

Staying Safe in Extreme Heat: Information and Education for Farm Workers, Older Adults, and At-Risk Populations

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Extreme summer heat is becoming more prevalent in the U.S., with future climate projections indicating an increase in the frequency and intensity of extreme heat events. Heat-related deaths have risen significantly, with approximately 1,602 in 2021, 1,722 in 2022, and 2,302 in 2023¹.

Who are at Risk?

Heat risk varies based on individual factors. Vulnerable groups include older adults, outdoor workers, infants, children, pregnant women, unhoused individuals, and those with chronic medical conditions².

- **Older adults**, particularly those over 65, are more susceptible to extreme heat due to a decreased sense of thirst and reduced ability to sweat³. There was 40% increase in excess deaths for people over the age of 65 and a 70% increase in excess deaths for people over 85 during the heat wave³.
- **Agricultural workers** face a significantly higher risk of heat-related death, more than 35 times higher than other occupations, due to prolonged outdoor exposure¹. Without adequate protection, they are prone to heat-related illnesses¹.

Impact of Heat on Health:

Heat can affect individuals in varying degrees of severity and can impact different parts of the body. The most common heat-related illnesses include:

- **Heat Stroke:** The most severe heat illness, heat stroke occurs when the body can no longer regulate its temperature, leading to a rapid rise in body temperature.
- **Heat Exhaustion:** This condition results from excessive loss of water and salt due to sweating. It primarily affects older adults, those with high blood pressure, and workers in hot environments.
- **Rhabdomyolysis:** Associated with heat stress and intense physical exertion, rhabdomyolysis involves the rapid breakdown of muscle tissue, which can lead to kidney

damage and other serious complications. Symptoms include muscle pain, weakness, and dark-colored urine. Medical attention is necessary.

- **Heat Syncope:** This refers to fainting or dizziness due to prolonged standing or sudden rising in hot conditions, often caused by dehydration or lack of acclimatization.
- **Heat Cramps:** Painful muscle cramps often occur in workers who sweat excessively during strenuous activity. These cramps are caused by a loss of salt and moisture from the muscles.
- **Heat Rash:** A skin irritation caused by excessive sweating, often appearing as red clusters of pimples or blisters.

Please see *Table 2* for the **detailed signs, symptoms, and essential first aid measures** for these heat illnesses. Heat exacerbates various health issues, including heart disease, asthma, chronic obstructive pulmonary disease (COPD), kidney injury, stress, anxiety, cognitive impairment, acute psychiatric and substance use symptoms, and mental health disorders¹.

Heat and Medication

Certain medications, such as diuretics, antipsychotic meds, antidepressants, antihypertensive meds, and antihistamines, can also increase the risk of heat-related illnesses⁴. Certain medications may lead to a decrease in fluid volume in the body (volume depletion), low blood pressure (hypotension), and reduced heart function (cardiac output), which can raise the risk of fainting, falls, and potentially reduced blood flow to the kidneys. This can increase the chances of kidney damage, particularly when taking medications that are toxic to the kidneys (nephrotoxic drugs). Examples of such medications include non-steroidal anti-inflammatory drugs (NSAIDs), diuretics (water pills) such as furosemide, acetazolamide, beta blockers like propranolol, and laxatives such as bisacodyl and docusate.

Consult your health care provider to determine if any of your medications increase your risk of overheating or sunburn, to monitor the effects of the medications and make necessary adjustments during hot weather periods.

Heat can degrade or damage some meds such as inhalers, EpiPens, insulin. Inhalers can explode in high temperatures⁴. EpiPens might fail or deliver a reduced dose of epinephrine if exposed to heat. Insulin shouldn't be stored in places where it might be exposed to extreme temperatures, whether very hot or very cold. Storing insulin in the freezer, direct sunlight, or the glove compartment of a car could affect its effectiveness. Before using insulin, the vial should be checked to ensure it looks normal.

Some antifungals and antibiotics can increase skin sensitivity from sun exposure⁴. Some antifungal medicines, such as flucytosine, griseofulvin, and voriconazole, and certain antibiotics like metronidazole, tetracyclines, and fluoroquinolones, can make your skin more sensitive to sunlight, which might cause a rash like a sunburn.

