

Health Risks of Extreme Heat

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Plan for today

- Define **what is “extreme heat”** from a medical standpoint
- Explore **what constitutes a “vulnerable patient”** or population of patients
- Learn about the human **body’s response to heat** and the ways in which failures of these mechanisms can lead to illness and death
- Review **treatments for heat related illness**



Financial Disclosures/COI

- No financial COIs to report
- Non-financial interests of note
 - Represent the American Thoracic Society at the American Medical Association
 - Represent Suffolk County, MA physicians at the Massachusetts Medical Society
- Income unrelated to this topic (past 36 months)
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What temperature is dangerous to health?

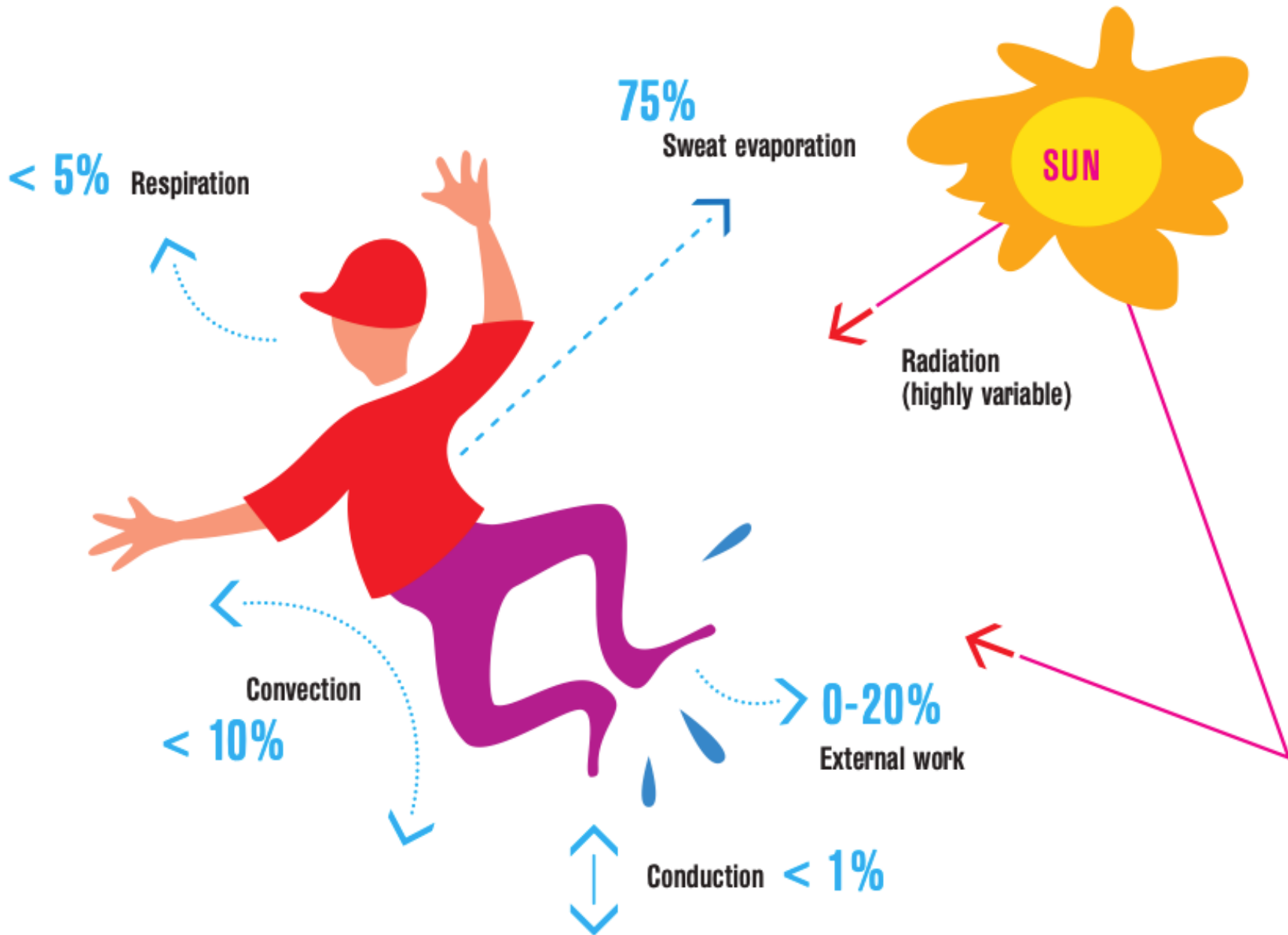
- A highly satisfying answer: **IT DEPENDS**
 - It depends on patients' **underlying medical status and medications**
 - It depends on **other atmospheric conditions** like humidity and pollutants
 - It depends on **ability to hydrate**
 - It depends on **ability to rest and cool off**
- Many of these factors will be **highly influenced by the typical outdoor temperature** for a given region in a given season
- The best measure of “temperature” as it relates to the human body is the **wet bulb globe temperature**



