

Hypothermia

The body's core temperature drops below 35°C (95°F), and the machinery that makes and keeps heat cannot keep up.

THE STORY IN ONE SENTENCE

The body's core temperature drops below 35°C (95°F), and the machinery that makes and keeps heat cannot keep up.

"Hypothermia means the body is losing heat faster than it can make it. Nobody is dead until warm and dead."

Normal anatomy — the body's job

Your body keeps its core at 37°C (98.6°F) because that is the only temperature where enzymes, cells, and organs work right. The hypothalamus (a control center deep in your brain) reads blood temperature every second and fires two main tools to keep you warm: shivering (your muscles shake fast to burn fuel and make heat) and vasoconstriction (blood vessels squeeze tight so warm blood stays near your heart, lungs, and brain instead of leaking out through your skin). Keep that picture in your head, because every weird finding in hypothermia only makes sense as a change from that normal job.

BODY'S JOB

The hypothalamus is like a thermostat. It reads the temperature of your blood, and if it drops even a little, it sends two emergency orders: (1) shiver — your muscles contract and relax super fast, which burns glucose and oxygen and makes heat, and (2) squeeze your skin blood vessels tight — this keeps the warm blood circulating close to your vital organs (heart, brain, lungs, liver) instead of losing heat through your skin. If you do not know that normal job first, the weird findings — shivering, then no shivering, fast heart then slow heart, confusion, J waves — seem random. They are not. They are the body trying to cope, then failing.

1. The hypothalamus reads blood temperature every second.
2. If temperature drops, it fires the sympathetic nervous system (your body's gas pedal) to release norepinephrine (a chemical that speeds the heart and squeezes blood vessels).

3. Shivering starts: skeletal muscles contract and relax fast, burning glucose and oxygen to make heat.
4. Vasoconstriction starts: blood vessels in your skin and limbs squeeze tight so warm blood stays in your core (heart, lungs, brain).
5. Your heart rate goes up to pump that warm blood faster.
6. This loop keeps your core at 37°C even when the air or water around you is cold.

What breaks

Hypothermia happens when heat leaves your body faster than your muscles and metabolism can make it. The most common cause is cold exposure (being outside in freezing air, falling into icy water, or wearing wet clothes in the wind). Water pulls heat out of your body 25 times faster than air at the same temperature, so immersion hypothermia happens fast. But hypothermia can also happen indoors if something inside your body breaks the heat-making machinery: sepsis (overwhelming infection that drops your metabolism), hypothyroidism (low thyroid hormone, so your cells burn fuel slowly), low blood sugar (hypoglycemia) (low blood sugar, so your muscles have no fuel to shiver), malnutrition (no fuel reserves), alcohol (which dilates blood vessels so heat pours out through your skin and also clouds judgment so you do not feel the cold), or trauma (which can damage the hypothalamus or spinal cord). Once shivering stops around 32°C, the body cannot save itself — your muscles are out of fuel and oxygen, and now you are just a passive object losing heat.

CLINICAL TERM

Hypothermia is defined as a core body temperature below 35°C (95°F). It is caused by environmental cold exposure (air, water immersion, wet clothing with wind) or by endogenous failure of thermogenesis (sepsis, hypothyroidism, low blood sugar (hypoglycemia), adrenal insufficiency, malnutrition, ethanol intoxication, or CNS injury affecting the hypothalamus). Water immersion accelerates heat loss by conduction. Alcohol causes peripheral vasodilation and impairs shivering. Sepsis and hypothyroidism reduce basal metabolic rate. Low blood sugar depletes substrate for shivering thermogenesis. Trauma, especially spinal cord injury, disrupts autonomic thermoregulation. Below 32°C, shivering ceases and thermogenesis fails.

How the body compensates

At first, the body fights hard to keep core temperature up: you shiver like crazy, your heart races, and blood vessels squeeze tight. Vital signs can look almost normal while the body is burning all its reserves. That is the dangerous middle, because it lets the team miss where the patient really is on the curve. Once shivering stops (around 32°C), the body has no more tools

left, and the crash comes fast: heart slows, brain shuts down, and the heart becomes so irritable that any bump can trigger ventricular fibrillation or asystole (no heartbeat).