If you're taking these medications, it might be a good idea to limit direct sun exposure as much as possible. Wearing protective clothing and a hat, along with applying a broad-spectrum sunscreen that blocks both UVA and UVB rays with an SPF of 30 or higher, can help protect your skin. *Check* with your healthcare provider to see if any of your medications might make your skin more prone to overheating or sunburn. They can help monitor how these medications affect you and adjust your treatment if needed, especially during hot weather.

Identifying Heat Risks

The Wet Bulb Globe Temperature (WBGT) (*See Figure 1*) is a crucial measure of heat stress, accounting for temperature and humidity. It is essential for outdoor workers to monitor WBGT and take breaks in air-conditioned environments when necessary¹. Heat Stress Category (WBGT) and Work/Rest Cycle & Water Intake Per Hour Recommendation are outlined (*See Figure 2*)

Relative humidity (%)	Temperature (°F)															
	68.0	71.6	75.2	78.8	82.4	86.0	89.6	93.2	96.8	100.4	104.0	107.6	111.2	114.8	118.4	122.0
0	58.6	60.9	64.3	65.5	67.7	69.9	72.1	74.3	76.4	78.5	80.6	82.6	84.7	86.6	88.6	90.5
5	59.6	62.1	65.6	67.0	69.3	71.7	74.0	76.4	78.6	80.9	83.1	85.3	87.5	89.9	92.1	94.2
10	60.7	63.3	66.9	68.4	70.8	73.3	75.8	78.2	80.7	83.0	85.5	88.0	90.3	92.8	95.1	97.6
15	61.7	64.5	68.1	69.6	72.2	74.8	77.4	80.0	82.6	85.2	87.8	90.2	92.8	95.4	98.0	
20	62.7	65.6	69.4	70.9	73.6	76.3	79.2	81.8	84.5	87.1	89.8	92.5	95.2	97.8		
25	63.8	66.7	70.5	72.2	75.1	77.8	80.6	83.4	86.2	89.0	91.8	94.6	97.4			
30	64.8	67.6	71.7	73.4	76.3	79.2	82.1	84.9	87.8	90.8	93.6	96.6	99.4			
35	65.6	68.6	72.7	74.6	77.5	80.5	83.5	86.4	89.4	92.4	95.3	98.3				
40	66.7	69.6	73.8	75.7	78.8	81.8	84.8	87.8	90.9	94.0	97.0					
45	67.5	70.6	74.8	76.8	79.9	83.0	86.1	89.2	92.3	95.4	98.6					
50	68.4	71.5	75.8	77.8	81.1	84.1	87.4	90.5	93.7	96.9						
55	69.3	72.4	76.7	78.8	82.1	85.3	88.5	91.9	95.1	98.3						
60	70.1	73.3	77.7	79.8	83.2	86.4	89.8	93.1	96.3	99.6						
65	70.9	73.8	78.6	80.9	84.2	87.5	90.8	94.1	97.5							
70	71.7	75.0	79.5	81.7	84.9	88.6	91.9	95.3	98.6							
75	72.4	75.9	80.3	82.7	86.1	89.6	92.9	96.4								
80	73.2	76.7	81.2	83.6	87.1	90.4	93.9	97.4								
85	74.0	77.4	82.0	84.5	88.0	91.5	94.9	98.5								
90	74.7	78.2	82.9	85.3	88.9	92.3	95.9	99.4								
95	75.5	78.9	83.6	86.1	89.6	93.2	96.8									
100	76.1	79.7	84.4	86.9	90.5	94.1	97.7									

Temperature	Category	Risk level
77° to 81.9°F (25° to 27.7°C)	Caution	Possible fatigue with prolonged exposure
82° to 84.9°F (27.8° to 29.4°C)	Extreme caution	Heat-related illness possible with long exposure
85° to 88.9°F (29.5° to 31.6°C)	Danger	Heat stroke possible, heat-related illness likely
≥ 89°F (≥ 31.7°C)	Extreme danger	High risk of heat stroke

Figure 1: Wet Bulb Globe Temperature (WBGT). Wet bulb globe temperature based on temperature and humidity, assuming a clear sky (maximum solar load) and atmospheric pressure of 1 ATA (760 mm Hg). Source: Gauer, R., & Meyers, B. K. (2019). Heat-related illness

Recommended Work-Rest Cycles and Water Intake per Hour by Heat Stress Category (WBGT) for Moderate and Hard Work

