

Heat Illness and Hypothermia

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THE STORY IN ONE SENTENCE

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“Heat stroke and hypothermia both break the body's thermostat—one cooks the organs, the other freezes the heart.”

Normal anatomy — the body's job

The hypothalamus (your brain's thermostat, sitting just above the brainstem) constantly measures blood temperature and defends a core setpoint of 37°C by balancing heat production (from muscles and metabolism) with heat loss (through skin blood flow, sweat, and breathing).

BODY'S JOB

When core temperature rises even half a degree, the hypothalamus opens blood vessels in the skin (so heat radiates out) and tells sweat glands to pour water onto the skin (so evaporation cools you). When temperature drops, it closes skin vessels to trap warmth inside, makes muscles shiver to generate heat, and releases thyroid hormone and epinephrine (adrenaline) to speed up metabolism and burn more fuel.

1. The hypothalamus reads temperature from blood flowing past it.
2. If too hot: signals travel down to sweat glands → sweat evaporates and cools skin; signals also tell skin arterioles (tiny arteries) to dilate → more blood flows near the surface and dumps heat into the air.
3. If too cold: signals make skin arterioles constrict → blood stays in the core where organs need it; signals trigger shivering (rapid muscle contractions that burn fuel and make heat); the thyroid gland releases more hormone to speed up every cell's furnace.

4. Normally this feedback loop keeps core temperature in a narrow 36.5–37.5°C band, even when the outside air swings from freezing to blazing.

What breaks

The thermostat loses the fight when outside heat (or cold) is too extreme, when your muscles make heat faster than sweat can dump it, when you're dehydrated and can't sweat, or when drugs or illness jam the hypothalamus signals.

CLINICAL TERM

Heat illness occurs when heat gain (environmental exposure plus metabolic heat from exertion) exceeds heat loss (impaired sweating, high humidity, or inadequate acclimatization), raising core temperature above the thermoregulatory capacity.

Hypothermia occurs when environmental cold and wet conditions strip heat faster than the body can generate it, or when central thermoregulation is impaired by intoxication, endocrine failure, or sepsis, dropping core temperature below 35°C.

How the body compensates

At first the body tries hard to defend 37°C—sweating buckets and racing the heart in heat, shivering and clamping skin vessels in cold—but these very efforts drain fluid, sugar, and energy, so vital signs can look almost okay right up until the system suddenly crashes into multi-organ failure or a lethal heart rhythm.

1. {'what': 'Heat: skin vessels dilate and heart rate climbs', 'why': 'The body shunts warm blood to the skin so heat radiates out, but this drops blood pressure in the core; the heart speeds up (often to 120–140) to keep pressure up and push blood through the wide-open skin circulation.', 'cost': 'The faster heart burns oxygen and can trigger chest pain or arrhythmias in anyone with a weak heart. Blood pools in the legs, so less reaches the brain—causing dizziness and fainting (heat fainting (syncope)).'}
2. {'what': 'Heat: sweating pours out water and salt', 'why': 'Evaporating sweat is the body's main cooling tool, but you can lose more than a liter of water per hour in extreme heat or exercise.', 'cost': 'Volume drops → blood gets thick and pressure falls → kidneys get less flow and start to fail. Salt (sodium) washes out in sweat, so muscles cramp and the brain gets confused from low sodium (hyponatremia).'}

3. {'what': 'Cold: skin vessels constrict and shivering starts', 'why': 'Shutting blood flow to the skin traps warmth in the core where the heart, brain, and kidneys need it. Shivering (fast, tiny muscle contractions) burns sugar and fat to make heat.', 'cost': 'Shivering drains glucose and glycogen stores, so blood sugar can drop (hypoglycemia). It also demands oxygen, so the heart and lungs work harder. Once core temperature falls below $\approx 32^{\circ}\text{C}$, muscles get too stiff to shiver and heat production stops—this is the danger point.'}
4. {'what': 'Cold: heart slows (bradycardia) and rhythm becomes unstable', 'why': "Cold slows every enzyme, including the pumps that move sodium and potassium in and out of heart cells, so the heart's electrical system misfires.", 'cost': 'Atrial fibrillation (an irregular, quivering heartbeat) is common below 32°C ; ventricular fibrillation (a lethal quiver that pumps no blood) can happen below 28°C , especially if the heart is bumped or moved suddenly.'}
5. {'what': 'The plateau before the crash', 'why': "For a window of time—minutes to an hour in heat illness, hours in hypothermia—the body's compensations keep blood pressure and oxygen barely acceptable, so the person looks 'stable' even though the core problem is getting worse.", 'cost': "This plateau tricks teams into thinking there's time to spare. In reality the system is one step from falling off a cliff: in heat stroke, multi-organ failure (brain, kidneys, liver, clotting) erupts once temperature tops 40°C ; in severe hypothermia, any rough handling or rewarming shock can trigger V-fib and sudden death."}

