

HEALING HANDS



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Exposure-Related Conditions: Symptoms and Prevention Strategies

Exposure-related conditions are a constant reality faced by homeless individuals who spend most days and many nights outside. Without shelter against the elements, they are dependent on mild temperatures and dry weather for a tolerable existence. And while some people who live on the streets may have tents or cardboard structures to provide a modicum of protection and privacy, they are still susceptible to hypo- or hyperthermia as well as associated maladies including frostbite, sunburn, and heat exhaustion. Those who are very young, old, malnourished or exhausted are at increased risk of serious health problems from exposure to temperature extremes. This issue discusses signs and symptoms of cold- and heat-related pathologies and how to prevent them.

Lack of adequate shelter places people at increased risk for pathologies that often result from exposure to temperature extremes. Because unsheltered or inadequately sheltered persons are particularly difficult to enumerate with a high degree of certainty, calculating this risk is especially challenging.

The U.S. Department of Housing and Urban Development (HUD) stated in its First Annual Homeless Assessment Report (AHAR) to Congress (2007) that of 754,147 people identified as homeless on a single day in January 2005, approximately 45% (338,781) were unsheltered — “living on the streets, in cars, or in abandoned buildings or other places not meant for human habitation.”¹ This estimate was based on point-in-time counts required of Continuum of Care applicants as part of the HUD-McKinney-Vento competitive funding process.

Although such counts are thought to significantly under-represent the actual number of people living without sufficient shelter, the AHAR findings suggest that during one of the coldest months of the year, over 300,000 homeless people in America were at higher risk for cold-related pathologies. (National data for other times of the year are not available.)

EPIDEMIOLOGY According to the Health Resources and Services Administration’s 2006 National Aggregate Uniform Data System (UDS) Report on the Health Center Program, approximately 11% (70,704) of 701,623 clients served by 184 Health Care for the Homeless (HCH) grantees in CY 2006 were living on the street; and 1,004 HCH clients had primary diagnoses of exposure to heat or cold or dehydration, requiring approximately two encounters per patient.² These numbers omit clients for whom exposure-related conditions were co-occurring but not primary diagnoses and do not account for homeless people who presented directly to hospital emergency rooms.

Although these exposure-related conditions are infrequently the cause of death in homeless people, a study of homeless adults in Boston found that those “with a history of frostbite, immersion foot (trench foot), or hypothermia had an eightfold increased risk of dying than matched controls.”³ Thus, individuals who have suffered extreme weather-related stress should be considered among the most vulnerable. Centers for Disease Control and Prevention (CDC) statistics confirm anecdotal reports of HCH clinicians that exposure to the environment is often a contributing factor to morbidity and mortality from other causes.⁴

Risk Factors for Cold-Related Morbidity & Mortality

Our bodies produce heat by metabolizing food and water, through chemical actions, and by physical labor using our muscles. The body loses heat through the skin and lungs in the following ways:⁵

1. **Radiation** accounts for 65% of heat loss (an uncovered head can lose up to 50%).
2. **Conduction** transfers heat to a nearby object

(wet clothing can cause a 20-fold increase in heat loss).

3. **Convection**, caused by the movement of air, displaces a warm layer of heat near the body (winds at 12 mph increase heat loss by 5 times).
4. **Evaporation** through sweating and respiration accounts for 20% of the body’s heat loss.

When individuals spend much of the day or night outside, an awareness of how to retain body heat is critical. They need to wear hats and gloves and dress in layers, adding newspaper and plastic bag padding for increased insulation.