Heat Stress Category (WBGT)	Moderate Work		Hard Work	
	Work/Rest Cycle	Water Intake Per Hour	Work/Rest Cycle	Water Intake Per Hour
White ≤76.9° F (≤24.9° C)	60/15 Minutes	300 ml (1/3 qt)	40/20 Minutes	500 ml (1/2 qt)
Green 77-81.9° F (25-27.7° C)	60/15 Minutes	750 ml (3/4 qt)	40/20 Minutes	1000 ml (1 qt)
Yellow 82-84.9° F (27.8-29.4° C)	40/20 Minutes	1000 ml (1 qt)	30/30 Minutes	1000 ml (1 qt)
Red 85-88.9° F (29.5-31.6° C)	30/30 Minutes	1000 ml (1 qt)	Exercise is forbidden. Very high risk for heat casualties.	
Black ≥89° F (≥31.7° C)	Exercise is forbidden. Very high risk for heat casualties.			

Figure 2: Ariel's checklist, Heat Stress Category (WBGT) and Work/Rest Cycle & Water Intake Per Hour Recommendation.
Source: Ariel's Checklist; This chart was developed by Professor Yoram Epstein to be used for the hikers.
<https://arielschecklist.com>

Figure 3 outlines the necessary actions in response to the heat risk level (Green, Yellow, Orange, Red, Magenta) assessed based on geographic location. Figure 4 displays the Heat Risk Map of San Francisco North Bay Area: Marin, Sonoma, and Napa Counties with color coding (Green, Yellow, Orange, Red, Magenta) accessed on July 11, 2024. Up-to-date HeatRisk map is available here <https://t.ly/HeatRiskMap>

HeatRisk Level	Risk of Heat-Related Impacts	Recommendation
0 Green (Little)	Little to no risk.	Great weather for outdoor activities!
1 Yellow (Minor)	This level of heat primarily affects those individuals extremely sensitive to heat, especially when outdoors without effective cooling and adequate hydration.	<ul style="list-style-type: none"> • Increase hydration. • Reduce time spent outdoors or stay in the shade when the sun is strongest. • Open windows at night and use fans to bring cooler air inside buildings.
2 Orange (Moderate)	Moderate risk for heat sensitive groups, especially those without effective cooling and hydration. Some risk for sun-exposed, active individuals in the general population.	<ul style="list-style-type: none"> • Reduce time in the sun between 10 a.m. & 4 p.m. • Stay hydrated. • Stay in a cool place during the heat of the day. • Move outdoor activities to cooler times of the day. • Open windows at night and use fans to bring cooler air.
3 Red (Major)	This level of heat affects anyone without effective cooling and adequate hydration. Major risk for sun-exposed individuals, outdoor enthusiasts, and heat-sensitive groups.	<ul style="list-style-type: none"> • Try to avoid being outdoors in the sun between 10 a.m. and 4 p.m. • Stay hydrated. • Stay in a cool place especially during the heat of the day. • If you have access to air conditioning, use it. Set thermostats to 78 or higher. Fans may not be adequate. • Cancel outdoor activities during the heat of the day.
4 Magenta (Extreme)	Entire population is at risk. Heat risk can be deadly for heat sensitive groups, without effective cooling. Poor air quality and power outages are also likely.	<ul style="list-style-type: none"> • Avoid being outdoors in the sun between 10 a.m. and 4 p.m. • Stay hydrated. • Stay in a cool place, including overnight. • If you have access to air conditioning, use it. Set thermostats to 78 or higher. Fans will not be adequate. • Cancel outdoor activities.

Figure 3: HeatRisk level, Risk of Heat-Related Impacts and Action Recommendations, Reference: Health and Human Services, Marin County

Hydration and Nutrition

Proper hydration is critical. Humans can only survive for a few days without water. Water makes up 75% of body weight in infants and 55% in the elderly, playing a crucial role in maintaining cellular homeostasis and sustaining life⁵.

- Workers should drink 1 cup (250mL or 8 oz.) of water every 15-20 mins during moderate activities⁶. Generally, fluid intake should not exceed 6 cups per hour⁷. Federal regulations, workers protection standard, require water to be available in the field and bathrooms. Water should be potable, <15°C (59°F), and made accessible near the work area⁷.
- Opt for sports drinks with balanced electrolytes during prolonged sweating⁶.
- Maintaining electrolyte balance with beverages like sport drinks, coconut water and electrolyte solutions is beneficial. However, sports drinks often contain a lot of sugar. Check the nutrition labels to find those without excess sugar⁶.

