Pregnant people and children – Implications for clinical practice

Katie Huffling, DNP, RN, CNM, FAAN
Executive Director,
Alliance of Nurses for Healthy Environments
Acknowledgments:

- Yuval Baharav
- Lilly Nichols
- Anya Wahal
- Owen Gow
- Kurt Shickman
- Maya Edwards
- Adrienne Arsht-Rockefeller Foundation Resilience Center

The scope of the problem

By 2070, without migration, 1 in 3 people around the world will be living with mean average temperatures of ≥ 29.0 °C (84.2 °F)

Xu C et al. Future of the human climate niche. PNAS.
Heat is an environmental justice issue
Pregnancy is a time of increased susceptibility to heat.
Obstetric complications

- Gestational hypertension, preeclampsia, & eclampsia
- Cardiovascular events
- Placental abruption
- Preterm birth
- Early pregnancy loss
# Neonatal complications

<table>
<thead>
<tr>
<th>Complication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fetal distress</td>
</tr>
<tr>
<td>Meconium aspiration</td>
</tr>
<tr>
<td>Neonatal ventilator use</td>
</tr>
<tr>
<td>Fetal growth restriction and low birth weight</td>
</tr>
<tr>
<td>Congenital heart disease</td>
</tr>
<tr>
<td>Sudden infant death syndrome</td>
</tr>
</tbody>
</table>
Children are not little adults

- Lungs are still developing.
  - Breathing zone is closer to the floor
  - Breathe more rapidly (exposed to more pollutants per body weight)
- Brain & central nervous system continues to develop
- Immune and reproductive systems still developing
- Gastrointestinal: greater absorption of some toxicants (lead).
- Have more trouble regulating temperature
- Children have little control over their environments – rely on adults
Heat risk factors in children

- Chronic diseases
- Medications
- Reduced ability to communicate needs

Photo by Andrew Seaman on Unsplash
Heat impacts in children

- Dehydration
- Fever
- Heat exhaustion
- Heat stroke
- Exertional heatstroke

Photo by Nicole Green on Unsplash
Risk factors for exertional heatstroke

- Hot and/or humid weather
- Excessive physical exertion
- Lack of access to fluids
- Multiple day sessions
- Overweight or obese
- Chronic disease
- Medication
- Current or recent illness
- Clothing or uniform

Adapted from Pediatric Environmental Health 4th Edition
Recommendations to reduce risk of exertional heat stroke

- Regular consumption of fluids
- Gradual adaptation to climate
- Modification of activity
- Rest/recovery time
- Avoid or limit participation if ill
- Monitor for s/sx of heat illness
- Training to respond to heat illness

Adapted from Pediatric Environmental Health 4th Edition
Recommendations for pregnant patients & families

- Heat wave alerts
- Drink extra water
- Guidance for cooling home if no A/C
- Signs and symptoms of preterm labor
- Over 42 °C (107.6 °F), avoid using a fan.
- Provide guidance for patients that work outdoors
- Emergency plan for school activities
- Cooling centers
- Avoid heavy exercise during peak hours
- Do not leave children unattended in vehicles
Resources for providers

• The Climate Resilience for Frontline Clinics Toolkit https://www.americares.org/what-we-do/community-health/climate-resilient-health-clinics/
• Global Heat Health Information Network https://ghhin.org/
• National Integrated Heat Health Information System https://www.heat.gov/
• Local health department guidance
Thank you!
Katie Huffling
240.753.3729
katie@enviRN.org
www.enviRN.org
Impact of Heat on Outdoor Workers

MANIJEH BERENJI MD MPH FACOEM
CHIEF, OCCUPATIONAL HEALTH, VA LONG BEACH HEALTHCARE SYSTEM
CLINICAL ASSISTANT PROFESSOR, UC IRVINE SCHOOL OF MEDICINE AND PROGRAM IN PUBLIC HEALTH
Disclosures

- None pertaining to the topic of this talk
The Population: Outdoor Workers
Outdoor Workers

- Among the occupations with the most outdoor exposure are cement masons and concrete finishers, construction laborers, firefighters, highway maintenance workers, landscaping and groundskeeping workers, and roofers.
- 32.9 percent of workers in 2022 were exposed to the outdoors as a regular part of their job.