1. Stage 1 (mild hypothermia, 32–35°C): The hypothalamus fires maximum sympathetic drive. You shiver violently. Heart rate climbs (tachycardia). Blood vessels squeeze tight (vasoconstriction). Blood pressure may be normal or high. You feel cold, confused, and clumsy, but you are still awake.
2. Stage 2 (moderate hypothermia, 28–32°C): Shivering stops because muscles run out of ATP (energy) and oxygen. The sympathetic drive fades. Heart rate drops (bradycardia). Pupils dilate. Consciousness fades into stupor. The ECG shows a J wave (Osborn wave) — a small hump after the QRS — because cold slows the heart's electrical recovery.
3. Stage 3 (severe hypothermia, below 28°C): The brain shuts down into coma. Breathing slows or stops (apnea). The heart becomes profoundly bradycardic and electrically unstable — any movement, rough handling, or IV drug can trigger ventricular fibrillation or asystole. Pupils are fixed and dilated. The patient looks dead, but cells are preserved by the cold (like putting organs on ice). This is why we say: nobody is dead until warm and dead.
4. The body keeps vital signs near-normal in stage 1, which is the trap — the team may not realize how close the patient is to cardiovascular collapse.
5. The crash point to watch for is: loss of shivering (stage 2) and onset of ventricular arrhythmias or asystole (stage 3). Once the heart fibrillates or stops, survival depends entirely on continuous CPR and active rewarming.
6. Current guidelines (AHA, Wilderness Medical Society) say: continue CPR until core temperature is above 32°C (some say 35°C). There are documented cases of full neurologic recovery after hours of CPR in severe hypothermia, because cold protects the brain from oxygen-starved (hypoxic) injury.
7. Watch the trend, not just one number. A patient at 34°C who is shivering and alert may be stable. A patient at 34°C who was shivering an hour ago and now is not — that patient is crashing.
8. Rewarm gently in mild cases (warm blankets, warm IV fluids, warm room). Rewarm actively in moderate-to-severe cases (heated IV saline, heated humidified oxygen, and in the most severe cases, extracorporeal membrane oxygenation [ECMO] or cardiopulmonary bypass to warm the blood directly). Do NOT rub the skin or give hot drinks to an unconscious patient — you can trigger arrhythmias or aspiration.

Domino effect

1. Cold exposure, water immersion, or broken heat control (sepsis, low thyroid, low blood sugar, alcohol, malnutrition, or CNS injury) pulls heat out faster than the body can make it. — Heat leaves through conduction (touching cold water or ground), convection (wind blowing warm air away), radiation (your body glowing infrared heat into cold air), and evaporation (wet clothes). If the hypothalamus or fuel supply is broken, thermogenesis fails. Core temperature starts to drop.
2. Core temperature drops to 32–35°C (mild hypothermia). The hypothalamus fires maximum sympathetic drive: violent shivering, a fast heart rate (tachycardia) (fast heart), vasoconstriction (squeezed blood vessels), confusion, and clumsiness. — The hypothalamus detects the falling blood temperature and releases norepinephrine to speed the heart and squeeze vessels. Shivering muscles burn glucose and oxygen to make heat. But this costs huge amounts of energy. If cold keeps winning, the body cannot sustain this effort.
3. Core drops to 28–32°C (moderate hypothermia). Shivering stops. Heart rate slows (bradycardia). Consciousness fades into stupor. The ECG shows a J wave (Osborn wave). — Muscles run out of ATP and oxygen, so shivering fails. The sympathetic nervous system is exhausted. Cellular metabolism slows. The heart slows to conserve oxygen. The J wave appears because cold delays repolarization of the ventricles. Now the body has no more tools to make heat — it is passively cooling.
4. Core drops below 28°C (severe hypothermia). The patient is unconscious (comatose), pupils fixed and dilated, breathing slow or absent, heart profoundly slow or in ventricular fibrillation or asystole. — The brain shuts down because neurons cannot fire below 28°C. The brainstem stops driving respiration. The heart's electrical system becomes wildly unstable — any mechanical bump (moving the patient, starting an IV, intubating) or chemical bump (giving certain drugs) can trigger ventricular fibrillation (the heart quivers uselessly) or asystole (no heartbeat at all). The good news: cold protects the brain and organs from oxygen-starved (hypoxic) damage, like putting them on ice. This is why prolonged CPR and rewarming can bring patients back with full recovery.
5. Every weird finding — shivering then no shivering, fast heart then slow heart, confusion, J waves, arrhythmias — is the body trying to keep blood flow and oxygen going, then failing as cold wins. — None of this is random. Shivering and a fast heart rate (tachycardia) are the body fighting. A slow heart rate (Bradycardia) and pauses in breathing (apnea) are the body giving up to save oxygen. J waves are a direct electrical effect of cold on heart cells. Arrhythmias happen because cold makes the heart irritable. Each finding is a marker of how far down the curve the patient has slid.