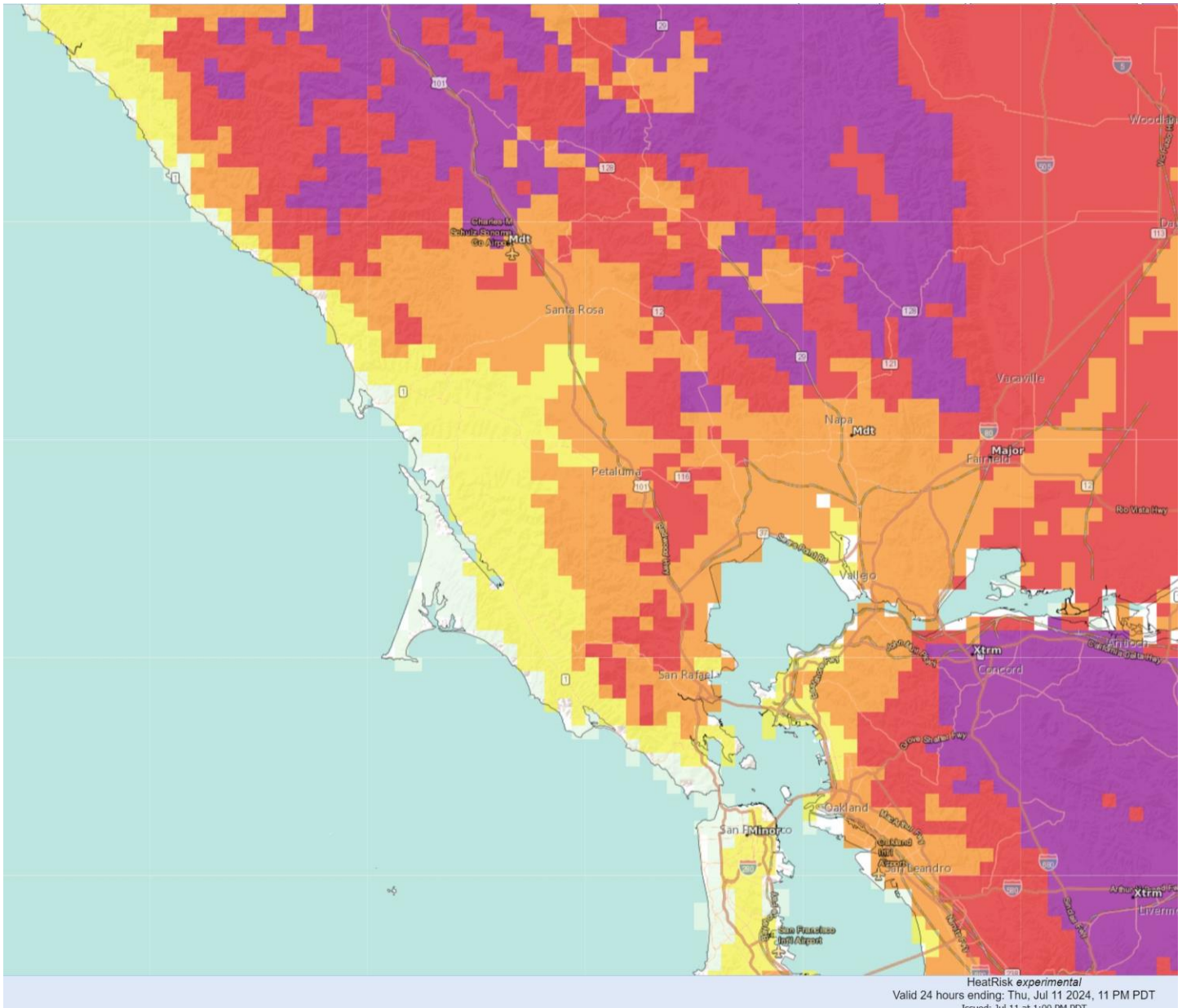


Figure 4: Heat Risk Map of San Francisco North Bay Area: Marin, Sonoma, Napa Counties as of July 11, 2024, Source: National Weather Service. Up-to-date HeatRisk map is available here <https://t.ly/HeatRiskMap>