Domino effect

1. Heat illness: core temperature climbs above the safe zone ($>40^{\circ}\text{C}$ / 104°F) — Environmental heat plus exertion or impaired sweating overwhelm the body's cooling, so the hypothalamus can't bring temperature back down and the core keeps heating like an oven.
2. Direct heat injury to cells and proteins — Above 40°C , the heat unfolds (denatures) enzymes and structural proteins in neurons, liver cells, kidney tubules, and muscle fibers—like cooking an egg, the proteins clump and stop working—so brain cells swell and die, liver enzymes spill into blood, kidneys clog with debris, and muscles break open (rhabdomyolysis) releasing myoglobin and potassium into the bloodstream.
3. Multi-organ failure cascade in heat stroke — The brain's temperature control center itself gets cooked, causing confusion, seizures, and coma. Muscle breakdown dumps myoglobin into the kidneys, which clogs the filters and causes acute kidney injury. Liver cells die and release transaminases (ALT, AST shoot up into the thousands). Clotting factors denature, so the blood won't clot (coagulopathy and disseminated intravascular coagulation/DIC), leading to spontaneous bleeding. The heart struggles with low volume (from sweating) and high demands (fast rate, thick blood), so it can fail or throw clots.

4. Hypothermia: core temperature drops below 35°C (95°F) — Cold exposure (especially cold water, wet clothing, or wind) strips heat faster than shivering and metabolism can replace it; alcohol, drugs, or hypothyroidism blunt the shiver response, so temperature spirals down.
5. Cold slows chemistry and electrical conduction — Every enzyme works slower in the cold—metabolism drops roughly 6% per 1°C fall—so the brain gets sluggish (confusion, slurred speech, then coma), the heart beats slowly and irregularly (bradycardia, atrial fib, then ventricular fib), and kidneys make dilute urine despite dehydration because cold impairs the hormones that concentrate urine.
6. Severe hypothermia (<28°C): the heart becomes electrically unstable — Profound cold makes heart muscle stiff and disrupts sodium/potassium pumps, so any bump, rough movement, or sudden attempt to rewarm the shell before the core can trigger ventricular fibrillation—a chaotic quiver that pumps no blood and causes sudden cardiac arrest. Blood also gets thick and won't clot properly (cold inhibits clotting enzymes), so trauma or procedures cause uncontrolled bleeding.
7. Both cascades share a common thread: the body's compensations become part of the problem — In heat illness, sweating and skin vasodilation—meant to cool you—drain fluid and tank blood pressure, which then starves organs. In hypothermia, shivering and vasoconstriction—meant to warm you—burn through glucose and oxygen, exhausting reserves, and the slowed heart can't deliver what's left. So the very reflexes meant to restore 37°C accelerate the slide toward organ failure or arrest.
8. The treatment breaks the chain by directly fixing temperature — In heat stroke, rapidly cooling the core below 39°C within the first hour (ice packs to groin/axilla/neck, cold IV fluids, evaporative cooling, or ice-water immersion) stops the protein damage before permanent organ failure sets in. In hypothermia, gently rewarming the core (warm IV fluids, warm humidified oxygen, or extracorporeal warming for severe cases) restores enzyme function and rhythm without triggering V-fib. Everything else—IV fluids, oxygen, treating seizures or arrhythmias—is supportive; only correcting temperature stops the dominos.