Heat Hazard Risks to Outdoor Workers

- Extent of heat exposure depends on the heat index, duration of time outside, type of work, degree of physical exertion.
- Workers at greater risk of heat stress include those who are 65 years of age or older, are overweight, have heart disease or high blood pressure, or take medications that may be affected by extreme heat.
- Black/African American and Hispanic/Latino workers are disproportionately represented in many outdoor occupations.

https://www.cdc.gov/niosh/topics/heatstress/default.html#text=Workers%20who%20are%20exposed%20to%20heat%20cramps%2C%20or%20heat%20rashes.
Objective: Estimate the association between environmental temperature (wet bulb globe temperature [WBGT]) and work rate over the course of a workday.

Methods: Repeated-measures regression was used to identify characteristics impacting work rate in a cross-sectional study of Latino farmworkers. Minute-by-minute work rate (measured by accelerometer) and WBGT were averaged over 15-minute intervals. Results: Work rate decreased by 4.34 (95% confidence interval [CI], −7.09 to −1.59) counts per minute per degree Celsius WBGT in the previous 15-minute interval. Cumulative quarter hours worked (2.13; 95% CI, 0.82 to 3.45), age (−3.64; 95% CI, −4.50 to −2.79), and dehydration at the end of the workday (51.37; 95% CI, 19.24 to 83.50) were associated with counts per minute as were gender, pay type (piece rate vs hourly) and body mass index ≥25 kg/m². The effects of pay type and body mass index were modified by gender. Conclusion: Increased temperature was associated with a decrease in work rate.

Keywords: environmental temperature, farmworkers, heat illness, work rate

Farmworkers are at a high risk of heat-related illness (HRI), particularly as their peak work season, which includes strenuous bouts of outdoor labor, corresponds to high summer temperatures. In an analysis of California Workers’ Compensation claims during 2000 to 2017, the industry sector “Agriculture, Farming, Fishing, and Forestry” had the highest rate of HRI. In addition, the crop production industry was identified as a high-priority industry for intervention, with 41.1 claims per 100,000 workers. An analysis of nationwide heat-related mortality cases reported to the US Bureau of Labor Statistics 2000 to 2010 found that the agricultural industry had the highest HRI mortality rate. Between 2005 and 2021, 32% of the 502 fatal and catastrophic heat cases in California were among workers in the Agriculture, Forestry, Fishing, and Hunting industry. Of these cases, 94% were farmworkers. However, these are likely to represent a significant undercount of the true number of HRI cases and mortalities, especially in industries such as agriculture where workers are less likely to be aware of their right to compensation or less willing to report injury and illness. In addition to HRI morbidity and mortality, heat exposure is associated with increased injuries and acute kidney injury among farmworkers.

Farmworkers’ exposure to high temperatures will intensify as a result of global climate change. The temperature in California is projected to increase between 5.6°F and 8.8°F by the end of the century, with the annual temperatures having already increased by greater than 1°F across most of the state. In addition to increasing the risk for HRI, agricultural

LEARNING OUTCOMES

1. Outline the importance of farmworkers’ risk of heat-related illness.
2. Summarize the factors associated with changes in work rate.

https://journals.lww.com/joem/fulltext/2023/07000/how_does_environmental_temperature_affect.17.aspx
Too Hot to Work

Assessing the Threats Climate Change Poses to Outdoor Workers

The COVID-19 pandemic underscored weaknesses and stark variations in the protections available to workers in the United States. Across the nation, millions of people lost their jobs or were furloughed; their financial present and futures suddenly cast into doubt. And while those in some types of jobs could reduce their exposure to COVID-19 by working from home, workers in many outdoor occupations were deemed essential. In planting and harvesting food to fill our plates, responding to community emergencies, caring for our roads and rails, and delivering supplies that shuttered stores could not provide, they risked infection, illness, and even death—their own, or their families’—as they performed their daily work.