Hypothermia, marked by body temperature less than 95° F (< 35° C), is usually caused by

prolonged exposure to cold temperatures without adequate protective clothing or shelter. Moderate to severe hypothermia constitutes a preventable medical emergency.⁶⁻⁸

Related differential diagnoses are important because in addition to exposure, other conditions can cause hypothermia or exacerbate its risk. An individual's susceptibility to cold is influenced by many factors:^{7,8}

- General: infancy, advanced age, malnutrition, exhaustion
- Substance abuse: alcohol, sedatives, meperidine, clonidine, neuroleptics
- Metabolic: hypoglycemia, hypothyroidism, adrenal insufficiency, diabetes
- Cardiovascular: peripheral vascular disease, smoking cigarettes
- Neurologic: peripheral neuropathy, spinal cord damage, autonomic neuropathy, hypothalamic disease
- Trauma: falls (head or spinal injury), fracture causing immobility
- Infection: sepsis

Malini Singh, MD, MPH, an emergency department physician at San Francisco General Hospital, has also worked in emergency medicine in Boston, Chicago, and New York. Despite San Francisco's large number of community shelter resources, Singh reports seeing a high rate of hypothermia among homeless people, often associated with alcohol use by those who do not use shelters. "Fortunately, the number of patients with severe hypothermia is limited by our more temperate climate," she says.

PLANNED RESPONSE Between 1979 and 2002, an average of 689 exposure-related deaths in the U.S. were attributed to excessive cold each year.⁶ Just as understanding the heat index (HI) is important in preventing heat-

related conditions, recognizing the usefulness of wind chill designations issued by the National Weather Service can help prevent cold-related emergencies.

A temperature of 30° F with a 5 mph wind equates to a wind chill temperature of 25° F; when the temperature is 15° F with the same wind, the wind chill temperature is 7° F. But when the temperature is 5° F with a 30 mph wind, the wind chill temperature falls to a dangerous -19° F and frostbite can occur in 30 minutes or less.⁵

During cold weather, clinicians and shelter staffs can remind clients to wear hats, mittens, and layers of clothing to hold warm air in while providing a barrier against the wind. Outer-ware should be waterproof or resistant to rain and snow. Clients should also be encouraged to avoid alcohol and other cognition-altering drugs. And everyone should learn to recognize the early stages of hypothermia that are warnings to seek shelter and call for help: **shivering, slurred speech, and somnolence.**⁹

Providing emergency kits to homeless people and those living in under- or unheated housing is another positive strategy. Kits can include blankets, radios, noncaffeinated fluids (caffeine may exacerbate dehydration), high-energy food, and an extra supply of medications for chronic conditions.¹³ Programs to check on older adults and temporary shelters are additional public health initiatives.

BALTIMORE'S CODE BLUE SHELTER In the late 1990s, deaths related to cold exposure in Baltimore, MD, reached crisis levels. **Melisa Lindamood, MPS**, Assistant Director of Federal Affairs at Johns Hopkins Institutions, was then working for the Baltimore City Health

Recognizing Cold-Related Emergencies: Symptoms of Hypothermia⁷⁻⁸

May include the following:

- Moderate hypothermia - [core body temperature 82° F-90° F (28° C-32° C)]
- Severe hypothermia - [core body temperature < 82° F (< 28° C)]
- Shivering is lost and cooling is rapid.
- Hypoventilation, respiratory acidosis, hypoxemia, aspiration pneumonia, atelectasis progress to apnea, and adult respiratory distress syndrome (ARDS)
- Pancreatitis, gastric erosions
- Hyperkalemia, hyperglycemia, lactic acidosis
- Rigidity progresses to rhabdomyolysis
- Hemoconcentration, hypercoagulability progress to disseminated intravascular coagulation, and bleeding
- Hyporeflexia, agitation, hallucination, dilated pupils progress to areflexia, coma, absent pupil responses, brain-dead-like state
- Arrhythmia

Department and looked for programs in other cities that might be good models. "There really weren't any good matches," she says. "Philadelphia had a huge, comprehensive program in each of its shelters with a large commitment from city leadership and dedicated funding, but the shelters in Baltimore couldn't expand to take in more folks in winter." So the city launched its own stand-alone winter shelter that is now open every day from November 1 through March 31, 5:00 pm to 8:00 am.