Symptoms · what the patient feels, and why

- Heavy sweating that later stops (in heat stroke): At first, the body's cooling system — your sweat glands — works overtime trying to bring your temperature down. But when the core temperature climbs too high (above 104°F or 40°C), the brain's temperature control center (the hypothalamus, which acts like your body's thermostat) gets damaged and can no longer trigger sweating. When sweating stops in extreme heat, the skin becomes hot and dry, which is a dangerous sign that the body has lost its ability to cool itself.

- Confusion, slurred speech, or acting strange: Both extreme heat and extreme cold harm the brain's nerve cells (neurons). In heat illness, high core temperature literally cooks proteins inside brain cells and makes them swell. In hypothermia, cold slows down the chemical reactions that let brain cells send signals. Either way, the brain — especially the cerebral cortex (the outer layer responsible for thinking and speaking) — struggles to do its job, so thinking becomes fuzzy, words come out garbled, and behavior gets odd.
- Shivering (in mild hypothermia) or no shivering (in severe hypothermia): Shivering is your muscles' automatic way of making heat: they contract rapidly to burn energy and warm the blood. When core temperature drops to around 95°F (35°C), the hypothalamus orders muscles to shiver. But if the core keeps falling below about 90°F (32°C), the muscles run out of fuel (glucose and ATP, the body's energy currency) and the brain signals fade, so shivering stops. When shivering stops in a cold person, it means the body is too cold to defend itself anymore.
- Fast heart rate (tachycardia) or slow heart rate (bradycardia): In heat illness, the heart pumps faster to move hot blood from the core to the skin, where it can release heat through sweating. The sympathetic nervous system (the 'fight or flight' wiring) releases adrenaline, which speeds the heart. In hypothermia, cold slows every chemical reaction, including the electrical signals in the heart's pacemaker cells (in the sinoatrial node), so the heart rate drops — sometimes dangerously low, under 40 beats per minute.
- Nausea, vomiting, or loss of appetite: Both heat and cold stress the gut. In heat illness, blood is diverted away from the stomach and intestines to the skin (to cool the body), starving gut cells of oxygen (ischemia). This triggers nausea and can make the gut lining leak, releasing toxins. In hypothermia, cold slows gut motility (the wave-like muscle squeezes that push food along), causing nausea and a queasy feeling. The brain's vomiting center (in the medulla, at the base of the brain) gets activated by these signals.
- Muscle cramps or weakness: Heat cramps happen when heavy sweating washes out sodium and other electrolytes (minerals like potassium and magnesium) that muscles need to contract and relax smoothly. Without enough sodium, the nerve-muscle connection misfires and muscles lock up painfully. In hypothermia, cold makes muscles stiff and slow because the enzymes that drive muscle contraction work poorly at low temperatures, leading to clumsiness and weakness.
- Pale, cold, clammy skin (in heat exhaustion) or hot, flushed skin (in heat stroke): In heat exhaustion, blood vessels in the skin widen (dilate) to release heat, but the person is often dehydrated, so blood pressure drops. The body responds by narrowing skin vessels to keep blood flowing to vital organs, making the skin pale, cool, and sweaty. In heat stroke, the sweating system fails and skin blood vessels stay wide open, trapping heat, so the skin becomes hot, red, and dry. In hypothermia, vessels clamp down to save core warmth, making skin pale, cold, and waxy.

- Dizziness, fainting, or feeling lightheaded: In heat illness, blood pools in the dilated vessels of the arms and legs, plus sweating depletes fluid volume, so less blood returns to the heart and less gets pumped to the brain. When the brain doesn't get enough oxygen-rich blood, you feel dizzy or pass out. In hypothermia, the slow heart rate and thickened blood reduce brain blood flow, causing similar lightheadedness. This is called orthostatic low blood pressure (hypotension) (a drop in blood pressure when standing).
- Rapid, shallow breathing or slow, shallow breathing: In heat illness, the body tries to cool itself by breathing faster (hyperventilation), which releases heat through exhaled air and also helps blow off carbon dioxide that builds up during stress. In hypothermia, cold slows the respiratory center in the brainstem (the medulla), so breathing becomes slow and shallow. Very cold people may breathe so slowly that carbon dioxide accumulates in the blood, making them even more drowsy.
- Seizures (in severe cases): Both extreme heat and extreme cold disrupt the brain's electrical balance. In heat stroke, swelling (cerebral swelling (edema)) and damage to neurons cause abnormal electrical storms. In severe hypothermia, low temperature scrambles the ion channels (tiny gates in nerve cells that control electrical signals), triggering seizures. Electrolyte imbalances (like low sodium or low blood sugar) that accompany both conditions also make seizures more likely.