Yet the novel coronavirus is only the latest addition to a long list of on-the-job hazards confronting outdoor workers. Each summer, the roughly 32 million outdoor workers across the United States—from construction workers to farmworkers to emergency responders—regularly face a brutal choice: risk their health by enduring dangerous exposure to heat or risk their jobs by staying home.
Prevention Strategies
Prevention of Occupational Heat-Related Illnesses

High ambient temperatures and strenuous physical activity put workers at risk for a variety of heat-related illnesses and injuries. Through primary prevention, secondary prevention, and treatment, OEM health providers can protect workers from the adverse effects of heat. This statement by the American College of Occupational and Environmental Medicine provides guidance for OEM providers who serve workers and employers in industries where heat exposure occurs.

Therefore, it is likely that US workers will be at risk of HRIs more often and in more parts of the country. Therefore, it is likely that US workers will be at risk of HRIs more often and in more parts of the country.9

Through primary prevention, secondary prevention, and treatment, occupational and environmental medicine (OEM) health care providers can protect workers from the adverse effects of heat. This statement by the American College of Occupational and Environmental Medicine (ACOEM) contains guidance for OEM providers who serve workers and employers in industries where heat exposure occurs. Table 1 provides a brief overview of the recommendations. More details are contained in the following sections. A prior ACOEM guidance statement about climate change contained general heat-related recommendations50; reviewing that article will be of benefit in understanding this document.

Description of Occupational Heat-Related Illnesses

1. Heatstroke is a medical emergency that can cause death if not treated promptly. It is characterized by high body temperature, decreased sweating, and altered mental status. Prevention includes shade, hydration, and acclimatization.

2. Heat exhaustion is a milder condition that results from excessive heat exposure. Symptoms include dizziness, headache, nausea, and fatigue. Prevention includes gradual increase in activity and adequate hydration.

3. Heat cramps are muscle spasms or pain following physical activity in hot environments. Heat cramps often affect the muscles of workers’ legs, upper extremities, back, or abdomen.

4. Heat syncope is an episode of orthostatic fainting due to transient reduction of cerebral blood flow during heat exposure. Heat-related changes in vascular resistance and blood distribution can cause the pooling of blood in the lower extremities, leading to syncope.
Outcomes for a Heat Illness Prevention Program in Outdoor Workers: A Nine-Year Overview

Perkison, William B. MD, MPH¹; Schaefer, Caroline M. MPH²; Roy, Rachel White MPH, PhD¹; Green-McKenzie, Judith MD, MPH³; Shofer, Frances PhD⁴; McCarthy, Ronda B. MD, MPH⁵

Author Information


Abstract

https://journals.lww.com/joem/abstract/9900/outcomes_for_a_heat_illness_prevention_program_in.487.aspx
Heat Illness Prevention

Every year, dozens of workers die and thousands more become ill while working in hot or humid conditions. OSHA’s Heat Illness Prevention campaign educates employers and workers on heat hazards and provides resources to keep workers safe.

Employer Responsibilities
Employers can keep workers safe in the heat. Learn More

Information for Workers
Understand workers’ rights and what workers should know about heat illness. Learn More

More Resources on Heat
Heat illness is serious, but you can prevent it. Learn More
Policy Solutions
FACT SHEET: Biden Administration Mobilizes to Protect Workers and Communities from Extreme Heat

SEPTEMBER 20, 2021

New Initiatives at OSHA and Across Agencies Will Enhance Workplace Safety, Build Local Resilience, and Address Disproportionate Heat Impacts

Today, President Biden is launching a coordinated, interagency effort to respond to extreme heat that threatens the lives and livelihoods of
Secretary Walsh joins Vice President Kamala Harris to announce first ever national emphasis program to protect workers from indoor and outdoor heat hazards

WASHINGTON – For the first time, the U.S. Department of Labor’s Occupational Safety and Health Administration has launched a National Emphasis Program to protect millions of workers from heat illness and injuries. Through the program, OSHA will conduct heat-related workplace inspections before workers suffer completely preventable injuries, illnesses or, even worse, fatalities.

Secretary Marty Walsh today joined Vice President Kamala Harris at the Sheet Metal Workers Local 19 Training Center in Philadelphia to announce the new enforcement program.