6. If you trace backwards from each finding to its cause, they all point to one broken step: the body cannot make or keep heat because of cold exposure, water immersion, or broken thermogenesis inside the body (sepsis, hypothyroidism, low blood sugar (hypoglycemia), alcohol, malnutrition, CNS injury). — Hypothermia is not a collection of random problems. It is one upstream break (heat out > heat in) that cascades through every system. Fix the upstream cause (get the patient out of the cold, rewarm gently, replace glucose, treat sepsis, give thyroid hormone if needed), and the dominoes reverse. Miss the upstream cause, and rewarming alone may not be enough.
7. The key teaching: nobody is dead until warm and dead. Keep CPR going, rewarm actively, and prepare for full recovery even after hours of resuscitation. — Cold protects the brain. Patients have survived hours underwater in icy water or buried in snow and walked out of the hospital neurologically intact. Do not stop resuscitation based on appearance or initial rhythm. Rewarm to at least 32–35°C (guidelines vary) before declaring death. This is one of the few true 'miracles' in medicine, and it is backed by physiology and documented cases.

Symptoms · what the patient feels, and why

- Core body temperature below 95°F (35°C): The body loses heat faster than it can make it — from cold air, cold water, wet clothes, or not eating enough fuel to burn. A regular mouth or ear thermometer won't catch it; you need a low-reading rectal or esophageal thermometer that can measure down into the danger zone.
- Shivering at first, then shivering stops: When you first get cold, your muscles shake fast to make heat (shivering). But once your core drops below about 90°F (32°C), your brain and muscles run too cold to keep shaking, so shivering stops — that's a sign things are getting worse, not better.
- Confusion, slurred speech, or acting drunk: The prefrontal cortex (the front part of the brain that thinks and decides) slows down when it gets cold, so thinking gets fuzzy, speech gets sloppy, and judgment goes out the window — people may take off clothes or make dangerous choices without realizing it.
- Heart rate slows down (bradycardia): Cold slows every chemical reaction in the body, including the signals that tell the heart to beat. The SA node (the heart's natural pacemaker) fires more slowly, so the pulse drops — sometimes to 30 or 40 beats per minute or even lower.
- Breathing slows and gets shallow: The brainstem (the part at the base of your brain that controls automatic breathing) slows down in the cold, so breaths come less often and don't pull in as much air. In severe cases, breathing may be so quiet and slow it's hard to notice.
- J waves (Osborn waves) on the ECG: Cold changes the way electricity moves through heart muscle. A small extra hump (called a J wave or Osborn wave) appears at the end of the QRS complex on the heart monitor tracing — it's a classic sign that the heart itself is cold.

- Skin feels ice-cold and may look pale, blue, or waxy: Blood vessels in the skin clamp down (vasoconstriction) to save heat for the core organs, so less warm blood reaches the surface. Skin gets cold to the touch, turns pale or bluish from lack of oxygen, and in severe cases can freeze into frostbite (ice crystals form inside the tissue and damage cells).
- Muscles feel stiff and movements are clumsy: Cold slows the nerves that tell muscles when to fire and makes the muscles themselves sluggish, so coordination falls apart — fingers won't grip, legs stumble, and fine tasks become impossible.