Focused exam

- Core temperature above 40°C (104°F) in heat stroke, or below 32°C (90°F) in severe hypothermia: Core temperature tells you how far the body's thermostat has failed. Above 40°C, proteins inside cells start to unravel like overcooked eggs. Below 32°C, the heart and brain slow down so much they may stop working. The number tells you how fast you must act.
- Altered mental status: confusion, slurred speech, or unresponsive: The brain needs a steady 37°C (98.6°F) to think clearly. Heat above 40°C scrambles the electrical signals between brain cells. Cold below 32°C slows the brain's chemistry so much it cannot stay awake. Confusion or drowsiness means the brain is already damaged.
- Skin hot and dry (heat stroke) or cold, pale, and waxy (hypothermia): In heat stroke, the body has stopped sweating — the main way we cool down — so heat builds up fast. In hypothermia, blood vessels squeeze shut to keep warm blood in the core, leaving the skin cold and hard. Both mean the body has given up its normal temperature control.
- Heart rate above 120 and thready pulse (heat illness) or below 50 with irregular rhythm (hypothermia): Heat makes the heart race to pump more blood to the skin for cooling, but eventually the heart muscle itself overheats and weakens. Cold slows the heart's natural pacemaker (the SA node in the top right chamber) and makes the heart skip beats or stop. Both mean the pump is failing.

- Breathing fast and shallow (heat illness) or slow and barely visible (hypothermia): Heat makes the body gasp because the blood turns acidic as organs fail and oxygen drops. Cold slows the brain stem (the part that controls breathing without you thinking about it) so much that breaths come only every 20 or 30 seconds. Fast or absent breathing tells you organs are shutting down.
- Muscle stiffness or rigidity in hypothermia, or muscle twitching and seizures in heat stroke: Below 32°C, muscles freeze into rigid blocks because the chemical pumps that let muscle fibers slide are too cold to work. Above 40°C, the brain misfires and muscles twitch or seize because the electrical system is overheating. Both mean the nervous system has lost control.

Diagnostics · every test answers a question

- Core temperature (rectal, esophageal, or bladder thermometer) → What is the body's actual core temperature, and how far is it from the safe zone of 36–38°C?
- Serum electrolytes (sodium, potassium, chloride, bicarbonate) → Are the body's salts balanced, or has sweating, kidney failure, or muscle breakdown thrown them off?
- Creatine kinase (CK) and myoglobin → Is muscle breaking down and clogging the kidneys?
- Arterial blood gas (ABG) → Is the blood turning acidic, and is the body getting enough oxygen?
- Complete blood count (CBC) with platelets → Is the blood clotting system breaking down, and are red blood cells being destroyed?
- Electrocardiogram (ECG) → Is the heart rhythm stable, or is it starting to skip beats or stop?
- Blood glucose → Is the brain getting enough sugar to stay awake?
- Creatinine and blood urea nitrogen (BUN) → Are the kidneys filtering waste, or are they shutting down?

Treatment logic

- Immediate rapid cooling for heat stroke: ice-water immersion, cold IV saline, or evaporative cooling (mist + fans), targeting core temperature 38.5°C (101°F) within 30 minutes → Pulls heat out of the body faster than any other method. Cooling stops proteins from denaturing (unraveling), protects the brain and heart, and reverses the spiral toward multi-organ failure. Every minute above 40°C increases the risk of permanent brain damage.