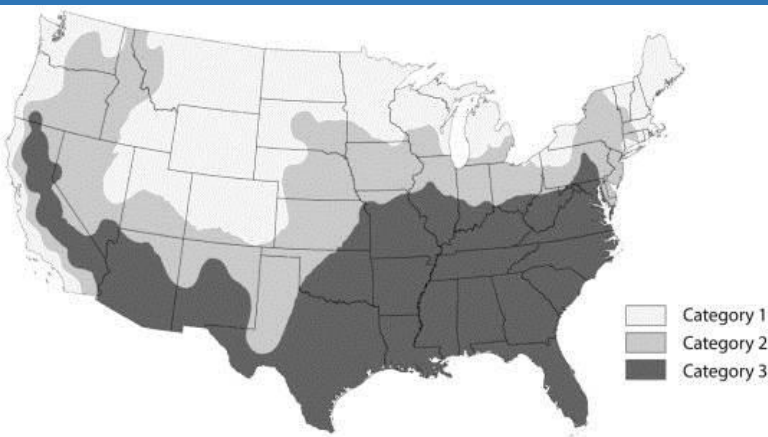
Wet-bulb globe temperature

- Better than simple temperature measurements or heat index since it **accounts for all major environmental factors that impact body temperature**
- Combined measure of:
 - **Air temperature**
 - **Humidity**
 - **Radiant heat** (e.g. sun, furnaces, surfaces, etc.)
 - **Air movement** (e.g. wind, ventilation)





Source: adapted from Havenith (2003).



WBGT by Region (F)			Proposed Activity Guidelines
Cat 1	Cat 2	Cat 3	
<72.3	<75.9	<78.3	Normal activities, monitor fluids
72.3-76.1	75.9-78.7	78.3-82.0	Normal activities, monitor fluids
76.2-80.1	78.8-83.7	82.1-86.0	Plan intense or prolonged exercise with discretion
80.1-84.0	83.8-87.6	86.1-90.0	Limit intense exercise and total daily exposure to heat and humidity
>84.0	>87.6	>90.0	Cancel exercise

University of Georgia Guidelines, based on regions. Grundstein, Andrew & Williams, Castle & Phan, Minh & Cooper, Earl. (2015). Regional heat safety thresholds for athletics in the contiguous United States. Applied Geography. 56. 55-60. 10.1016/j.apgeog.2014.10.014.



Work/Rest and Water Consumption Table

Applies to average sized, heat-acclimated Soldier wearing ACU, hot weather. (See TB MED 507 for further guidance.)