- Commercial electrolyte products are not all identically formulated, some are too concentrated. If ready-to-drink electrolyte beverages are selected, these solutions should provide approximately 20-30 mEq (milliequivalents) or 460-690 mg (milligrams) of sodium per liter, 2 to 5 mEq (78-195 mg) of potassium per liter, and chloride as the only anion⁸. The carbohydrate content should be glucose or sucrose maltodextrin, or other complex carbohydrate in a concentration of 5% to 10%⁸.
- For infants and young children, solutions such as Pedialyte can help maintain electrolyte balance during illness or heat exposure⁹.
- Avoid caffeinated and alcoholic beverages, which can cause dehydration⁶.
- Avoid using salt tablets unless directed to do so by a physician¹⁰.

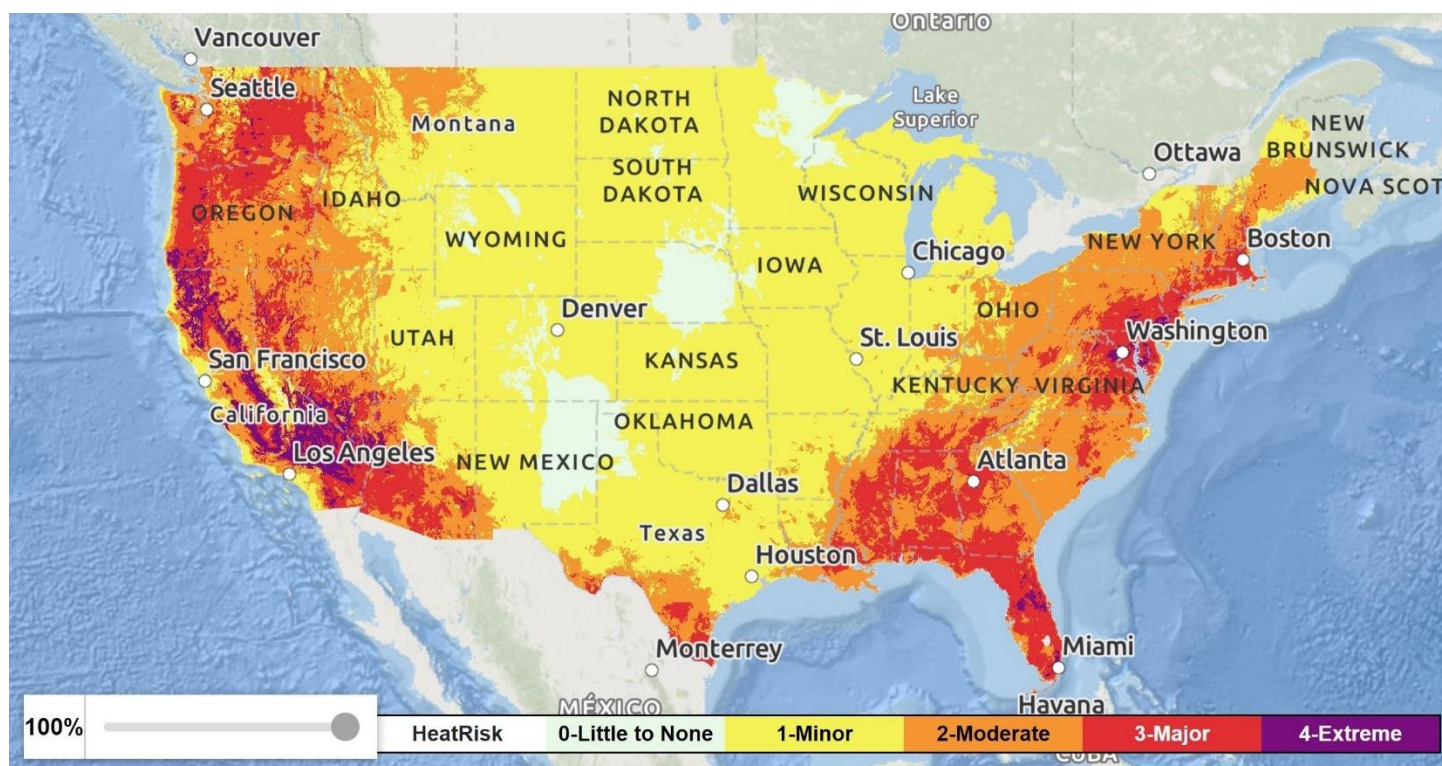


Figure 5: HeatRisk Map of the U.S. Taken on July 10, 2024, Source: National Weather Service. Up-to-date HeatRisk map is available here <https://t.ly/HeatRiskMap>