Heat illness affects thousands of indoor and outdoor workers each year and can tragically lead to death. Reducing workplace heat-related illnesses and injuries is a top priority for the Department of Labor, and this National Emphasis Program is a way to immediately improve enforcement and compliance efforts, while continuing long-term work to establish a heat illness prevention rule. These efforts are part of a larger, interagency Biden-Harris administration effort to protect workers and communities from extreme heat and rising temperatures resulting from climate change.

“Tragically, the three-year average of workplace deaths caused by heat has doubled since the early 1990s. These extreme heat hazards aren’t limited to outdoor occupations, the seasons or geography. From farm workers in California to construction workers in Texas and warehouse workers in Pennsylvania, heat illness – exacerbated by our
An Open Call For Policy Ideas To Tackle The Extreme Heat Crisis

08.14.23 | 5 MIN READ
Summation

- The evidence is conclusive: extreme heat does impact outdoor workers
- Only a handful of states have a heat standard that protects outdoor workers; no federal heat standard right now
- Heat illness prevention programs do work but not uniformly applied
- Need additional data infrastructure to develop early warning systems that are fully integrated (healthcare systems, public health, emergency response, local/regional governments, employers)
“Too Hot To Work” documentary

The film by Mikael Lefrançois and Camille Robert shows knowledge on the effects of extreme heat on workers. It starts with the law of the sun. Every day, people around the world who work in agriculture, construction and even tourism face - often unprotected - the law of the sun, which forces the body to slow down. As climate change exacerbates heat, workers worldwide will continue to labor without the protections they need to work safely. The film aims to show what happens when workers labor without protection from extreme heat, and which measures are being taken. “Too Hot To Work” takes you around the world on a tour of the current state of labor in extreme heat. The film delves into how a warmer climate may transform the way we work and how workers, businesses and governments have to adapt to this growing risk. The documentary features powerful testimonies from workers across different backgrounds, regions of the world and sectors, including agriculture, construction, delivery package workers, clothing and more.

The trailer can be watched here. For hosting a film screening, you can get in touch with La Isla Network.

See video outside Climate-ADAPT

Thank you!
HEAT AND THE PSYCHIATRIC PATIENT
Robert Feder, M.D.

- Medical Society Consortium on Climate and Health
- APA Committee on Climate Change
- Climate Psychiatry Alliance
- New Hampshire Healthcare Workers for Climate Action
- No Coal No No Gas
SCHIZOPHRENIA
Schizophrenia affects 1% of the population but is associated with 8% of heat-related deaths.
1) Confusion or bizarre ideas related to heat and assistance-seeking
2) Homelessness and poverty (no air conditioning, reduced access to liquids)
3) Schizophrenia impairs hypothalamic heat-regulating mechanisms
4) Antipsychotic medications impair hypothalamic heat-regulating mechanisms
5) Anticholinergic medications impair sweating
“Heat’s Hidden Risk”
Story of Stephen Goodwin
MAJOR
DEPRESSIVE
DISORDER
Emergency Room Visits in New York State

Yoo, et al, 2021
Rising Temperatures and Suicide Rates

- Suicide rates increase by 1-2% for each 1 degree centigrade rise in ambient temp
- Global temp will increase by 8.5 degrees centigrade by 2100 if recent trends continue

Dumont, et al, 2020
ANTIDEPRESSANTS

SSRIs (Prozac, Zoloft, Paxil, Lexapro, etc)
SNRIs (Effexor, Cymbalta)
All can increase sweating, leading to dehydration
TCA’s (Elavil, amitriptyline, imipramine, nortriptyline)
All reduce sweating, leading to increased body temp

ANTIPSYCHOTICS

Vraylar, Abilify, Seroquel, Latuda, Zyprexa
Directly impair hypothalamic heat regulation
BIPOLAR DISORDER
Increased activity in manic state = increased heat production

Antipsychotic medication –
  Impaired hypothalamic temperature regulation

Lithium - Increases dehydration by increasing urination
  Dehydration causes lithium toxicity

Increased suicide risk as temperature increases
DEMENTIA
Mainly an issue for those living at home
Decreased awareness of heat
Decreased hypothalamic regulatory ability
Confusion about what to do about heat
Limited income
    Reduced access to air conditioning
    Reduced access to adequate hydration
ATTENTION-DEFICIT HYPERACTIVITY DISORDER (ADHD)
Increased activity = increased heat production