Easy Work	Moderate Work	Hard Work
<ul style="list-style-type: none"> • Weapon Maintenance • Walking Hard Surface at 2.5 mph, < 30 lb Load • Marksmanship Training • Drill and Ceremony • Manual of Arms 	<ul style="list-style-type: none"> • Walking Loose Sand at 2.5 mph, No Load • Walking Hard Surface at 3.5 mph, < 40 lb Load • Calisthenics • Patrolling • Individual Movement Techniques, i.e., Low Crawl or High Crawl • Defensive Position Construction 	<ul style="list-style-type: none"> • Walking Hard Surface at 3.5 mph, ≥ 40 lb Load • Walking Loose Sand at 2.5 mph with Load • Field Assaults

- The work/rest times and fluid replacement volumes will sustain performance and hydration for at least 4 hrs of work in the specified heat category. Fluid needs can vary based on individual differences ($\pm \frac{1}{4}$ qt/hr) and exposure to full sun or full shade ($\pm \frac{1}{4}$ qt/hr).

- **NL** = no limit to work time per hr.
- **Rest** = minimal physical activity (sitting or standing) accomplished in shade if possible.

- **CAUTION: Hourly fluid intake should not exceed 1½ qts.**

Daily fluid intake should not exceed 12 qts.

- If wearing body armor, add 5°F to WBGT index in humid climates.

- If doing Easy Work and wearing NBC (MOPP 4) clothing, add 10°F to WBGT index.

- If doing Moderate or Hard Work and wearing NBC (MOPP 4) clothing, add 20°F to WBGT index.

Heat Category	WBGT Index, F°	Easy Work		Moderate Work		Hard Work	
		Work/Rest (min)	Water Intake (qt/hr)	Work/Rest (min)	Water Intake (qt/hr)	Work/Rest (min)	Water Intake (qt/hr)
1	78° - 81.9°	NL	$\frac{1}{2}$	NL	$\frac{3}{4}$	40/20 min	$\frac{3}{4}$
2 (green)	82° - 84.9°	NL	$\frac{1}{2}$	50/10 min	$\frac{3}{4}$	30/30 min	1
3 (yellow)	85° - 87.9°	NL	$\frac{3}{4}$	40/20 min	$\frac{3}{4}$	30/30 min	1
4 (red)	88° - 89.9°	NL	$\frac{3}{4}$	30/30 min	$\frac{3}{4}$	20/40 min	1
5 (black)	> 90°	50/10 min	1	20/40 min	1	10/50 min	1

For additional copies, contact: U.S. Army Public Health Command Health Information Operations Division at (800) 222-9698 or USAPHC - Health Information Operations@epg.amedd.army.mil. For electronic versions, see <http://chppm-www.apgea.army.mil/heat>. Distribution unlimited. Local reproduction is authorized. CP-033-0811



WBGT	Non-acclimatized, unfit or high risk individuals	Acclimatized, fit, low-risk individuals
65.1-72.0	Increase the rest:work ratio. Monitor fluid intake	Normal activity
72.1-78.0	Increase the rest:work ratio. Decrease total duration of activity	Monitor fluid intake
78.1-82.0	Decrease intensity and total duration of activity	Monitor fluid intake
82.1-86.0	Increase the rest:work ratio to 1:1. Limit intense exercise. Watch at-risk individuals carefully	Plan intense for prolonged activity with discretion. Watch at-risk individuals carefully
86.1-90.0	Cancel or stop practice and competition	Limit intense exercise and total exposure to heat and humidity. Watch for early signs/symptoms of heat stress
>90.0	Cancel exercise	Cancel exercise. Heat stress exists for all athletes

American College of Sports Medicine (ACSM) guidelines for training or non-continuous activities.