- Slow, controlled rewarming for hypothermia: passive warming (blankets, warm room) for mild (32–35°C), active external warming (warm blankets, forced-air warmers) for moderate (28–32°C), or active core rewarming (warm IV fluids, warm humidified oxygen, or extracorporeal warming) for severe (below 28°C), targeting 0.5–1°C per hour → Raises core temperature slowly so the heart does not go into a deadly rhythm (ventricular fibrillation) from sudden warming. Gentle warming wakes up the brain, unfreezes the heart's pacemaker, and restarts the body's normal chemistry. Fast rewarming or rough handling can trigger cardiac arrest.
- IV normal saline bolus (1–2 liters in adults, 20 mL/kg in children) to restore blood volume → Heat stroke causes massive fluid loss through sweating, which drops blood pressure and makes the heart struggle to pump. Replacing fluid brings blood pressure back up, improves oxygen delivery to organs, and helps the kidneys flush out muscle breakdown products (myoglobin). In hypothermia, warm IV fluids also add gentle core heat.
- Remove from heat source or cold environment immediately; stop exercise → Stops more heat from entering the body (sun, exercise, hot environment) or stops more heat from leaving the body (wind, water, wet clothes). Removing the trigger is the first step — no treatment works if the body keeps gaining or losing heat.
- Treat seizures with benzodiazepines (lorazepam 2–4 mg IV or diazepam 5–10 mg IV); intubate and ventilate if airway is unsafe or brain swelling worsens → Heat stroke causes brain cells to swell and misfire, leading to seizures. Benzodiazepines calm the brain by boosting GABA (the brain's main calming chemical). Intubation protects the airway so the patient does not choke and ensures oxygen reaches the brain while it cools and heals.
- Continuous cardiac monitoring; treat dangerous arrhythmias (ventricular fibrillation, ventricular a fast heart rate (tachycardia)) with defibrillation or medications (amiodarone, lidocaine) as needed → Both heat and cold make the heart's electrical system unstable. Heat makes the heart race and skip beats; severe hypothermia (below 28°C) can trigger ventricular fibrillation (the heart quivers uselessly). Defibrillation or medications restore normal rhythm so the heart can pump blood again. In hypothermia, defibrillation often does not work until the core warms above 30°C.
- Correct electrolyte imbalances (give calcium for high potassium, insulin + glucose to shift potassium into cells, give bicarbonate for severe too much acid in the blood (acidosis)); transfuse blood products if clotting fails (DIC) → High potassium (from muscle breakdown) can stop the heart; calcium protects the heart muscle, and insulin + glucose move potassium back into cells. Bicarbonate buffers acid in the blood when organs are failing. Replacing clotting factors stops internal bleeding when the clotting system breaks down.

Medications

Heat stroke: Cold-water immersion (ice-water bath or evaporative cooling) · Physical cooling intervention (not a drug)

Cold water pulls heat out of the body quickly through the skin, like dunking a hot pot into a sink of ice water. The goal is to drop the core body temperature to 102°F (39°C) as fast as possible—usually within 30 minutes—to stop the brain, kidneys, and muscles from cooking. We stop cooling at about 101°F (38.5°C) so the body doesn't overshoot and get too cold. Ice-water immersion (the person sits in a tub of water with ice) is the fastest method. Evaporative cooling (misting the skin with water and blowing air over it) is the backup if immersion isn't available. This is the single most important step in heat stroke; no drug can replace it.

1. The person is placed in ice water up to the neck, or misted with water and fanned.
2. Heat flows out of the blood through the skin into the water (heat always moves from hot to cold).
3. Cooler blood circulates back to the brain, heart, kidneys, and muscles, stopping the heat damage.
4. We measure core temperature continuously (rectal thermometer) and pull the person out when it hits 101–102°F to avoid rebound hypothermia.

SAFETY WATCH

Do NOT stop cooling too early—brain damage continues until temperature is below 102°F. · Watch for shivering during cooling; if it happens, it makes more heat and slows the process, so we may give a sedative (benzodiazepine) to stop it. · Check temperature every few minutes to avoid overcooling below 100°F. · If the person has a seizure or very low blood pressure, treat those at the same time as cooling.

Heat stroke supportive care: Intravenous (IV) normal saline · Isotonic crystalloid fluid (not a drug, but a fluid resuscitation tool)

Normal saline is salt water that matches the body's fluid. We give it through an IV to refill the blood volume that dropped from sweating and from blood vessels opening wide in the heat. This raises blood pressure, helps kidneys make urine to flush out muscle breakdown products (myoglobin), and keeps organs fed with oxygen. We usually give 1–2 liters fast, then adjust based on urine output and blood pressure. This does NOT cool the body—only cold water does that—but it supports the organs while cooling happens.

1. IV saline flows into a vein and spreads through the bloodstream.
2. Blood volume rises, which pushes blood pressure up.