Nutritional strategies

Nutritional strategies include consuming light, fresh meals during hot days and avoiding heavy, greasy foods that can increase body heat⁶. During extremely hot days, best timing for meals is breakfast, as it is the coolest part of the day⁵. You may eat a little heavier after workday is over or cooling down in the later evening⁶. Foods with high water content (90–99% water content) fat-free milk, cantaloupe, strawberries, watermelon, lettuce, cabbage, celery, spinach, pickles, and cooked squash⁵, (80–89% water content) fruit juice, yogurt, apples, grapes, oranges, carrots, cooked broccoli, pears, and pineapple are beneficial⁵.

Clothing

Light-colored, light-weight clothing and a wide brim hat are recommended for field workers or when going out, to prevent heat stress⁶.

Heat tolerance or acclimation

Humans get used to the heat within 4 to 14 days. But they can also lose their acclimatization as quick as in 2 days⁷.

Home/Workplace Cooling Strategies

To keep homes or workplaces cool, use air conditioners, fans, and reflective shades. Close drapes during the day and open windows at night to create cross-ventilation in places without air conditioning. Minimize the use of heat-producing appliances during the hottest parts of the day¹⁰.

Safety Tips

- Never leave individuals in closed cars. When the outside temperature is 80°F, the inside of a car can reach 99°F within 10 minutes, 109°F in 20 minutes, 118°F in 40 minutes, and 123°F in 60 minutes, posing life-threatening risks¹¹.
- Prepare for power outages or an evacuation. Please see details here <https://t.ly/PoweredPrepared>, <https://t.ly/PowerOutages>.
- Utilize cooling centers in your area (*See Table1*).
 - Marin County- <https://t.ly/CoolingCentersMarin>
 - Sonoma County- <https://t.ly/CoolingCentersSonoma>
 - Napa County- <https://t.ly/CoolingCentersNapa>

Table 1: Cooling centers and other places to escape the heat and cool down in North Bay Counties

Sonoma County	Geyserville Park & Ride, Russian River Senior Center , El Verano Elementary School Gym, COTS Mary Isaak Center, Rohnert Park Community Center, Senior Recreation Center Cooling Safe Haven , Healdsburg Senior Center, Finley Community Center, Ridgway Swim Center, Spray Ground at Prince Gateway Park, Steele Lane Community Center : https://t.ly/CoolingCentersSonoma
Marin County	Albert J. Boro Community Center / Pickleweed Library, Belvedere Tiburon Library, Bolinas Library, Fairfax Library, Hamilton Community Center, Margaret Todd Senior Center , Marinwood Community Center and Pool, McNears Beach Park and Pool, Mill Valley Community Center and Pool, Northgate Library, Novato Library, San Rafael City Hall, San Rafael Public Library, Terra Linda Community Center and Pool https://t.ly/CoolingCentersMarin
Napa County	American Canyon Library, SDA church at Pacific Union College, Calistoga Library, Calistoga Community Center, South Napa Day Shelter, St. Helena Public Library, Yountville Library https://t.ly/CoolingCentersNapa

Table 2: First Aid for Heat Illnesses- Know these important ‘First Aid’ for Heat Illnesses. (CDC, NIOSH)