Stimulants
  a) Impair hypothalamic heat regulation
  b) Reduce ability to sweat via vasoconstriction
  c) Reduce unpleasant sensations of overheating
Substance Use Disorders
Reduced perception of overheating when high

Homelessness and poverty (no air conditioning, reduced access to liquids)

Methamphetamine and MDMA (Ecstasy) directly interfere with hypothalamic temperature control

Alcohol increases dehydration

18% of all heat-related deaths involve drug ODs

MMWR June 19. 2020; 69(24):729-734
What can we do?
Educate each other
Include in resident training
Educate our patients
Community Mental Wellness and Resilience Act

• HR 9201 – Introduced in House 10/18/22 by Rep. Tonko of New York

• S 5251 - Introduced in Senate on 12/14/22 by Sen. Markey of Massachusetts

• Establishes funding through the CDC for community-based programs designed to address mental health issues of the climate crisis
Preparing Vulnerable Populations for 2024 Heat Waves: Medication Management

Hayley Blackburn, PharmD, BC-ADM
Associate Professor of Pharmacy Practice
University of Montana Skaggs School of Pharmacy
Meds & Heat – Why Do We Care?

- Heat affects medication stability
- Heat affects medication pharmacokinetics
- Medications can alter thermoregulation and increase risk of harm
- Medications are a cornerstone of clinical management of vulnerable populations
Heat & Medication Stability

- Study of at-home med storage: 30% were improperly stored according to manufacturers’ labeling acceptable 59-86 °F range

  Real-world studies often indicate acceptable stability at higher temps, but often don’t examine effects of packaging, tablet splitting, humidity, and other common factors

- Products of concern:
  - Refrigerated medications: insulin, biologics, vaccines
  - Emergency medications: epinephrine, naloxone
  - Delivery devices: metered-dose inhalers

- Point-of-care glucose testing: meters and test strips exposed to short term heat/humidity (15 min at 83% RH, 42 °C) resulted in erroneous results up to 33 mg/dL above control values

Heat Effects on Medication Kinetics

Direct: Increased vasodilation and skin perfusion alters transdermal, topical, or subcutaneous drug absorption and distribution

Indirect: Dehydration leading to alterations in drug distribution and elimination

Ambient Temp & Insulin Absorption

Higher ambient temperature was associated with increased hypoglycemia events in national samples of U.S. and Taiwan older adults using insulin.

Heat → cutaneous vasodilation → increased insulin absorption → risk of hypoglycemia

Insulin users: risk of serious hypoglycemic events was $\sim 40\%$ higher on days with a HI $\geq 99$th percentile vs days with HI in 25–74th percentile in both US and Taiwan

Study design: Retrospective, time-stratified, case-crossover study of adults $\geq 65$ years using insulin during summer 2016-2019

Exposure: Heat Index (HI), categorized into percentile categories (HI $\geq 99$, 95-98, 85-94, 75-84, 25-74, <25th %tiles) based on ZI code-level temp. distribution. HI incorporates both relative humidity and absolute temp. A HI of 90, for example, can refer to a temp of 84 F and 70% relative humidity

Outcome: Serious hypoglycemia (based on primary emergency department visit or hospitalization ICD-10 codes)

Patients & providers should be aware that extreme heat may increase risk of hypoglycemia in individuals using insulin

Meds & Thermoregulation


Alterations in central thermoregulation:
- Antipsychotics
- Anticholinergics
- Stimulants

Behavioral thermoregulation

Sedation/cognitive impairment reducing heat avoidance behavior:
- Anticonvulsants
- Opioids
- Alcohol

Impaired sweating:
- Antipsychotics
- Anticholinergics

Impaired vasodilation:
- Stimulants
- Beta-blockers

Central hypovolemia

Decreased splanchnic blood flow

Renal strain
Systemic inflammatory response

Decreased blood pressure

Increased heart rate & contractility

CV strain

Fluid loss & dehydration
Electrolyte abnormalities

Exacerbation of dehydration and electrolyte abnormalities:
- Diuretics
- SGLT2i
- ACEI/ARB
- SSRIs, SNRIs

