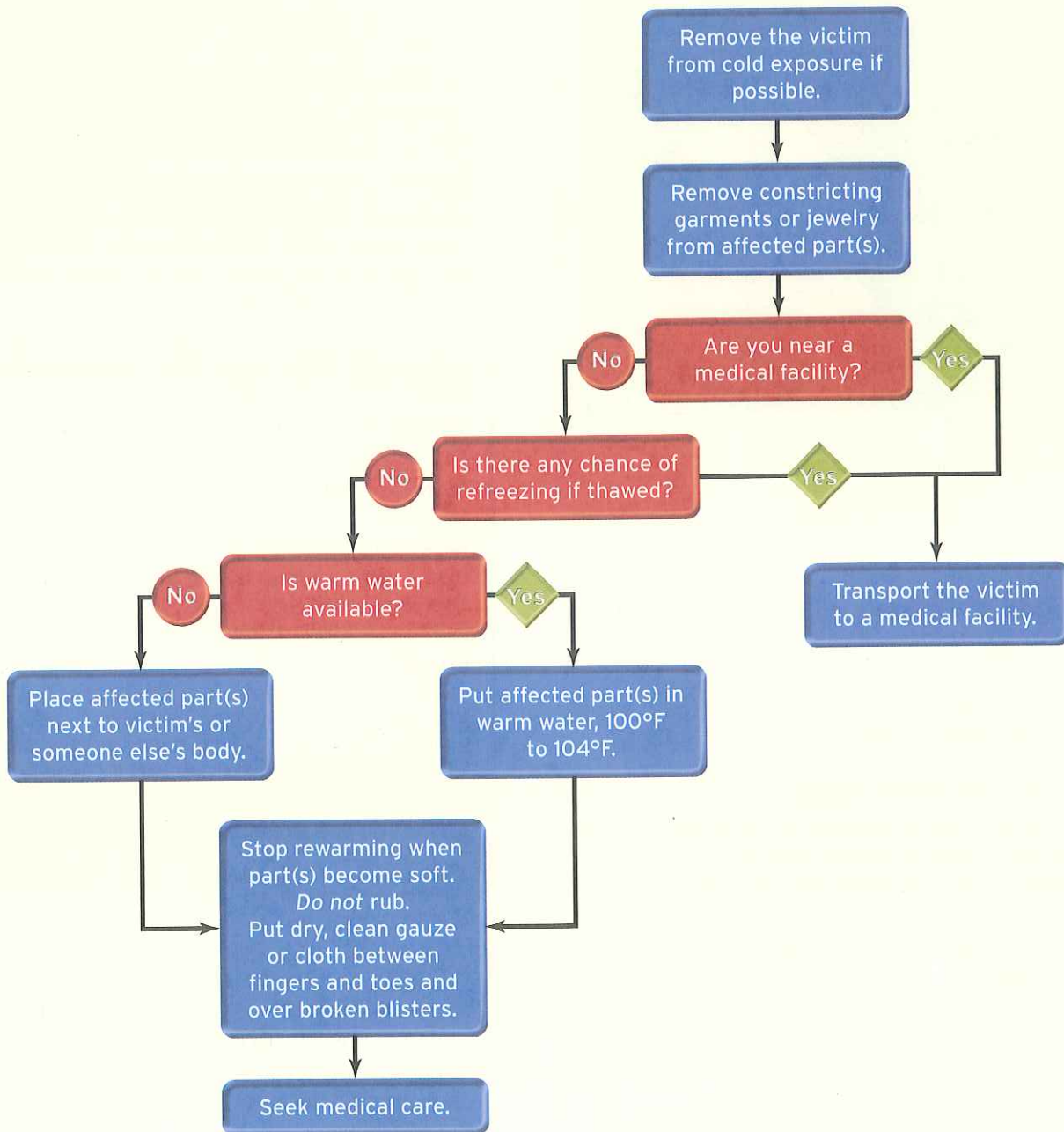
DO NOT rewarm if close to a medical facility.

adding warm water as needed. Rewarming usually takes 20 to 40 minutes or until the tissues are soft. To help control the severe pain during rewarming, give the victim aspirin (adults only) or ibuprofen. For ear or facial injuries, it is best but may be difficult to apply warm, moist cloths, changing them frequently.

5. After thawing:

- If the feet are affected, treat the victim as a stretcher case—the feet will be impossible to use after they are rewarmed.
- Protect the affected area from contact with clothing and bedding.