"The addition of 300 beds is not a total solution; and the really tricky thing concerns clients who won't come because this is a voluntary program," Lindamood adds. As it happened, the start-up in 2002-2003 coincided with one of the coldest winters on record in Baltimore, "which made that first year



Photos, Melisa Lindamood, MPS

Bus transportation to Code Blue Shelter in Baltimore, MD



Homeless man sleeps on park bench to avoid cold ground.



Code Blue cots ready for a new winter season.

horrendous. But our timing proved to be lucky because we were able to lower the number of deaths that year and prove the program worked — which secured its ongoing funding.”

The Code Blue Shelter is now in its fifth year, a collaborative initiative of the Baltimore City Health Department and the Baltimore Housing Office of Homeless Services. Its mission is to provide emergency health services, food, and shelter to reduce death and cold weather-related injury among people experiencing homelessness on the coldest winter nights.

CLINICAL SYMPTOMS Early recognition of the symptoms of hypothermia is critical. There are three stages of hypothermia related to the body's core temperature:⁶⁻⁹

- **Mild hypothermia**, 90°–95° F (32°–35° C): Evidenced by increased heart and respiratory rates, hyperventilation, difficulty walking, slurred speech, impaired judgment, pronounced shivering, cold diuresis causing frequent urination
- **Moderate hypothermia**, 82°–90° F (28°–32° C): Evidenced by lowered pulse, shallow breathing and slowed respiratory rate, slowed reflexes, shivering stops, confusion and disorientation, common cardiac arrhythmias, paradoxical undressing
- **Severe hypothermia**, < 82° F (< 28° C): Evidenced by hypotension, slow pulse, pulmonary edema, coma, ventricular arrhythmias (including ventricular fibrillation), possible asystole or “flat line” EKG

Physical assessment of people with moderate to severe hypothermia is difficult because those who have lapsed into a coma often appear to be dead. Clinicians must continue resuscitation efforts until the body temperature reaches

90°–95° F (32°–35° C), and assume that no one is dead “until warm and dead.”⁵

MANAGEMENT Passive rewarming using blankets and warm liquids with electrolytes (warm soup or juices) may be used in mild hypothermia unless the patient is unable to generate heat through shivering because he or she is exhausted or of advanced age.⁷⁻⁹ “Moderate to severe hypothermia is a medical emergency necessitating maintenance of the airway, breathing and circulation,” as well as monitoring core body temperature using a rectal probe.⁷

Moderate hypothermia may respond to active rewarming with warm intravenous fluids, oxygen, lavage, or immersion baths. Severe conditions may require active rewarming with cardiopulmonary bypass. In both cases, the core body temperature should be rewarmed by 2°–4° F (1°–2° C) per hour. Supportive care should be provided, electrolytes replenished as needed, and cardiac rhythms monitored.⁹

“A rectal temperature is essential,” advises **Stephen Hoffman, MD**, attending physician at San Francisco General Hospital Emergency Department. “If it is over 97° F (> 35° C), bundle the patient up and give him/her warm beverages with electrolytes. But if the body temperature is less than 96° F, the patient needs to be warmed with 3 to 4 liters of IV fluids, and possibly more, in addition to active rewarming using heating blankets, water jackets, and infrared heat lamps, and then reevaluated.”

Hoffman offers this caveat to clinicians treating homeless clients: “It does not have to be cold for a person to experience hypothermia. If [the individual] has suffered ongoing exposure to 70° F temperatures

without thermal protection and food or nutrients, he or she will finally become hypothermic.” Indeed, some of the most dangerous environmental situations occur in temperate climates when the temperature drops suddenly.