Autonomic thermoregulation

Peripheral vasodilation

Sweating
## Vulnerable Populations & Medication Use

<table>
<thead>
<tr>
<th>Vulnerable Populations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Older age</td>
</tr>
<tr>
<td>Mental health disorders</td>
</tr>
<tr>
<td>Cardiovascular disease</td>
</tr>
<tr>
<td>Chronic kidney disease</td>
</tr>
<tr>
<td>Diabetes</td>
</tr>
<tr>
<td>Dementia</td>
</tr>
<tr>
<td>Parkinson’s Disease</td>
</tr>
<tr>
<td>Multiple Sclerosis</td>
</tr>
<tr>
<td>Drug use</td>
</tr>
</tbody>
</table>

### References

Medications & Heat-Related Outcomes: Current Evidence

- Increased risk of hospital admission for dehydration or HRI following initiation of anticoagulants, NSAIDs, antipsychotics, antidepressants, CV medications – highest risk with initiation of ACEi + diuretic (approximately 3X increase)\(^1\)

- Increased risk of heat-related hospitalizations in adults >65 years old taking heat-sensitizing medications throughout summer months, even in the absence of exposure to extreme heat event (ACEi, ARB, anticholinergic, antipsychotics, loop diuretic)\(^2\)

- Use of levothyroxine in older adults associated with risk of hyperthermia leading to ED-presentation/hospitalization\(^3\)

- Short-term associations between elevated temps greater than 17 ºC and ED visits for substance use or overdose (amphetamines, cocaine, opioids)\(^4\)

- Use of statins, empiric potassium in patients receiving furosemide ≥40 mg/day may reduce all-cause mortality related to heat exposure\(^5,6\)

---

2. Layton JB. PLoS ONE. 2020
Limitations

● Relatively few well-controlled studies examining relationships between specific medications and heat-related harms in real-world situations:
  Most studies examine entire medication class, not individual drugs
  Most studies do not evaluate medication doses, anticholinergic burden, or drug interactions
  Most studies evaluate morbidity/mortality related to HRI, not other outcomes (e.g., falls)

● Difficult to separate risk associated with medication from risk associated with underlying comorbidity

● Lack of evidence to guide clinical decision-making
Clinical Recommendations\textsuperscript{1-3}

1. Consider medication management with careful risk/benefit analysis in individualized heat action plans.

2. Use the lowest effective dose for the shortest possible duration; consider risk of additive effects across medication classes.

3. If practical, avoid initiation or dose increase of medications known to impact thermoregulation before/during hot weather.

4. Have a proactive, individualized plan to avoid dehydration, especially in those taking diuretics.

References:
# Recommendations for Heat Adaptations: 1-5

## Medication Management

<table>
<thead>
<tr>
<th>Medication review</th>
<th>Evaluation of high-risk medications, polypharmacy, drug interactions, high-risk conditions; integration into preexisting medication review processes, programs, and reimbursement structures (e.g., CMR/TMR, LTC 30-day reviews, Medicare Annual Wellness)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient screening</td>
<td>Alerts in pharmacy systems or EHR for high-risk medications or underlying conditions; screening for risk factors (chronic conditions, environmental, socioeconomic) and adaptive capacity (e.g., access to cooling)</td>
</tr>
<tr>
<td>Patient education</td>
<td>Individualized plans for heat response, hydration, self-monitoring and self-management at strategic time points (prescribing, summer refills, discharge/TOC); medication &amp; medical supply storage</td>
</tr>
<tr>
<td>Patient access</td>
<td>Pharmacies/pharmacists as access points for more regular patient contact</td>
</tr>
<tr>
<td>Interprofessional practice</td>
<td>Pharmacy partnerships for public health planning, referrals for medication review, development of effective clinical response protocols &amp; guidelines</td>
</tr>
</tbody>
</table>

Montana: Case Study

% of Population ≥65 years old and living alone

May-September 2021: # of days >90 ºF
Healthcare Access & Pharmacy Programs
Policy/Systems Change

- Proactive testing requirements for medication stability at elevated temperatures
- Push/pull incentives within existing opportunities for medication review and management that increase attention to heat-related risks
- Funding & research to develop better clinical guidance for medication management during heat events
- Health professions education – accreditation standards and continuing professional education
References

Monthly global temperature compared with preindustrial levels

Source: Copernicus/ECMWF
Global CO2 emissions have grown almost continuously...

