HYPERTHERMIA



HYPERTHERMIA

- **Increase in core temperature above the normal physiologic setpoint > 40 °C**
- **United States averaged 700+ deaths annually associated with excessive heat exposure**
- **Acute heat surge caused 600 deaths in Washington and Oregon during a single week in 2021**



Eifling KP, Gaudio FG, Dumke C, et al. Wilderness Medical Society Clinical Practice Guidelines for the Prevention and Treatment of Heat Illness: 2024 Update. Wilderness & Environmental Medicine. 2024;35(1_suppl):112S-127S. doi:10.1177/10806032241227924

Condition	Definition
Hyperthermia	A rise in body temperature above the hypothalamic set point when heat-dissipating mechanisms are impaired (by clothing or insulation, drugs or disease) or overwhelmed by external (environmental) or internal (metabolic) heat production.
Heat edema	Dependent extremity swelling due to interstitial fluid pooling.
Heat cramps	Exercise-associated painful involuntary muscle contractions during or immediately after exercise.
Heat syncope	Transient loss of consciousness with spontaneous return to normal mentation.
Heat exhaustion	Mild-to-moderate heat illness due to exposure to high environmental heat or strenuous physical exercise; signs and symptoms include intense thirst, weakness, discomfort, anxiety, dizziness, syncope; core-temperature may be normal or slightly elevated >37 °C (98.6°F) but < 40 °C (104°F).
Heat stroke	Severe heat illness characterized by a core temperature >40 °C (104°F) and central nervous system abnormalities, such as altered mental status (encephalopathy), seizure, or coma resulting from passive exposure to environmental heat (classic heat stroke) or strenuous exercise (exertional heat stroke).

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PATHOPHYSIOLOGY

- **Rise in blood temperature —> hypothalamic regulation:**
  - **Increased blood flow to skin (facilitates heat loss)**
  - **Decreased central blood flow (renal/spanchnic perfusion decreases by ~30%)**
- **Elevated environmental temperature and/or clothing can impair body's ability to dissipate heat**
- **When metabolic heat production > heat dissipation, core temperature rises and heat illness can occur**