3. Kidneys get more blood flow and start making urine again, flushing out myoglobin (the toxic protein from broken-down muscle).
4. Organs get better oxygen delivery because circulation improves.

SAFETY WATCH

Give fluids carefully if the person has heart failure or kidney disease—too much can flood the lungs. · Watch for fluid overload: listen to the lungs for crackles (wet sounds) and check oxygen levels. · If the kidneys are badly injured (no urine output despite fluids), the person may need dialysis.

Heat stroke seizure control: Benzodiazepine (lorazepam or diazepam) · Benzodiazepine (a sedative and anti-seizure medication)

Heat stroke can cause seizures when the brain overheats. Benzodiazepines boost GABA (the brain's main calming signal) at receptors in the neurons, which slows down the electrical storm causing the seizure. Lorazepam (Ativan) or diazepam (Valium) are given IV to stop the seizure quickly. We also use these if the person is shivering hard during cooling, because shivering makes more heat and fights the ice bath.

1. Lorazepam or diazepam is injected into an IV.
2. The drug locks onto GABA-A receptors on brain neurons, making the calming signal (GABA) work stronger.
3. Neurons slow their firing, which stops the electrical seizure.
4. Muscles relax, stopping the shivering or convulsion.

SAFETY WATCH

Can slow breathing or lower blood pressure, so the person needs close monitoring (pulse oximetry, blood-pressure checks). · Use cautiously if the person already has low blood pressure—may need fluids first. · If seizures don't stop after two doses, a second-line agent (like levetiracetam or phenytoin) may be needed.

Severe hypothermia: Active rewarming (external and internal) · Physical rewarming intervention (not a drug)

When core temperature drops below 90°F (32°C), the heart can stop (cardiac arrest) and normal CPR doesn't work until the body warms up. We rewarm slowly at first (1–2°F per hour) to avoid shocking the heart with sudden temperature swings. External rewarming uses heated blankets, warm IV fluids, and warm humidified oxygen. For severe cases (temperature below 82°F or cardiac arrest), we use internal rewarming: warmed IV saline, bladder lavage (flushing the bladder with warm fluid), chest-cavity lavage, or ECMO (extracorporeal membrane

oxygenation—a machine that pulls blood out, warms it, and pumps it back). The rule is: 'No one is dead until they are warm and dead'—we continue resuscitation until core temperature is at least 90°F.

1. Remove wet clothes and wrap the person in heated blankets (external rewarming).
2. Give warm IV fluids (98–104°F) and warm, humidified oxygen through a mask or breathing tube.
3. If the person is in cardiac arrest or has a core temperature below 82°F, start internal rewarming: flush the bladder or chest cavity with warm saline, or connect to ECMO.
4. Continue CPR (with modified ACLS: shocks and medications spaced further apart) until core temperature reaches at least 90°F.
5. Once warm, reassess heart rhythm and brain function.

SAFETY WATCH

Do NOT rewarm too fast—can cause 'rewarming shock' (sudden drop in blood pressure) or dangerous heart rhythms (ventricular fibrillation). · Handle the person very gently—rough movement can trigger a fatal heart rhythm in severe hypothermia. · Monitor potassium closely during rewarming—levels can swing and cause arrhythmias. · Continue resuscitation even if it seems futile—people have survived cold-water drowning with full recovery after hours of CPR during rewarming.

Hypothermia cardiac-arrest support: Modified ACLS (Advanced Cardiac Life Support) · Resuscitation protocol modification (not a single drug)

In severe hypothermia, the heart is so cold that it doesn't respond normally to defibrillation (shocks) or medications like epinephrine. We follow modified ACLS rules: give one shock for ventricular fibrillation or pulseless V-tach, then focus on rewarming. If there's no response, hold further shocks and epinephrine doses until core temperature is above 86°F (30°C). Once the person is warmer than 86°F, resume standard ACLS (shocks and drugs every few minutes). The heart needs to be warm enough for the electrical system and the medications to work.

1. Start CPR immediately (chest compressions and rescue breaths).
2. Give one defibrillation shock if the rhythm is shockable (V-fib or pulseless V-tach).
3. If the person does not respond, focus on active rewarming (see above) rather than more shocks or drugs.
4. Once core temperature reaches 86°F, resume standard ACLS: epinephrine every 3–5 minutes, defibrillation for shockable rhythms.
5. Continue CPR until the person is warm (at least 90°F) and still shows no signs of life, or until they recover.