Focused exam

- Core temperature below 35°C (95°F) measured with a low-reading thermometer (esophageal, rectal, or bladder probe): Regular thermometers bottom out around 34°C and miss the diagnosis. You need a probe that reads down to 25°C to see how cold the person really is and decide the right warming method.
- Shivering (if mild) or complete absence of shivering (if moderate to severe): Shivering is the body's emergency heater — muscles shake to make warmth. When core temperature drops below 32°C (90°F), the hypothalamus (the brain's thermostat) runs out of fuel and shivering stops. Once shivering quits, the body cannot warm itself anymore.
- A slow heart rate (Bradycardia) (slow heart rate) that is unexpectedly low for the clinical picture: Cold slows every chemical reaction in the body, including the heart's electrical system. A heart rate of 40 beats per minute may be the body's normal response at 30°C core temperature — it is protecting itself by using less oxygen.
- Altered mental status: confusion, slurred speech, clumsy movements, or appearing intoxicated: The cerebral cortex (the thinking part of the brain) needs warm blood to work. When core temperature falls, brain cells slow down and the person loses judgment, coordination, and awareness of danger — they may not even realize they are freezing.
- Osborn wave (J wave) on the electrocardiogram — a small hump at the end of the QRS complex before the ST segment: The J wave appears when the heart muscle is cold and is seen most clearly in leads II and V6. It warns you the myocardium (heart muscle) is irritable and can flip into ventricular fibrillation (chaotic, deadly rhythm) if you jostle the person, do chest compressions too hard, or insert lines roughly.
- Absent or barely detectable pulse and respirations, with pupils that may be fixed and dilated: In severe hypothermia (core below 28°C or 82°F), metabolism drops so low the person may look dead but is not. The cold brain and heart need very little oxygen. You must warm the person first — they are not dead until they are warm and dead.

Diagnostics · every test answers a question

- Core body temperature using esophageal, rectal, or bladder thermometer (low-reading probe) → What is the true core temperature, and which stage of hypothermia is the person in?
- 12-lead electrocardiogram (ECG) → Is the heart showing signs of cold damage or dangerous rhythm?
- Serum potassium → Is potassium dangerously high from cell breakdown, signaling non-viable tissue damage?
- Arterial blood gas (ABG) without temperature correction → Is the person acidotic or oxygen-starved (hypoxic), and what is the lactate level?
- Serum glucose → Is low blood sugar (hypoglycemia) (low blood sugar) the cause or a complication of hypothermia?
- Thyroid-stimulating hormone (TSH) and free T4 → Is severe hypothyroidism (myxedema coma) the reason the person cannot make heat?
- Toxicology screen (urine and serum) and blood alcohol level → Did alcohol, sedatives, or other drugs impair judgment and prevent the person from seeking warmth?
- Complete blood count (CBC), metabolic panel, and coagulation studies (PT, aPTT) → Are there signs of infection, kidney failure, or clotting problems from the cold?

Treatment logic

- Remove all wet clothing and move the person to a warm environment (room temperature 21–24°C or 70–75°F); for mild hypothermia (32–35°C), use passive external rewarming with blankets; for moderate (28–32°C), add forced-air warming blankets (Bair Hugger) at 40–42°C → Stops ongoing heat loss and lets the body's own metabolism (if still working) raise core temperature by 0.5–2°C per hour. Shivering may restart as the hypothalamus warms up.
- Give warm intravenous fluids (normal saline or lactated Ringer's heated to 40–42°C or 104–108°F) and deliver warm humidified oxygen (42–46°C or 108–115°F) through a mask or endotracheal tube → Delivers heat directly to the core through the bloodstream and prevents heat loss through the lungs. This speeds rewarming in moderate hypothermia and supports blood pressure as cold blood vessels begin to dilate (widen) during warming.
- Handle the person extremely gently — no rough movement, no vigorous chest compressions unless absolutely needed, and avoid unnecessary procedures like central line insertion until the core is warmer → Prevents mechanical irritation of the cold, electrically unstable myocardium (heart muscle), which can trigger ventricular fibrillation even from a gentle jostle or a bump during transport.

- For severe hypothermia (core below 28°C or 82°F with cardiac arrest or ventricular fibrillation), initiate extracorporeal life support — either ECMO or cardiopulmonary bypass — as soon as possible → Pumps blood out of the body, warms it with a heat exchanger, and returns it, raising core temperature 1–2°C every 10–15 minutes. This is the only way to restart a cold, fibrillating heart and restore blood flow (perfusion) (blood flow) to the brain and organs.
- Do NOT give standard ACLS medications (epinephrine, amiodarone, lidocaine) or attempt defibrillation more than once until core temperature is above 30°C (86°F); cold hearts do not respond to these drugs → Avoids stacking toxic doses of medications that will not work until the heart warms up. Once core reaches 30°C, resume standard ACLS dosing and defibrillation attempts.
- Identify and treat the upstream cause: give intravenous antibiotics (e.g., ceftriaxone and vancomycin) for sepsis, intravenous levothyroxine 200–400 mcg plus hydrocortisone 100 mg for myxedema coma, dextrose 25–50 g IV for low blood sugar (hypoglycemia), thiamine 100 mg IV before glucose if alcohol use or malnutrition is suspected → Fixes the broken metabolic step so the body can make heat again once core temperature is restored. For example, thyroid hormone restarts the cellular furnaces that generate warmth; antibiotics stop the infection that diverted energy away from heat production.
- Rewarm slowly and continuously until core temperature reaches at least 32–35°C (90–95°F) and vital signs stabilize; do not stop rewarming efforts in cardiac arrest until core is above 32°C — continue CPR during rewarming → Gives the heart and brain time to recover as they warm. Many people who look dead at 25°C wake up neurologically intact at 35°C because cold protects the brain from injury during low blood flow.