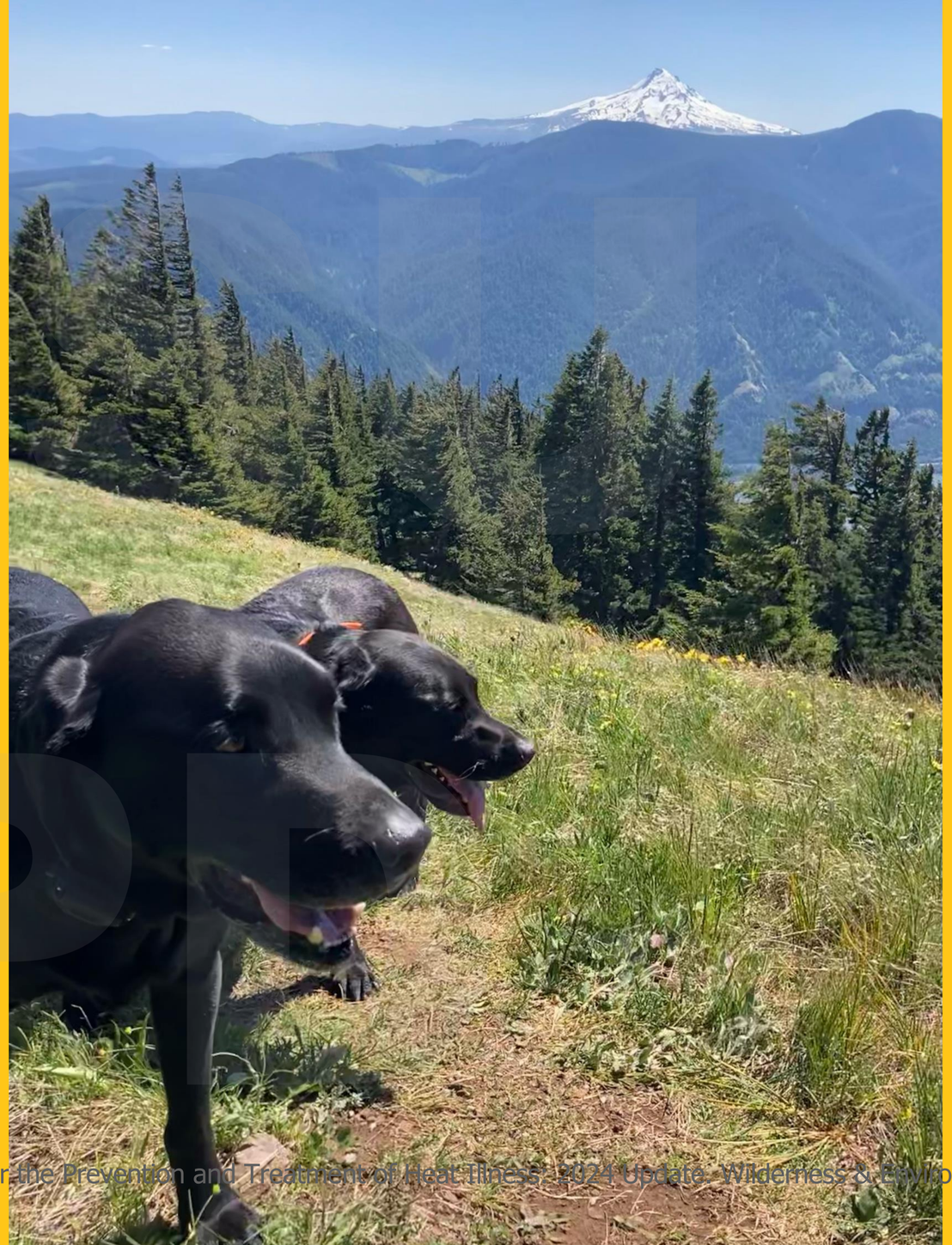


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PREVENTION

- **Acclimatization**
  - **As few as three 90 min exposures within 1 week can reduce physiologic strain ~20%**
  - **Benefits of acclimatization are 75-80% complete after 7 days of moderate exertion in heat**
- **Hydration**
  - **Dehydration increases physiologic strain, decreases sweat rates, increases perceived exertion, and increases core temperatures**



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HYPERTHERMIA

ENVIRONMENT

- **Higher temps impair body's ability to lose heat via conductive/convective/radiative processes**
  - **Leaves evaporation as the only potential cooling mechanism**
  - **Evaporative cooling less effective in high humidity**