SAFETY WATCH

Do NOT give up early—successful resuscitation has been reported after many hours of CPR during rewarming. · Do NOT give repeated doses of epinephrine or amiodarone while the person is very cold—the drugs pile up in the tissues and can cause toxicity once the body warms. · Monitor core temperature continuously with an esophageal or rectal probe. · Coordinate with a center that has ECMO capability if local resources cannot rewarm the person fast enough.

Red flags

- Core temperature above 104°F (40°C) or below 95°F (35°C)
- Confusion, slurred speech, or loss of consciousness
- Hot, dry skin with no sweating in a hot environment (heat stroke)
- Seizures or uncontrollable shivering
- Very slow heart rate (under 50 beats/min) or irregular heartbeat in a cold person

Nursing priorities

1. Measure core body temperature using a rectal thermometer every 5 to 10 minutes and start immediate cooling if temperature is above 40 degrees Celsius (104 degrees Fahrenheit) — Core temperature above 40 degrees causes proteins in the brain and organs to break down; every minute of high temperature kills more brain cells, so rapid measurement and cooling prevents permanent brain damage and death
2. Remove all clothing and immerse the patient in ice water up to the neck, or apply ice packs to neck, armpits, and groin while pouring cold water over the body until core temperature reaches 38.5 degrees Celsius (101.3 degrees Fahrenheit) — Ice-water immersion cools the body fastest by pulling heat from the blood vessels near the skin surface; cooling must stop at 38.5 degrees to prevent overcooling into hypothermia (too-cold body temperature)
3. Start a large-bore IV line and give normal saline bolus at 20 milliliters per kilogram of body weight rapidly, while watching for lung crackles or shortness of breath — Heat causes blood vessels to dilate (widen) and fluid to leak out of vessels, dropping blood pressure and reducing blood flow to kidneys and brain; IV saline restores circulating blood volume and prevents kidney failure and shock
4. Assess mental status every 5 minutes using simple commands like squeeze my hand and tell me your name; protect airway and prepare suction if patient cannot follow commands — Brain swelling from heat stroke causes mental status to worsen rapidly; if the patient cannot protect their airway they may breathe in vomit or saliva and develop pneumonia or stop breathing completely

5. Place patient on continuous heart monitor and watch for irregular heart rhythms (arrhythmias), checking potassium and calcium levels immediately — High body temperature and shifts in potassium and calcium electrolytes cause dangerous heart rhythms like ventricular a fast heart rate (tachycardia) that can stop the heart; early detection allows immediate treatment with correct electrolytes or heart medicines
6. Draw blood to check sodium, potassium, kidney function (creatinine), liver enzymes, and clotting times (PT, PTT, INR), and repeat every 4 to 6 hours — Heat stroke damages the liver, kidneys, and clotting system; low sodium causes more seizures, high potassium stops the heart, kidney failure requires dialysis, and clotting problems cause internal bleeding that needs fresh frozen plasma or platelets
7. If seizure occurs, give lorazepam 2 to 4 milligrams IV slowly, protect head from injury, turn patient to side, and prepare intubation equipment at bedside — Seizures increase brain metabolism and heat production, making brain injury worse; lorazepam (a benzodiazepine sedative) stops the seizure, and side positioning prevents choking if patient vomits during the seizure
8. Measure urine output every hour with a urinary catheter, targeting at least 0.5 milliliters per kilogram per hour, and watch for dark brown or tea-colored urine — Low urine output means kidneys are failing from low blood flow and heat damage; dark urine signals rhabdomyolysis (muscle breakdown releasing myoglobin) that clogs kidney filters and requires extra IV fluids and sometimes dialysis to prevent permanent kidney death

Sources

- Wilderness Medical Society Clinical Practice Guidelines for Heat Illness (2019)
- Wilderness Medical Society Clinical Practice Guidelines for Hypothermia (2019)
- CDC Environmental Health – Extreme Heat and Cold
- American College of Emergency Physicians (ACEP) Clinical Policy on Heat-Related Illness

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