Medications

Passive external rewarming (dry clothing, blankets, warm room) · Non-pharmacologic rewarming strategy

For mild hypothermia (core temp 32–35°C / 90–95°F), the body can warm itself if you stop the heat loss. Remove wet clothes, wrap the person in dry blankets, and move them to a warm room. The body's own metabolism (the energy-burning process in every cell) will slowly raise the core temperature. This works because the heart and brain are still functioning normally and can control blood flow to keep vital organs warm.

1. Wet clothes are removed so evaporation (water turning to vapor and stealing heat) stops.
2. Dry blankets trap a layer of air around the body, which the skin warms and holds close.
3. The person is moved to a room above 21°C (70°F) so the air itself stops pulling heat away.
4. The body's cells continue burning glucose and fat for energy, and that energy is released as heat.

5. Blood vessels in the skin slowly open back up (vasodilate) as the core warms, spreading warmth outward.

SAFETY WATCH

Handle the person gently—rough movement or jostling can trigger ventricular fibrillation (a deadly chaotic heart rhythm) because the cold heart is electrically unstable. · Do NOT use this method alone if core temperature is below 32°C (90°F)—the body cannot rewarm itself safely at that point. · Do NOT rub the arms or legs vigorously; it can push cold blood back to the heart too fast and cause core temperature to drop further (afterdrop).

Active external rewarming (forced-air warming blanket, heating pads) · Non-pharmacologic active rewarming strategy

For moderate hypothermia (core temp 28–32°C / 82–90°F), the body needs outside heat to warm up safely. A forced-air warming blanket blows warm air (around 43°C / 109°F) through a special blanket that covers the chest and torso. The warm air heats the skin, and blood flowing under the skin picks up that heat and carries it to the core organs (heart, lungs, brain).

Heating pads or warm-water bottles can be placed on the chest, neck, and groin (not the arms or legs) to target the large blood vessels near the surface.

1. Warm air or heating pads transfer heat through the skin.
2. Capillaries (tiny blood vessels in the skin) absorb the heat.
3. Warmed blood flows through veins back to the heart.
4. The heart pumps this warmed blood to the brain, lungs, liver, and kidneys.
5. Core temperature rises by 1–2°C per hour, restoring normal enzyme function and electrical activity in the heart.

SAFETY WATCH

Do NOT place heat sources on the arms or legs first—it can cause afterdrop (cold blood from the limbs flooding back to the core and dropping core temperature further). · Warm the trunk (chest and belly) FIRST to stabilize the heart before warming the extremities. · Watch for burns—cold skin has reduced sensation and the person may not feel pain from a heating pad that is too hot. · Move the person gently; the heart is still fragile and can fibrillate with rough handling.

Warm intravenous (IV) fluids · Non-pharmacologic active core rewarming strategy

For moderate to severe hypothermia (core temp below 32°C / 90°F), the body often has low blood volume (hypovolemia) because cold causes the kidneys to make more urine (cold

diuresis) and blood vessels to squeeze tight. Warmed IV fluids—normal saline or lactated Ringer's heated to 40–42°C (104–108°F)—are infused through a vein. The warm fluid travels through the bloodstream directly to the heart and other core organs, adding both heat and volume. This raises core temperature and improves blood pressure and circulation.

1. Warmed saline or Ringer's is given through a large IV catheter, often in the arm or central line.
2. The warm fluid enters the venous system and flows to the right side of the heart.
3. The heart pumps this warm blood to the lungs and then out to the body.
4. Core temperature rises by 1–2°C per hour.
5. Blood volume increases, which raises blood pressure and improves oxygen delivery to tissues.