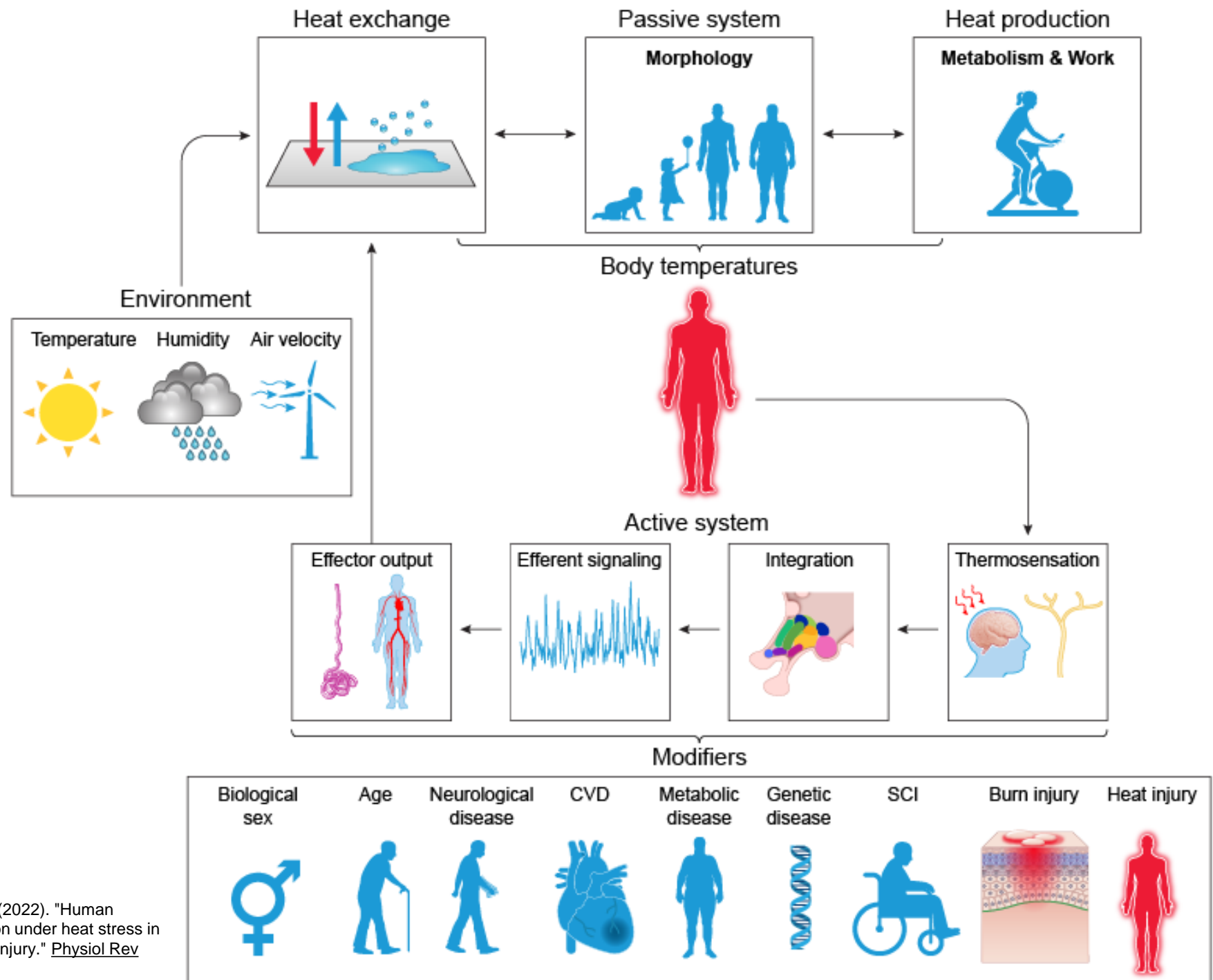


Who is “vulnerable”?

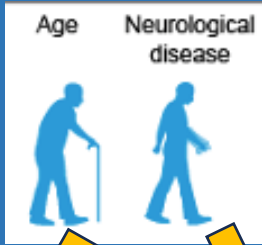
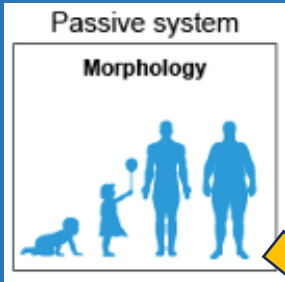
- Everyone
- The real questions:
 - **Who is *most* vulnerable?**
 - **Who needs special preparation?**
 - **Who would benefit from *proactive* interventions?**
 - **Who might struggle with *reactive* interventions?**