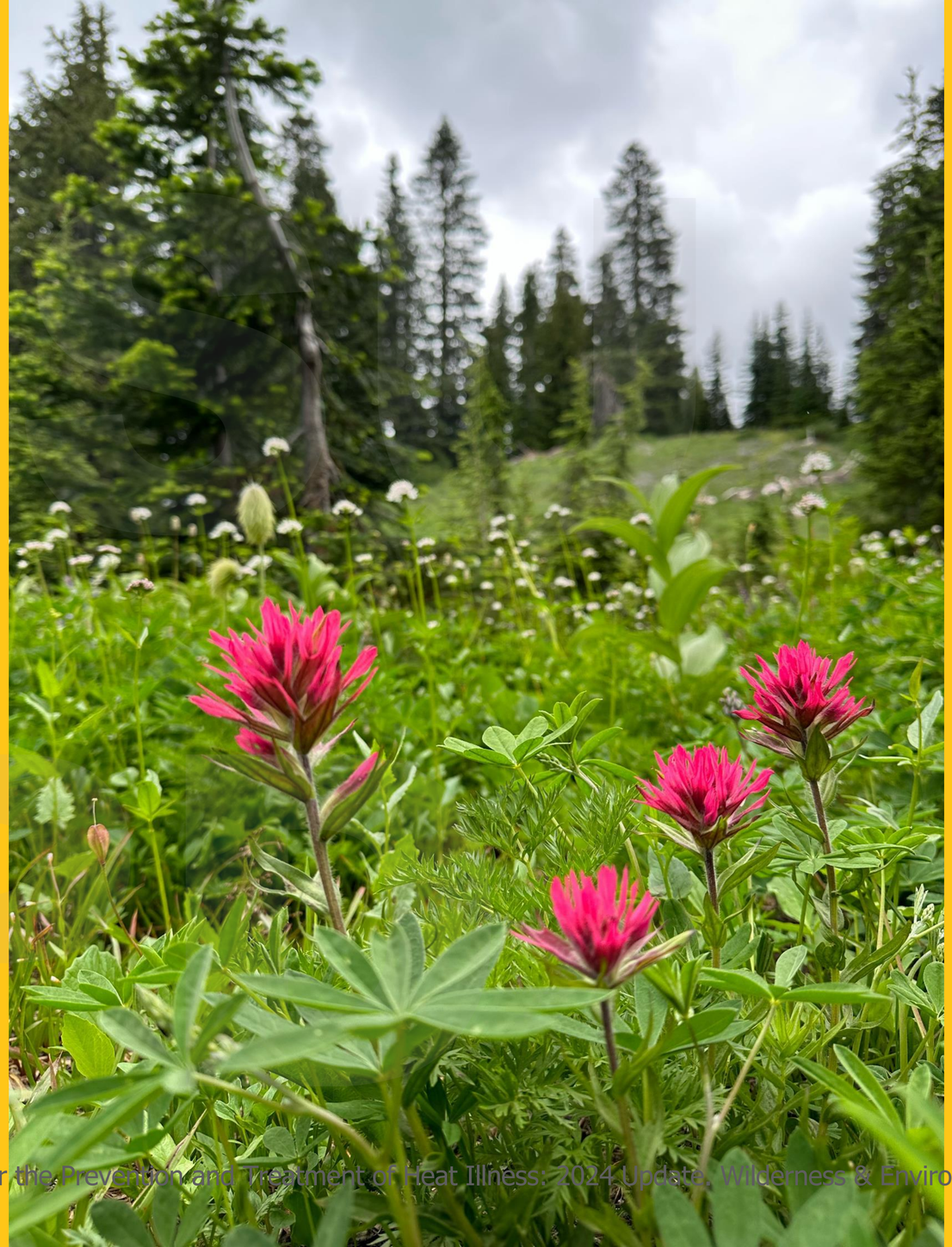


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FIELD TREATMENT

- **Morbidity is directly related to degree and duration of hyperthermia**
  - **Critical to remove patients from heat and provide rapid cooling**
- **If no life-threatening complications exist, on-scene cooling is potentially life-saving and should be immediately implemented prior to evacuation if logistically possible**



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Table 3. Heat illness treatments.

Severity of heat-related illness	Diagnosis	Treatment
Mild	Heat cramps	Oral isotonic or hypertonic fluid replacement
	Heat edema	Extremity elevation Compression stockings
Moderate	Heat syncope	Remove from heat source Passive cooling Oral hydration with isotonic or hypertonic fluids
	Heat exhaustion	Remove from heat source Evaporative, convective, or conductive cooling Oral hydration with isotonic or hypertonic fluids or intravenous hydration with isotonic fluids[a]
Severe	Heat stroke	Remove from heat source Supportive care of airway, breathing, and circulation Ice-water (preferred) or cold water immersion Whole body conductive cooling Intravenous hydration[a] Evacuation[b]

[a] Intravenous hydration with isotonic fluids (0.9% saline or lactated Ringer's), with 3% saline indicated if concern for exercise-associated hyponatremia as cause of encephalopathy.

[b] Initiate EMS if unable to rapidly cool patient, prolonged encephalopathy, or concern of multiorgan dysfunction.

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HYPERTHERMIA

TREATMENT

- **Heat syncope:**
  - **Self-limiting**
  - **Rest in a cool environment, hydration**
- **Heat exhaustion**
  - **Mild cases generally resolved by removing from hot environment, cessation of physical activity, and rehydration**
  - **Severe heat exhaustion typically has more pronounced volume depletion that may require IV replacement of fluids as well as conductive and convective cooling**



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TREATMENT

- **Passive Cooling**
  - **Decrease radiative heat and ambient temp: move to the shade**
  - **Decrease conductive heat from the ground: move to cool ground or use insulating barrier**
  - **Increase convective heat exchange: loosen/remove tight fitting clothing to increase air circulation**



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TREATMENT

- Hydration
  - Dehydration predisposes to hyperthermia by decreasing sweat rates
  - Goal: euhydration, IV/PO hydration equally effective
  - Caution: symptomatic exercise-associate hyponatremia (EAH) has similar presentation to heat exhaustion/stroke
    - EAH treatment is fluid restriction and/or hypertonic saline. Giving hypotonic fluids can worsen EAH



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TREATMENT

- **Heat stroke: Cold Water Immersion Therapy**
  - **Optimal field treatment to achieve rapid temperature reduction**
  - **Convective method of cooling**
  - **Remove insulating clothing/equipment and submerse patient's trunk and extremities in bath of ice water (or coldest water available)**
  - **In the field, natural body of water such as a stream, pond, river, or lake**
    - **Protect against currents, submersion**



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TREATMENT

- **Evaporative Cooling**
  - **If immersion/conductive cooling not available**
  - **Loosen/remove clothing and douse patient with cold water, wetting as much skin surface area as possible to make use of evaporative cooling. Facilitate convection with fanning**



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EVACUATION

- **Ample precedent for definitive treatment in field medical stations without the need for hospital transfer**
  - **In a large civilian case series, 100s of athletes with EHS at an annual road race treated on-site in medical tents and discharged home**
  - **Treatment: immediate cooling in prepared tubs with ice-water slurry and a period of observation before discharge**



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HYPOTHERMIA RE-CAP

- **Look for clinical signs: +/- shivering, level of alertness, movement/coordination**
- **No shivering means no heat generation: give ‘em heat!**
- **Resuscitate attempt despite initial temperature**

HYPERTHERMIA RE-CAP

- **As temperature/humidity increase, our ability to lose heat via evaporation decreases**
- **Hydrate, but don’t over-do it**
- **Cool ASAP, even in the field!**
- **Cold water/ice water immersion can be life saving**