...but policy shifts since before Paris could peak CO2 emissions as soon as 2023.

If met, the latest pledges would close the gap to 1.5°C...

...but current pledges remain very far from a 1.5°C path.

Source: IEA World Energy Outlooks
Heat
Key Factors Affecting the Risk of Heat-Related Illness

**Individual Susceptibility**
- Age
- Coexisting conditions
- Pregnancy
- Medications or drugs
- Cognitive impairments
- Disabilities
- Social isolation
- Immobility

**Sociocultural Factors**
- Poverty
- Structural and environmental racism
- Social cohesion
- Housing status
- Literacy
- Limited worker protections

**Heat Exposure**
- Ambient temperature and humidity
- Heat amplification (urban heat islands)
- Occupation (outdoor or indoor without cooling)
- Lack of access to cooling at home
- Indoor heat sources
More Than a Third of Heat Deaths Are Tied to Climate Change, Study Says

Sweeping new research found that 37 percent of heat-related deaths on average during warm seasons were attributable to global warming.
Heat & Human Health

FIGURE 3. How Heat Affects Our Bodies

Head
- headache
- dizziness
- irritability
- loss of coordination
- confusion
- delirium
- anxiety
- loss of consciousness
- seizures
- stroke
- coma

Mouth
- intense thirst
- dry mouth

Heart
- rapid heartbeat
- irregular heartbeat
- reduced bloodflow to the heart
- heart attack

Lungs
- increased breathing rate
- worsened allergies and asthma
- worsened chronic obstructive pulmonary disease

Liver
- liver injury

Kidneys
- kidney disease
- kidney failure

Skin
- flushed and clammy skin
- profuse sweating
- heat rash

Arms and Legs
- heat cramps
- muscle spasms
- weakness

General Physiology and Unique Circumstances

General
- dehydration
- electrolyte imbalance
- fatigue
- nausea
- vomiting
- drop in blood pressure
- fever

Pregnant People
- fetal nutrition deficits
- preterm delivery
- birth
- stillbirth

Union of Concerned Scientists,
Killer Heat in the United States
July 2019
Heat and the elderly

• More than 80% of the 12,000 people in U.S. who die of heat related causes yearly are over 60 (Geohealth, 2020)
• Of the 61,672 heat related deaths during 2022 European heat wave, 90% were people 65 and older (Nature Medicine, 2023)
• In last 20 years, there has been a 54% increase in heat related mortality for people 65 and older (Lancet 2021)
Why the elderly

- Body regulation/compensation for higher core temperature → lower capacity for CV response, blood shunting to skin, sweat response
- More co-morbidities including CV, mobility, cognitive function
- More medications vulnerable to heat impacts
- Climate change → higher nighttime lows → interferes with body reset, sleep, cognition
- Social vulnerability: 24% over 65% are socially isolated, economic resources, chronic impacts of structural racism
No Tropical Paradise: Urban 'Heat Islands' Are Hotbeds For Health Problems
Redlining & Urban Heat

Article

The Effects of Historical Housing Policies on Resident Exposure to Intra-Urban Heat: A Study of 108 US Urban Areas

Jeremy S. Hoffman 1,2,* , Vivek Shandas 3 and Nicholas Pendleton 1,2

1 Science Museum of Virginia, Richmond, VA 23220, USA; pendletonnv@mymail.vcu.edu
2 Center for Environmental Studies, Virginia Commonwealth University, Richmond, VA 23220, USA
3 Nohad A. Toulan School of Urban Studies and Planning, Portland State University, Portland, OR 97201, USA; vshandas@pdx.edu
* Correspondence: jhoffman@smv.org

Received: 5 November 2019; Accepted: 3 January 2020; Published: 13 January 2020
Over 4% of summer mortality in European cities is attributable to urban heat islands

30%

Increasing **tree cover** in cities to 30%

Can reduce the **temperature** of urban environments by up to **1.3 °C**

And **prevent 1/3 of premature deaths** attributable to urban heat islands in summer