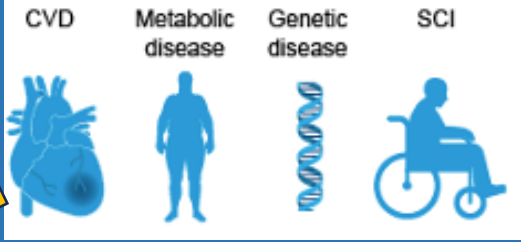




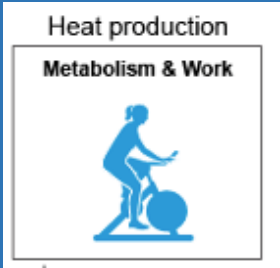
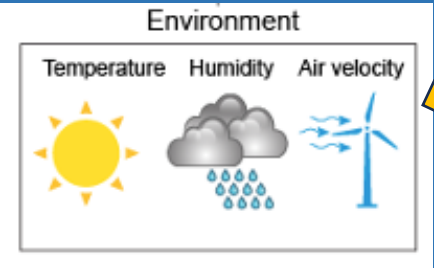
Cramer, M. N., et al. (2022). "Human temperature regulation under heat stress in health, disease, and injury." *Physiol Rev* 102(4): 1907-1989.

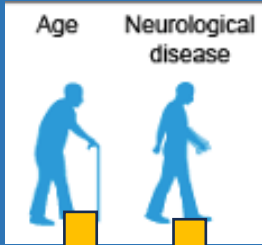
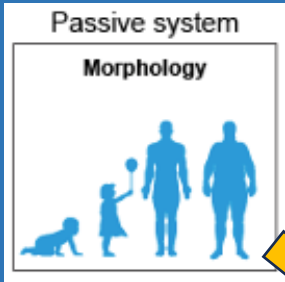


- Cognitive issues
- Age-related changes in sweating

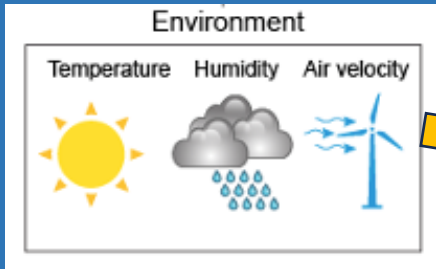


- Heart disease/fluids
- Obesity
- Composition of sweat
- Ability to sweat
- Medications





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Indirect Impacts

Direct Impacts

Impact on health services

- Increased ambulance call-outs and slower response times
- Heat cramps
- Response times
- Increased number of hospital admissions
- Storage of medicines



Increased risk of accidents

- Drowning
- Work-related accidents
- Injuries and poisonings



Increased transmission of

- Food and waterborne diseases
- Marine algal blooms



Potential disruption of infrastructure:

- Power
- Water
- Transport
- Productivity



Health Impacts of Exposure to Extreme heat



Heat illness

- Dehydration
- Heat cramps
- Heat stroke



Accelerated death from:

- Respiratory disease
- Cardiovascular disease
- Other chronic disease (mental health, renal disease)



Hospitalization

- Respiratory disease
- Diabetes mellitus
- Renal disease
- Stroke
- Mental health conditions



Basics of avoiding heat-related health issues

- **Stay away from heat**

- Go inside; if home/workplace is not cool, spend at least several hours somewhere cool (e.g. air conditioned public building)
- If outside, avoid mid-day heat/sun
- Seek shade
- Careful in cars—especially children

- **Keep living space cool**

- Air conditioning—one room better than none
- Window shades
- Fans may help less than you think

- **Avoid strenuous activity** (YMMV)



Basics of avoiding heat-related health issues

- **Cool the body**

- Cool showers, cool baths, sponging, cold packs
- Light, loose-fitting, clothing and hats
- Light linens/sheets

- **Stay hydrated**

- Drink water, yes, but food is also important for electrolytes and energy
- Avoid alcohol
- Avoid caffeine