FROSTBITE Exposure to severe cold that results in tissue freezing causes a cascade of cellular response:⁵

- Formation of ice crystals within the cells damages cell membranes and causes the cells to rupture, dehydrate, and die.
- Constriction of peripheral blood vessels in response to the cold deprives tissue of oxygen.
- Interruption of blood flow to capillaries leads to clotting or thrombosis in small arterioles and venules.
- Release of inflammatory mediators result from tissue damage, hypoxia, and thrombosis.
- Prostaglandins cause additional vasoconstriction, further depriving tissues of oxygen and causing platelet aggregation.

The goal of treatment is to reverse or limit each of the cascade's processes. Before transport to the hospital, carefully remove nonadherent wet clothing. If refreezing may occur in transit, caregivers should neither rewarm nor rub the affected area because both will worsen the tissue damage.

At the hospital, frostbitten tissue is rewarmed rapidly in a water bath of 104°–108° F (40°–42° C) for 15 to 30 minutes. Prophylactic tetanus, IV narcotics as needed, ibuprofen, and IV antibiotics complete the treatment protocol.^{5,7}

Generally, frostbite is classified as (1) superficial or (2) deep. Treatment is the



Photos, James O'Connell, MD

Denise Petrella, RN, CS, ANP, of the Boston HCH Program identifies early frostbite on the toes of a man who came to the clinic with a cold. He was admitted to McInnis House for respite care.



Improvement at one week



Resolution at two weeks

same until 3 to 6 weeks after injury when viable and nonviable tissue can be identified. Initial symptoms are described as cold, numb, and club-like or clumsy. After rewarming, numbness is replaced by severe throbbing pain that continues for a number of weeks. Electrical shock-like sensations may also run through the affected tissue. Sensory loss and increased sensitivity to cold are often ongoing symptoms. Deep frostbite has been associated with arthritis and chronic neuropathic pain.⁵

Post-thaw care strives to prevent secondary infection and support the patient while the affected tissue heals—a process that often takes several months. During this time a hard, black, leathery eschar forms. Gradually underlying tissue separates from the nonviable eschar; but clients must be monitored carefully for infection, and wound care is needed to treat shallow ulcers caused by blister formation.

When the frostbitten tissue does not heal, amputation is necessary, but the extent of the injury is not fully known for three weeks to several months.

Fred Cole, a client with the Homeless Individuals Partnership (HIP) program in Cincinnati, OH, suffered a frostbite injury to his left foot during the Korean War in 1953.

“My left foot was numb and I couldn’t walk,” he remembers. “The medic trimmed off the toenails and said I wouldn’t lose any toes, but I did.” Mr. Cole turned 77 recently and the memory of the pain still brings tears to his eyes. His case manager in the HIP program, **Nancy Lester, MSW**, relates that Mr. Cole has had to take extra care precautions over the years. “Cold bothers him a lot, so he needed to be bundled up and layered — particularly his feet with layers of socks and bags under his shoes —when he was living on the street. Now he can wear thermal socks in insulated boots at home.”

TRENCH FOOT Trench foot or immersion foot is an often overlooked condition that occurs following exposure to cold and wet conditions for prolonged periods, resulting in tissue hypoxia and vasoconstriction. The name for the disorder dates to World War I

when troops stood in water for days in the trenches on the Western Front.

The client’s soles can be blanched or grey, swollen, waxy, and wrinkled with no sensation to light touch.¹⁰ He/she may describe his/her feet as feeling numb but with pin-prick type pain when walking; somewhat like a sleeping limb “waking up.”

The CDC recommends the following treatment protocol:¹⁰

- Treat the affected area by soaking in warm water [102°–110° F (39°–43° C)] for approximately five minutes.
- Thoroughly clean and dry the feet.
- Put on clean, dry socks daily.
- Do not wear socks when sleeping.
- Seek medical attention.

(This information was derived from a HCH case report by **Dean Carpenter, APRN, BC**, Neighborhood Service Organization, Detroit, Michigan. See: <http://www.nhchc.org/CaseReports/CaseReportTrenchFoot062707.pdf>)

Heat Waves Demand a Prepared Response

The human body ordinarily cools itself by sweating, but built-in heat control mechanisms may not be sufficient to regulate rapidly rising body temperatures. During heat waves, high humidity exacerbates problems with thermoregulation because it is harder for sweat to evaporate. The combined stress of heat and humidity may make even healthy people vulnerable to overheating that can damage vital organs.