SAFETY WATCH

Do NOT give cold or room-temperature IV fluids—they will drop core temperature further. · Use a fluid warmer device; do NOT microwave or overheat fluids (risk of burns to veins or red blood cell destruction (hemolysis)—red blood cell destruction). · Watch for fluid overload if large volumes are given quickly, especially in elderly patients or those with heart failure. · Handle the person gently during IV placement—the cold heart is prone to arrhythmias.

Warm humidified oxygen · Non-pharmacologic active core rewarming strategy

For moderate to severe hypothermia, cold air in the lungs can pull heat away from the body with every breath. Giving oxygen that has been warmed (to 40–45°C / 104–113°F) and humidified (moistened with water vapor) through a mask or breathing tube delivers heat directly to the lungs. The warm, moist air warms the blood flowing through the millions of tiny capillaries in the alveoli (the air sacs in the lungs where oxygen enters the blood). This warmed blood then flows to the heart and the rest of the body.

1. Oxygen is passed through a heated humidifier, which warms it and adds water vapor.
2. The warm, moist oxygen is delivered through a face mask, nasal cannula, or endotracheal tube.
3. The warm air heats the lining of the airways and the alveoli.
4. Blood flowing through the pulmonary capillaries picks up the heat.
5. The left atrium receives this warmed blood and the left ventricle pumps it out to the brain, heart muscle, kidneys, and the rest of the body.

SAFETY WATCH

Do NOT give dry oxygen—it can dry out the airway lining and make secretions thick and hard to clear. · Do NOT overheat the oxygen (above 45°C / 113°F)—it can burn the airway. · If the person is intubated (has a breathing tube), make sure the humidifier is working correctly to prevent airway injury.

Extracorporeal membrane oxygenation (ECMO) or cardiopulmonary bypass · Non-pharmacologic invasive core rewarming strategy

For severe hypothermia with cardiac arrest (core temp below 28°C / 82°F, or heart stopped), ECMO or cardiopulmonary bypass is the fastest and most effective rewarming method. Blood is removed from the body through a large catheter, pumped through a machine that warms it and adds oxygen, and then returned to the body. This directly warms the blood and can raise core temperature by 2–4°C per hour. It also takes over the job of the heart and lungs, keeping the brain and organs alive while the body rewarms.

1. Large catheters are placed in the femoral vein and artery (in the groin) or in the neck vessels.
2. Blood is pulled out of the body and flows into the ECMO or bypass circuit.
3. The blood passes through a heat exchanger (a device that warms the blood to 37–39°C / 98.6–102°F).
4. The blood is oxygenated (oxygen is added and carbon dioxide is removed) by a membrane oxygenator.
5. The warmed, oxygenated blood is pumped back into the body, raising core temperature and perfusing the organs.

SAFETY WATCH

This is the MOST invasive rewarming method and is used ONLY for severe hypothermia with cardiac arrest or life-threatening arrhythmias that do not respond to defibrillation. · Requires a specialized team (cardiac surgeons, perfusionists, critical care physicians). · Risks include bleeding (from blood thinners needed for the circuit), infection, and clotting in the circuit. · Handle the person gently during catheter placement—the heart is extremely fragile and can fibrillate with stimulation. · Do NOT stop CPR until ECMO is running and the person is rewarmed—hypothermic patients can survive long periods of cardiac arrest because the cold protects the brain from injury.

Modified ACLS (advanced cardiac life support) medications · Cardiac arrest medications (used with caution in severe hypothermia)

When a person with severe hypothermia (core temp below 30°C / 86°F) has cardiac arrest, standard ACLS drugs—epinephrine (adrenaline), amiodarone, and others—may not work because the cold heart muscle is less responsive to electrical and chemical signals. Current guidelines (AHA 2020) recommend WITHHOLDING or SPACING OUT these drugs until core temperature is above 30°C (86°F). Once the person is warmer, epinephrine can help squeeze blood vessels and raise blood pressure, and amiodarone can help stabilize dangerous heart rhythms like ventricular fibrillation.