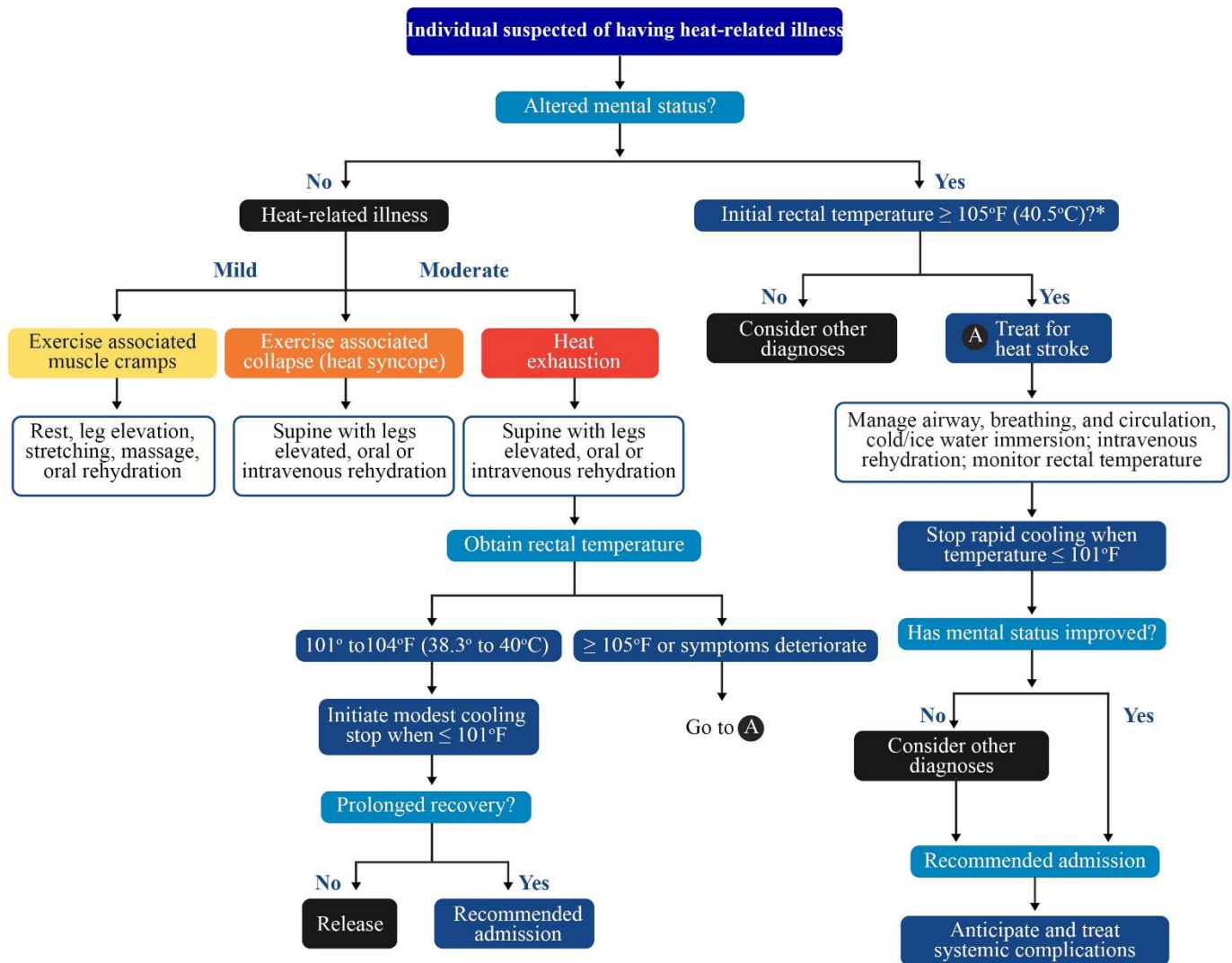
Symptoms can occur in any order. You don’t need to have all of the symptoms in a category to have heat illness.

	Signs and Symptoms	What to Do
Heat Rash/ Prickly Heat	<ul style="list-style-type: none"> •Red cluster of pimples or small blisters, usually on neck, upper chest, groin, under breasts, and in elbow creases •Extensive areas of skin that do not sweat on heat exposure, but present a gooseflesh appearance that subsides with cool environments 	<ul style="list-style-type: none"> •When possible, a cooler, less humid work environment is the best treatment •Keep rash area dry •Do not use ointments or creams, as they may impair cooling—warm, moist skin can make the rash worse
Heat Cramps	<ul style="list-style-type: none"> •Muscle cramps, pain, or spasms in the abdomen, arms, or legs 	<ul style="list-style-type: none"> •Drink fluids every 15 to 20 minutes and eat a snack or sports drink •Avoid salt tablets, but drinks containing electrolytes are OK •Get medical help if the worker has heart problems, is on a low sodium diet, or if cramps do not subside within 1 hour
Heat Syncope (Fainting)	<ul style="list-style-type: none"> •Fainting, dizziness, or light-headedness after standing or suddenly rising from a sitting/lying position 	<ul style="list-style-type: none"> •Sit or lie down in a cool place when beginning to feel faint or dizzy •Slowly drink water or clear juice
Heat Exhaustion	<ul style="list-style-type: none"> •Headache •Nausea •Dizziness, weakness •Irritability •Thirst, heavy sweating •Elevated body temperature •Decreased urine output 	<ul style="list-style-type: none"> •Call for medical help or take worker to a health facility for evaluation and treatment •Stay with worker until help arrives •Remove unnecessary clothing, including shoes and socks •Cool worker with water, cold compresses, an ice bath, or fans •Encourage frequent sips of cool water
Exertional Heat Stroke	<ul style="list-style-type: none"> •Confusion, altered mental state, slurred speech, loss of consciousness •Hot, dry skin or profuse sweating •Seizures •Very high body temperatures •Fatal if treatment delayed 	<ul style="list-style-type: none"> •This is an emergency! Call for emergency care immediately! •Move worker to a cool area and remove clothing •Immerse worker in a tub of ice water •If a tub is not available, place worker in a tarp with ice and water (e.g., tarp-assisted cooling with oscillation) •If cold-water immersion is not possible, <ul style="list-style-type: none"> ○Soak worker with cold water from a hose or shower ○Apply cold, wet towels to as much of the skin as possible, and replace towels frequently