Frostbite



- Place dry, sterile gauze between the toes and the fingers to absorb moisture and keep them from sticking together.
- Slightly elevate the affected part to reduce pain and swelling.
- Apply aloe vera gel, if advised by a physician, to promote skin healing.
- Provide aspirin (adults only), ibuprofen, or acetaminophen to limit pain and inflammation.

► Hypothermia

Body temperature falls when the body cannot produce heat as fast as it is lost. **Hypothermia** is a life-threatening condition in which the body's core temperature falls below 95°F. Generally, the core temperature will not fall until after many hours of continuous exposure to cold air, if the person is healthy, physically active, and reasonably dressed. However, because wet skin and wind accelerate body heat loss and the body produces less heat during inactive periods, the core body temperature can fall even when the air temperature is above freezing if conditions are windy, clothing is wet, or the person is inactive.

Hypothermia can occur year round. Most people think of hypothermia as related only to cold outdoor exposure. It can happen indoors, in the southern states, and even on a summer day. It does not require subfreezing temperatures.

Recognizing Hypothermia

Consider hypothermia in all victims who have been exposed to cold and who have an altered mental status. Suspect hypothermia in any person who has a temperature of less than 95°F. (Keep in mind that some thermometers do not measure below 95°F.) Shivering is a good clue, but it could be suppressed when energy stores (glycogen) are depleted. Suspect hypothermia in people with frostbite and those injured in a cold environment.

Some people die of hypothermia because they or those around them do not recognize the symptoms, which are difficult to recognize in the early stages. Here are some signs to watch for:

- Change in mental status. This is one of the first symptoms of developing hypothermia. Examples are disorientation, apathy, and changes in personality, such as unusual aggressiveness.

- Shivering. Shivering is the first, and most important, body defense against a falling body temperature. Shivering starts when the body temperature drops 1°F and can produce more heat than many rewarming methods. As the core temperature continues to fall, shivering decreases and usually stops at about 86°F. Shivering also stops as body temperature rises. If shivering stops as responsiveness decreases, assume that the core temperature is falling. If, on the other hand, shivering stops while the victim is becoming more coordinated and feeling better, assume that the core temperature is rising.
- Cool abdomen. Place the back of your hand between the clothing and the victim's abdomen to assess the victim's temperature. When the victim's abdominal skin under clothing is cooler than your hand, consider the victim hypothermic until proven otherwise.
- Low core body temperature. The best indicator of hypothermia is a thermometer reading of the core body temperature. The ability to reliably measure core temperature depends on the availability of an appropriate thermometer and access to the victim's rectum. Normal thermometers do not register below 94°F and so do not indicate whether the hypothermia is mild or severe. Because first aid for mild hypothermia is different from that for severe hypothermia, it is helpful to have a rectal thermometer that registers below 90°F. Oral and axillary (armpit) temperatures are influenced by too many external factors to make them reliable.

Measuring rectal temperatures in wilderness or remote locations is seldom done, mainly because low-reading rectal thermometers usually are not readily available. Also, taking a rectal temperature can be difficult, inconvenient, and embarrassing to the victim and rescuer. If done outdoors, such a procedure can further expose the already cold victim.

Types of Hypothermia

The difference between mild and severe hypothermia is based on the core body temperature, but taking a rectal temperature often is not possible. The second most significant difference is that with severe hypothermia, the victim becomes so cold that shivering stops, which

means the victim's body cannot rewarm itself internally and requires external heat for recovery. In fact, 50% to 80% of all victims of severe hypothermia die.

Recognizing Mild Hypothermia

Signs of mild hypothermia include the following:

- ⦿ Vigorous, uncontrollable shivering
- ⦿ Victim has the “umbles”
 - Grumbles—decreased mental skills
 - Mumbles—slurred speech
 - Fumbles—difficulty using fingers or hands
 - Stumbles—staggers while walking
- ⦿ Has cool or cold skin on the abdomen, chest, or back
- ⦿ Victims have a core body temperature above 90°F

Care for a Mild Hypothermia Victim

Do the following to care for victims of mild hypothermia:

1. Stop further heat loss:
 - ⦿ Get the victim out of the cold.
 - ⦿ Handle the victim gently.
 - ⦿ Prevent heat loss by replacing wet clothing with dry clothing and placing insulation (blankets, towels, pillows, wadded-up newspapers) beneath and over the victim. Cover the victim's head (50% to 80% of the body's heat loss is through the head).
 - ⦿ Cover the victim with a vapor barrier (such as a tarp, sheet of plastic, or trash bags). If you are unable to remove wet clothing, place a vapor barrier between clothing and insulation. For a dry victim, the vapor barrier can be placed outside of the insulation.
 - ⦿ Keep the victim in a horizontal (flat) position. Do not raise the legs.
 - ⦿ Do not let the victim walk or exercise. Do not massage the victim's body. Either activity could drive cold blood from the extremities to the torso and produce what is known as temperature after drop.
2. Call 9-1-1 for immediate medical transportation. Remember that hypothermia is more common in urban settings than in victims found in the wilderness.
3. Allow the victim to shiver—do not stop the shivering by adding heat to the victim. Shivering that generates heat will rewarm mildly hypothermic victims.
4. Give warm, sugary drinks, which can provide energy (calories) for the shivering

to continue. They may also provide a psychological boost. These drinks will not provide enough warmth to rewarm the victim.