1. If core temp is BELOW 30°C, withhold epinephrine and other ACLS drugs—focus on rewarming and CPR.
2. Once core temp reaches 30°C, give epinephrine 1 mg IV every 3–5 minutes (longer intervals than the usual every 3–5 min in normothermia).
3. Epinephrine binds to alpha-1 receptors on smooth muscle in artery walls, causing vasoconstriction and raising blood pressure to perfuse the brain and heart.
4. Epinephrine also binds to beta-1 receptors on the heart, increasing heart rate and contraction strength (if the heart has any activity).
5. If ventricular fibrillation or pulseless ventricular a fast heart rate (tachycardia) persists after defibrillation attempts, give amiodarone 300 mg IV once core temp is above 30°C.
6. Amiodarone blocks potassium channels, which prolongs the refractory period (the time heart cells need to reset) and helps stop the chaotic electrical loop causing the arrhythmia.

SAFETY WATCH

Do NOT give repeated doses of epinephrine or other drugs when the person is severely cold—they can accumulate in the body and cause dangerous high blood pressure, arrhythmias, or stroke once the person rewarms. · Space doses longer apart than in standard ACLS (e.g., every 6–10 minutes instead of every 3–5 minutes) if core temp is 30–32°C. · Do NOT assume the person is dead until they are WARM and dead—hypothermia can protect the brain for extended periods; cases of full recovery after hours of cardiac arrest have been documented. · AHA guideline: 'No one is dead until they are warm and dead.' Continue CPR and rewarming efforts until core temperature is at least 32–35°C before terminating resuscitation.

Red flags

- Core temperature below 90°F (32°C) — severe hypothermia with high risk of deadly heart rhythms

- Confusion, can't stay awake, or doesn't respond when you shake them — brain is shutting down
- Shivering has stopped but the person is still very cold — body can't fight back anymore
- Heart rhythm is chaotic or very slow (ventricular fibrillation or severe a slow heart rate (bradycardia)) — can stop any second
- Breathing is barely noticeable or has stopped — needs rescue breaths and advanced warming right away

Nursing priorities

1. Handle the patient extremely gently and keep them flat; no rough movement, vigorous rubbing, or aggressive position changes — The cold heart muscle is very irritable and even small bumps or movements can trigger ventricular fibrillation (deadly chaotic heart rhythm) that is almost impossible to fix until the body warms above 30°C
2. Remove all wet clothing immediately and replace with dry warm blankets; cover the head completely — Wet fabric pulls heat away 25 times faster than air and the head loses 30 percent of total body heat so stopping these heat losses is the fastest way to prevent deeper hypothermia
3. Place a continuous heart monitor and watch for J waves (extra bumps after the QRS complex) and dangerous rhythms like atrial fibrillation (an irregular, quivering heartbeat) or ventricular fibrillation — J waves appear when core temperature drops below 32°C and signal that the heart is cold enough to develop deadly rhythms; cold hearts often will not respond to defibrillation until rewarmed above 30°C
4. Insert an esophageal or rectal temperature probe to get accurate core temperature; do not rely on oral or ear thermometers — Regular thermometers only read down to 34°C and cannot measure severe hypothermia; treatment decisions depend on knowing the exact core temperature to choose passive versus active rewarming methods
5. Start warm intravenous normal saline or lactated Ringer's solution heated to 40–42°C through a fluid warmer — Cold blood makes the heart stop pumping well and warm IV fluids raise core temperature from the inside while replacing fluid lost from cold diuresis (excessive urination the cold body causes)
6. Apply a forced-air warming blanket set to 40–42°C if core temperature is between 28–32°C; use only regular blankets if temperature is 32–35°C — Active external rewarming (forced-air blanket) can cause afterdrop (core temperature drops further when cold blood from arms and legs rushes back to the heart) in mild hypothermia but is necessary when temperature falls below 32°C

7. Give warm humidified oxygen through a mask or breathing tube at 40–42°C — Each breath of cold air pulls heat out of the lungs and body core; warming the oxygen adds heat directly to the core and prevents further temperature drops from breathing
8. Check blood sugar immediately and repeat every 30 minutes during rewarming — Hypothermia stops the pancreas from releasing insulin correctly causing high blood sugar; then during rewarming insulin suddenly works again causing dangerous low blood sugar that looks like continued confusion from cold

Sources

- Wilderness Medical Society Practice Guidelines for the Prevention and Treatment of Frostbite and Hypothermia (2019)
- American Heart Association Advanced Cardiovascular Life Support (ACLS)
- CDC Hypothermia Prevention and Treatment
- New England Journal of Medicine (NEJM) Clinical Practice review on Accidental Hypothermia

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