Table 3: This table outlines **common onsite whole-body cooling strategies for Exertional Heat Stroke (EHS) casualties and their cooling rates.** Source: Roberts, W. O., Armstrong, L. E., Sawka, M. N., YeARGIN, S. W., Heled, Y., & O'Connor, F. G. (2023). ACSM expert consensus statement on exertional heat illness: recognition, management, and return to activity. *Current Sports Medicine Reports*, 22(4), 134-149.

Body Cooling Strategies	Approximate Cooling Rate (°Cmin ⁻¹)
Ice water (~2°C) or cold water (~20°C) immersion with stirring: (a) Immerse the full body up to the neck including upper and lower extremities (~90% body surface area) in a tank/tub, circulate the water to increase heat transfer, add ice during cooling to maintain water temperature, support head and airway above water level.	0.13 to 0.35
(b) Immerse as much of the torso and pelvic region (~65% body surface) following full body treatment notes, extremities not in water should be cooled using other strategies	0.04 to 0.25
Cold water dousing: Free flowing hose or bucket with cool tap water applied to the whole body—extremities, torso, hands, feet, neck, and head (with attention to the airway).	0.04 to 0.20
Tarp-assisted water ice/cold immersion: Providers hold the sides of the tarp with patient, water, and ice in the middle. Ensure as much of the torso, groin, and extremities are immersed as possible. Circulate the water as able.	0.14 to 0.17
Ice/cold water-soaked towels: Towels should be applied to the limbs (including feet and hands), trunk, and head with ice packs placed in the groin, axilla, and neck; include as much of the body as possible (~90% body surface area). Wring towels after soaking in bucket of ice water and change the towels rapidly.	0.11 to 0.16
Ice/cold water-soaked sheets: The whole body (~90% of body surface area) is wrapped in large sheets that are soaked with cold water. Sheets stay in place and are frequently rewetted. A fan directed at the body can be added.	0.05 to 0.06
Cold water immersion in portable water-impermeable bag: Immerse the full body up to the neck including upper and lower extremities (~90% body surface area) in the bag, support head and airway out of the bag.	0.04
Water spray/mister or high-powered fan with water spray: Patient should be placed supine on a cot or table. As much of the body surface should be exposed (<i>i.e.</i> , remove clothes and shoes) to the fan and mist as possible.	0.03 to 0.17

Exertional Heat Stroke is an emergency! Immediate emergency care is needed.



*-Initial temperature ≤ 105°F or unknown may still represent heat stroke. Treat for heat stroke if clinical history is consistent with diagnosis

Figure 6: Algorithm for the management of heat-related illness by healthcare providers. Reference: Gauer R, Meyers BK. Heat-Related Illnesses. Am Fam Physician. 2019 Apr 15;99(8):482-489. PMID: 30990296.

By understanding heat risks and implementing safety measures, farm workers, older adults, people at-risk can prepare to protect themselves from the dangers of extreme heat. Stay informed, stay hydrated, and stay cool to ensure safety during hot weather conditions. Scan the QR codes to follow UCCE Community Nutrition and Health Program or follow these links <https://t.ly/olderadult.ucce>, <https://t.ly/StayingSafeInExtremeHeat> for more information and updates.



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