Recognizing Severe Hypothermia

The following signs indicate severe hypothermia:



- ⦿ No shivering.
- ⦿ Skin feels ice cold and appears blue.
- ⦿ Muscles can be stiff and rigid, similar to rigor mortis.
- ⦿ Altered mental status—not alert.
- ⦿ Breathing and pulse slow.
- ⦿ Victim might appear to be dead.
- ⦿ Victim has a core body temperature below 90°F.

Care for a Severe Hypothermia Victim

Care for someone with severe hypothermia by doing the following:

1. Stop further heat loss:
 - ⦿ Get the victim out of the cold.
 - ⦿ Handle the victim gently. Rough handling can cause cardiac arrest.
 - ⦿ Prevent heat loss by replacing wet clothing with dry clothing and placing insulation (blankets, towels, pillows, wadded-up newspapers) beneath and over the victim. Cover the victim's head (50% to 80% of the body's heat loss is through the head).
 - ⦿ Cover the victim with a vapor barrier (such as a tarp, plastic sheets, or trash bags). If you are unable to remove wet clothing, place a vapor barrier between clothing and insulation. For a dry victim, the vapor barrier can be placed outside of the insulation.
 - ⦿ Keep the victim in a horizontal (flat) position. Do not raise the legs.
 - ⦿ Do not let the victim walk or exercise. Do not massage the victim's body. Either activity could drive cold blood from the extremities to the torso and produce what is known as temperature after drop.
2. Call 9-1-1 for immediate medical transportation. Remember that hypothermia is more common in urban settings than in victims found in the wilderness.
3. When the victim is in a remote location and far from medical care, warm the victim by any available external heat source (such as body-to-body contact).

FYI


Wind Chill Chart

Effective 11/01/01

Wind (mph)	Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5		36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10		34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15		32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20		30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25		29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30		28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35		28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40		27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45		26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50		26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55		25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60		25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times ■ 30 minutes ■ 10 minutes ■ 5 minutes

Wind Chill (°F) = 35.74 + 0.6215T - 35.75 (V^{0.16}) + 0.4275T (V^{0.16})
Where, T=Air Temperature (°F) V=Wind Speed (mph)

How Cold Is It?

In addition to cold, two other factors account for body heat loss: moisture and wind. Moisture—whether from rain, snow, or perspiration—speeds the conduction of heat away from the body.