In urban environments without green spaces to diffuse high temperatures, individuals with limited financial resources who are socially isolated, young children and older adults, people with substance use disorders and other chronic physical and mental illnesses, and manual laborers involved in heavy physical activity are at highest risk for heat-related illness. Stagnant atmospheric conditions trap air pollutants, exacerbating the effects of excessive heat.¹¹ Awareness of the importance of keeping as cool as possible and drinking liquids during hot weather is important for prevention of heat disorders.

During the summer of 2007 and an unusual six-week run of triple-digit temperatures in Nashville, TN, **Becca Richey, FNP**, Manager of the Downtown Clinic for the Homeless, gave out bottle upon bottle of cool water. “We felt lucky to hospitalize only three or four folks,” says her colleague **Tracy Beadle, FNP**. “Dehydration really exacerbates some conditions related to medications such as high blood pressure when the person is taking a diuretic.” Team members also conducted water patrols. HCH Coordinator **Scott Orman** made sure shelters usually closed during the day were open to allow homeless clients to get cooled down.



Photo by Christine Keith, *The Arizona Republic*

Physician assistant Keith Williamson, Maricopa County Health Care for the Homeless, treats Fernando Martinez for heat stress.

Although such temperatures are unusual in Nashville, they are a way of life during the summers in Phoenix, AZ. **Adele O’Sullivan, MD**, Medical Director of the Maricopa County Department of Public Health’s HCH project, says, “our clinicians work year round to prepare for the summer heat — pooling supplies, setting up logistics for cooling stations, finding places where homeless clients can get in out of the heat to cool down. From July through August 2005, even the temperature at night didn’t drop below 90° F. Public

Works set up air conditioned buses in areas of the community where there were homeless people, just to get folks off the sidewalk and cooled down.”

“In the blistering heat of summer, there is an all-out effort to get liquids out in the community, and the public is so good at helping to distribute them,” notes O’Sullivan. “But there’s a whole constellation of things going on — sunburn; medication side effects, particularly for blood pressure and psychiatric conditions; day laborers working construction or cleanup and doing heavy lifting outside or in hot warehouses; lack of air conditioned public buildings that are ‘homeless friendly’ and public spigots to rinse off.”

PLANNED RESPONSE Knowing that heat-related deaths are preventable, Phoenix keeps planning. All communities can create well-defined response plans to prepare for and prevent heat-related illnesses.

One step is for communities and clients to understand the relationship between the heat index (HI) and heat disorders. Devised by the National Weather Service, the Heat Index measures how hot it actually feels outside when relative humidity is combined with the air temperature.¹¹

- The HI was devised for shady, light wind conditions, so exposure to full sun can increase HI values by up to 15° F; and strong winds with very hot, dry air are extremely hazardous.
- HI of 80°–90° F may produce fatigue with prolonged exposure or physical activity.
- HI of 90°–130° F may produce sunstroke, heat cramps, or heat exhaustion with prolonged exposure or physical activity.
- With continued exposure to HI of 130° F or higher, heatstroke is highly likely.

Clinics need to make sure sunscreens with a rating of at least sun protection factor (SPF) 15 are available. Burned skin decreases the body’s ability to sweat effectively.¹² Clinicians should discuss with their clients the importance of seeking out cool places and drinking fluids on hot days, and should make sure clients’ medications do not place them at increased risk for dehydration.¹³ Communities should ensure access to public facilities with air conditioning and showers or water faucets where homeless people can cool off.