- **Seek necessary support**

- Vulnerable people may need assistance with tasks they normally don't need
- Those living alone should have someone to check in with
- Seek medical advice around medications—**psychiatric medications in particular**
- Learn signs and symptoms of heat related problems, ideally individualized by their doctor



HEAT-RELATED ILLNESSES

WHAT TO LOOK FOR

WHAT TO DO

HEAT STROKE

- High body temperature (103°F or higher)
- Hot, red, dry, or damp skin
- Fast, strong pulse
- Headache
- Dizziness
- Nausea
- Confusion
- Losing consciousness (passing out)

- Call 911 right away-heat stroke is a medical emergency
- Move the person to a cooler place
- Help lower the person's temperature with cool cloths or a cool bath
- Do not give the person anything to drink

HEAT EXHAUSTION

- Heavy sweating
- Cold, pale, and clammy skin
- Fast, weak pulse
- Nausea or vomiting
- Muscle cramps
- Tiredness or weakness
- Dizziness
- Headache
- Fainting (passing out)

- Move to a cool place
- Loosen your clothes
- Put cool, wet cloths on your body or take a cool bath
- Sip water

Get medical help right away if:

- You are throwing up
- Your symptoms get worse
- Your symptoms last longer than 1 hour

HEAT CRAMPS

- Heavy sweating during intense exercise
 - Muscle pain or spasms
 - Stop physical activity and move to a cool place
 - Drink water or a sports drink
 - Wait for cramps to go away before you do any more physical activity
- Get medical help right away if:**
- Cramps last longer than 1 hour
 - You're on a low-sodium diet
 - You have heart problems

SUNBURN

- Painful, red, and warm skin
- Blisters on the skin
- Stay out of the sun until your sunburn heals
- Put cool cloths on sunburned areas or take a cool bath
- Put moisturizing lotion on sunburned areas
- Do not break blisters

HEAT RASH

- Red clusters of small blisters that look like pimples on the skin (usually on the neck, chest, groin, or in elbow creases)
- Stay in a cool, dry place
- Keep the rash dry
- Use powder (like baby powder) to soothe the rash



How do we intervene?

- **Address underlying issues**
 - Climate change
 - Infrastructure
 - Social determinants & costs of staying cool
- **Promote awareness with education**
- **Make it easy to stay cool when needed**
 - Bring food and water to those who need it
 - Help cool the home
 - Cooling centers, splash pads, pools (with caution)
 - Clothing
 - Check ins (friend, family, neighbor, health care workers, others)



BEAT THE HEAT: Extreme Heat

Heat-related deaths are preventable

WHAT: Extreme heat or heat waves occur when the temperature reaches extremely high levels or when the combination of heat and humidity causes the air to become oppressive.

WHO: More males than females are affected. Children, Older adults, Outside workers, People with disabilities.

WHERE: Houses with little to no AC, Construction workites, Cars.

HOW to AVOID: Stay hydrated with water, Stay cool in an air conditioned area, Wear lightweight, light-colored, loose-fitting clothes.

During extreme heat the temperature in your car could be deadly!

Outside Temperature 80°	Inside 109°	Inside 118°	Inside 123°
	Time Elapsed: 20 minutes	Time Elapsed: 40 minutes	Time Elapsed: 60 minutes

HEAT ALERTS: Know the difference.

HEAT OUTLOOK	HEAT WATCHES	HEAT WARNING/ADVISORY
Minor: Excessive heat event in 3 to 7 days	Excessive heat event in 12 to 48 hours	Excessive heat event in next 36 hours

DID YOU KNOW?

Those living in urban areas may be at a greater risk from the effects of a prolonged heat wave than those living in rural areas.

Most heat-related illnesses occur because of overexposure to heat or over-exercising.

Sunburn can significantly slow the skin's ability to release excess heat.

During 1999–2009, an average of 658 people died each year from heat in the United States.

\$30 BILLION estimated total cost of the 2012 US drought and heatwave.



Questions/Comments/Discussion