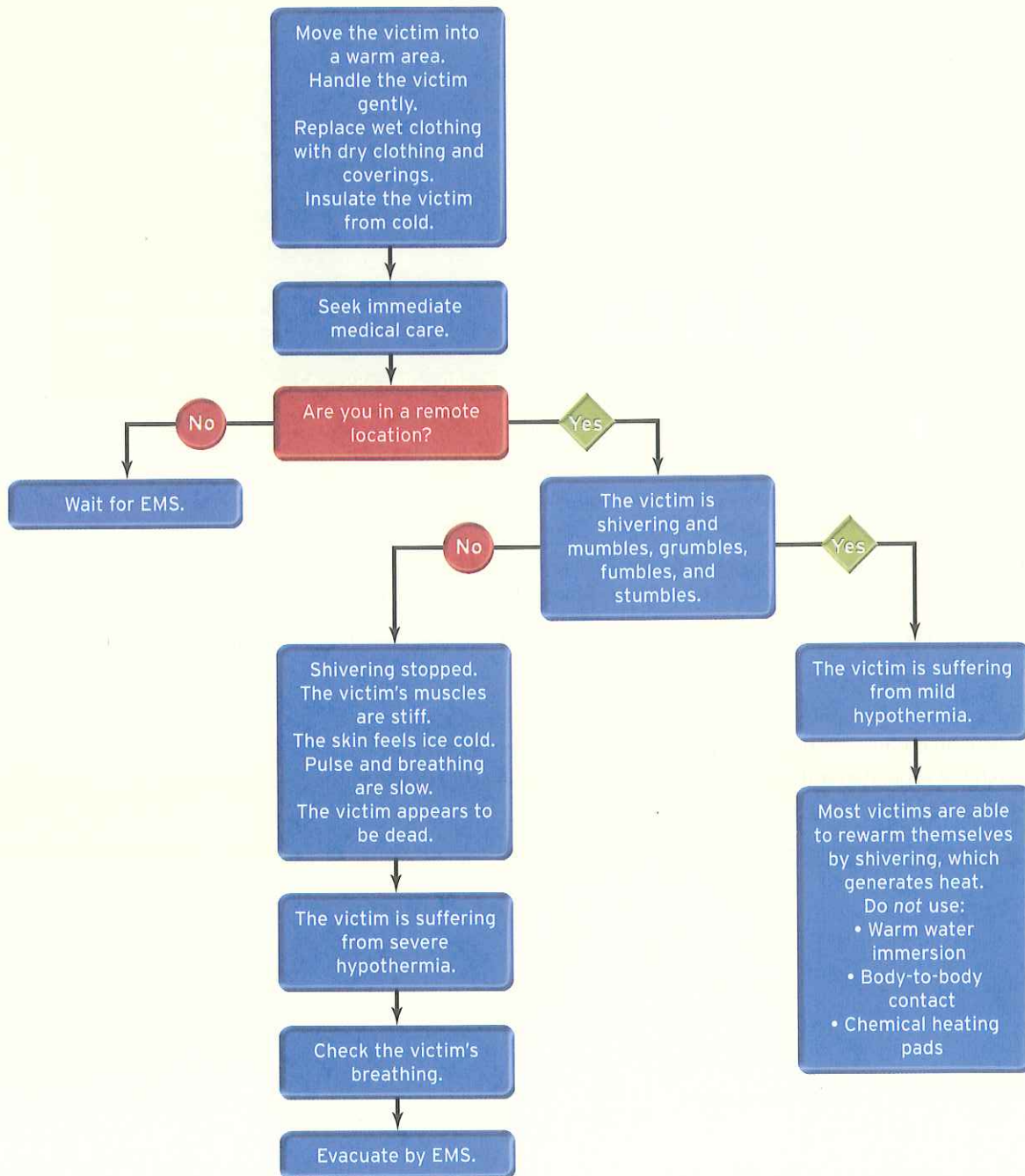
Wind causes sizable amounts of body heat loss. If the thermometer reads 20°F and the wind speed is 20 mph, the exposure is comparable to 4°F. This is called the windchill factor. Use the following rough measures of wind speed: if you feel the wind on your face, wind speed is at least 10 mph; if small branches move or if dust or snow is raised, it is 20 mph; if large branches are moving, it is 30 mph; and if a whole tree bends, it is about 40 mph.

To determine the windchill factor:

1. Estimate the wind speed by checking for the aforementioned signs.
2. Look at an outdoor thermometer reading (in degrees Fahrenheit).
3. Match the estimated wind speed with the actual thermometer reading in the following table.

Source: Courtesy of the National Weather Service/NOAA.

Hypothermia



CAUTION

DO NOT allow the victim to exert himself or herself (no walking, no climbing).

DO NOT try to rewarm a hypothermic victim outside a medical facility. External measures to rewarm should not be used, especially on the extremities, because surface rewarming leads to vasodilation (wider blood vessels), which can lead to a drop in blood pressure and temperature after drop.

DO NOT try to rewarm a hypothermic victim outside a medical facility because rewarming the skin will stop shivering, which is the most effective way to rewarm.

DO NOT put an unconscious victim in a bathtub.

DO NOT give the victim alcohol. Alcohol interferes with shivering and accelerates heat loss by dilating the blood vessels in the skin. The victim might feel warmer temporarily, but there is a greater risk of hypothermia.

DO NOT give the victim a caffeine drink. Caffeine has a diuretic effect, and the victim probably is already dehydrated.

DO NOT rub or massage the victim's arms or legs. Rubbing the skin suppresses shivering, dilates the blood vessels in the skin (resulting in more heat loss), and produces temperature after drop.

DO NOT raise the victim's legs, which allows cold blood from the legs to flow into the body core and adversely affect the heart. Keep the victim in a flat position.

Q&A**What is the coldest body temperature?**

The lowest recorded body temperature with a full recovery was 56.6°F (13.7°C). This was the temperature of D. Anna Bagenholm, age 29, who was trapped under ice for 80 minutes in May 2000, while skiing with friends near Narvik, Norway.