Formerly homeless people who live alone in hot rooms can be even more vulnerable than individuals living outdoors. It is important to have safety plans in place to monitor individuals and families living without air conditioning. When checking on clients, reminders that cool baths and showers may dissipate the heat are often helpful.¹²

CLINICAL SYMPTOMS & MANAGEMENT Extreme heat is marked by temperatures that stay 10° or more above the average high for a region over a period of weeks. A heat wave combined with drought can be especially dangerous.¹⁴ Clinicians should be prepared to respond to heat-related emergencies by reviewing symptoms of heat-related disorders:

- **Heat cramps** are painful spasms of the leg or stomach muscles that may be accompanied by heavy sweating. They do not require medical attention, but the person should stop all activity, sit quietly in a cool place, and drink water, juice, or a sports drink.^{12,14}
- **Heat exhaustion** is marked by extreme fatigue, heavy sweating, thirst, headache, dizziness, fast and shallow breathing, nausea and vomiting, pale and moist skin, and a fast, weak pulse. If untreated, the symptoms

Recognizing Heat-Related Emergencies: Symptoms of Heat Stroke¹⁴

May include the following:

- High body temperature (>103°F [>39.4°C])
- Red, hot, and dry skin (no sweating)
- Rapid, strong pulse
- Throbbing headache
- Dizziness
- Nausea
- Confusion, delirium, ataxia
- Unconsciousness
- Symptoms can progress to encephalopathy, liver and kidney failure, coagulopathy, and multiple organ system dysfunction.

may progress to heat stroke.^{12,14} Cooling measures may include rest in an air conditioned environment; light weight clothing; cool, nonalcoholic beverages; and a cool shower or bath.¹⁴

- **Heat stroke** is a life-threatening hyperthermic condition caused by breakdown of the body’s thermoregulation. The skin no longer sweats and becomes red, dry, and very hot. Body temperature is above 103°F and can rise rapidly to 106° F in as little as 15 minutes.¹⁴ Chest pain, shortness or shallowness of breath, and abdominal pain may be present along with confusion, anxiety, a rapid pulse, and throbbing headache. Until emergency medical care arrives, caregivers should start to cool the person rapidly with whatever methods are available: remove extra layers of clothing, fan, wrap in a wet sheet, sponge with any cool liquids, or spray with cool water from a garden hose.

Stephen Hoffman, MD, attending physician at the San Francisco General Hospital Emergency Department, cautions that “during an initial ED assessment, altered mental status combined with agitation and dehydration could point to a number of conditions; so it’s important to get a temperature early, preferably rectally for accuracy. If the temperature is under 100° F (38° C), the patient should continue to rest in a cool area, drink cool water or an energy drink, and be checked periodically.”

“In a true emergency,” Hoffman continues, “when the oral temperature is over 103° F (39° C) and there is no sweating, the patient should be undressed and covered with a sopping wet sheet. This acts to wick out the heat, somewhat like artificial sweating. The sheet should be rinsed and changed every 10 minutes. An IV should be started to infuse a couple of liters of normal saline over the first hour, and the rectal temperature should be checked every 10 to 15 minutes. A Foley catheter can be inserted to measure output and record the temperature digitally; the patient will start urinating when the IV fluids have caught up with the dehydration.”

In homeless patients, there can be numerous reasons for high temperature besides environmental heat exposure. After initial therapy is started, tests can be done to identify infection — urinary tract infection, pneumonia, meningitis — as well as the presence of amphetamines, cocaine, or psychotropic drugs in the bloodstream. “ED clinicians must always be alert to worrisome agitation,” Hoffman warns. “When a patient has been restrained, the body temperature can skyrocket as the exertion of fighting the restraints burns up calories. Clinicians must measure the patient’s temperature early to rule out hyperthermia.”

SOURCES & RESOURCES

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A number of these sources are available in the Clinical Resources section of the National Health Care for the Homeless Council's website:

- **Heat-related conditions:** <http://www.nhchc.org/heatrelatedconditions.html>
- **Cold-related conditions:** <http://www.nhchc.org/coldrelatedinjuries.html>

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