► Emergency Care Wrap-up

Condition	What to Look For	What to Do
Frostbite	<p>White, waxy-looking skin</p> <p>Skin feels cold and numb (pain at first, followed by numbness)</p> <p>Blisters, which may appear after rewarming</p>	<p>Move victim to a warm place.</p> <p>Remove tight clothing or jewelry from injured part(s).</p> <p>Place dry dressings between toes and/or fingers.</p> <p>Seek medical care.</p>
Hypothermia	<p>Mild</p> <p>Uncontrollable shivering</p> <p>Confusion, sluggishness</p> <p>Cold skin even under clothing</p> <p>Severe</p> <p>No shivering</p> <p>Muscles stiff and rigid</p> <p>Skin ice cold</p> <p>Appears to be dead</p>	<p>All victims:</p> <p>Move victim to a warm place.</p> <p>Prevent heat loss by</p> <ul style="list-style-type: none"> • Replacing wet clothing with dry clothing • Covering victim's head <p>Mild</p> <p>Give warm, sugary beverages.</p> <p>Do not add anything warm to the skin—let the shivering rewarm the body.</p> <p>Severe</p> <p>Do not rewarm unless in a very remote location.</p> <p>Call 9-1-1.</p>

► Ready for Review

- When a person is surrounded by air or water cooler than body temperature, the body loses heat.
- Humans protect themselves from cold primarily by avoiding or reducing cold exposure through the use of clothing and shelter.
- Nonfreezing cold injuries can occur when conditions are cold and wet and the hands and feet cannot be kept warm and dry.
- Freezing cold injuries can occur whenever the air temperature is below freezing.
- Hypothermia is a life-threatening condition in which the body's core temperature falls below 95°F.

► Vital Vocabulary

frostbite The damage to tissues as a result of prolonged exposure to extreme cold.

frostnip The superficial local tissue destruction caused by freezing; it is limited in scope and does not destroy the full thickness of skin.

hypothermia Decreased body temperature.

► Assessment in Action

You are on a winter hike with five friends high in the mountains. The snowshoeing has been great but it is very cold. At the trailhead, the temperature was 15°F (-9°C) and it has not warmed up much during your hike. One of your friends wore only tennis shoes but has not been complaining. When you return to the trailhead and begin to warm up in your car, your friend begins to complain of tingling and aching in his toes.

Directions: Circle Yes if you agree with the statement; circle No if you disagree.

- Yes No 1. It is difficult to determine if your friend has frostnip or frostbite.
- Yes No 2. Frostbite requires freezing temperatures (below 32°F [0°C]).
- Yes No 3. The skin and underlying tissue affected by superficial frostbite feel hard and solid.

- Yes No 4. As long as there is no danger of refreezing, you could begin warming his toes in warm water.
- Yes No 5. If you do not have warm water, you could rub his toes to increase circulation.

► Check Your Knowledge

Directions: Circle Yes if you agree with the statement; circle No if you disagree.

- Yes No 1. Shivering is a signal that clothing and shelter are inadequate to protect the body from the cold.
- Yes No 2. Up to 100% of the body's total heat production can be lost by radiation through a person's unprotected head.
- Yes No 3. Physically unfit people are more susceptible to cold injury.
- Yes No 4. Frostnip is caused when water on the skin surface freezes.
- Yes No 5. Shivering produces body heat.
- Yes No 6. Rub a frostbitten part to rewarm it.
- Yes No 7. Rewarm a hypothermic victim quickly in a hot shower or with chemical heat packs.
- Yes No 8. Replace any wet clothing with dry clothing for a hypothermic victim.
- Yes No 9. Seek medical care for a severe hypothermic victim.
- Yes No 10. Below-freezing temperatures are required for hypothermia to occur.

Heat-Related Emergencies

18

chapter *at a glance*

- ▶ **Heat-Related Emergencies**
- ▶ **Heat Illnesses**

Heat-Related Emergencies

When the temperature goes up, a multitude of problems can—and do—arise. Given the right (or wrong) conditions, anyone can develop heat illness. Some victims are lucky enough to have only heat cramps, but less fortunate people could be laid low by heat exhaustion or devastated by heatstroke.

▶ Heat Illnesses

Heat illnesses include a range of disorders [Table 1](#). Some of them are common, but only heatstroke is life threatening. Untreated heatstroke victims always die.

Heat Cramps

Heat cramps are painful muscle spasms that occur suddenly during or after vigorous exercise or activity. They usually involve the muscles in the back of the leg (calf and hamstring muscles) or the abdominal muscles. Some experts state they are caused by water and electrolyte losses during times of excessive sweating. Victims might be drinking fluids without adequate salt content. However, other experts disagree because the typical American diet is heavy with salt.