*Source: Jørgensen T., et al., The Lancet, 2023.*
Recommendations

- Counseling/preparation, esp hydration, use of heat pumps/cooling units
- “Unremarkable” heat may still impact elderly
- Monitor humidity/wet bulb temp
- Medication adjustments
- Identifying some who will support
- Structural solutions
  - Addressing inequities: prevention and response
  - Tree canopies and improved green built environment
  - Access to care and public health investment
Developing Approaches to Address Climate Hazards in Frontline Clinics

Caleb Dresser MD MPH
Harvard Chan Center for Climate, Health, and the Global Environment
Instructor, Emergency Medicine, Harvard Medical School
Instructor, Environmental Health, Harvard T.H. Chan School of Public Health
Connecting Climate Hazards with Health: Social Determinants Approach
Climate-Related Health Risk Modification

\[ \text{Risk} = \frac{\text{Hazard} \times \text{Exposure} \times \text{Vulnerability}}{\text{Capacity}} \]

“invest in energy systems that reduce future global warming and severity of future heat waves”

“painting roofs white means less urban heat”

“residential cooling keeps people cool during a heat wave”

“If my AC fails, I'll go stay with my cousin for a few days and then come back home”

“residential cooling keeps people cool during a heat wave”

“painting roofs white means less urban heat”

“If my AC fails, I'll go stay with my cousin for a few days and then come back home”

Business Insider
Climate Readiness Self-Assessment: US Clinics

Question: How resilient is your clinic to extreme weather events?  
(Sample size: 269)

Question: Has the potential risk or actual impact of extreme weather events on your clinic increased operational expenses? 
(Sample size: 266)
Question: For climate and health education, which of these tools will be most useful for patients? (Sample size: 130)

- Brief information sheets: 36.1%
- Group session guides: 6.6%
- Short videos: 16.3%
- Pamphlets: 21.1%
- Ready to use social media content: 17%
- Other: 2.7%

Question: For climate and health education, which of these tools will be most useful for clinic staff? (Sample size: 130)

- Brief information sheets: 20.6%
- Written checklists: 13.9%
- Clinical encounter discussion prompts: 12.5%
- Online learning modules: 14.6%
- Short informational videos: 14.9%
- In-person workshops: 8.4%
- Electronic record checklists or templates: 13.9%
- Other: 1.2%
Climate Readiness Pilot Intervention: Toolkits for Clinics

- Evidence-based
- Available online for free or open-source
- Guidance for specific users
  - Patients, providers, administrators
- Guidance for specific hazards
  - Heat, hurricane, fire, flood
- Implementation assessment, validation, and end-user feedback solicitation are ongoing

Heat

Wildfires

Hurricanes

Providers
- Establishing a Hurricane Action Plan
- Hurricanes and Health

Patients
- Hurricane Action Plan
- Hurricane Tip Sheet

Administrators
- Hurricane Communications Templates
- Hurricane Alert Plan
- Hurricane Immediate Actions Checklist
- Facility Repair and Re-Entry After Hurricanes
Flooding

Flooding can be forecasted several days before the event occurs. When a flood watch is announced, the following measures should be taken within 48 hours of precipitation beginning.

**Done** | **Task** | **Assigned to**
---|---|---
✔️ | Ensure all materials and supplies are raised off of the floor to prevent water damage in case the facility floods. | |
✔️ | Fill sandbags and place them around doors and low-lying windows that have the potential of letting flood water inside. | |
✔️ | If the facility commonly floods in the basement or ground level, purchase or rent a sump pump to ensure water can be removed as quickly as possible. | |
| | Test pumps. | |
✔️ | Clear all exterior drains and gutter systems to prevent large pools of water from forming. | |
✔️ | Lock and seal any low-lying windows. | |
Heat Toolkit

Providers
- CKD, ESRD, and Heat
- COPD, Asthma, and Heat
- CVD and Heat
- Dementia and Heat
- Diabetes and Heat
- Mental Health Disorders and Heat
- MS and Heat
- Pregnancy and Heat
- How to Establish a Heat Action Plan
- How to Access Weather Alerts

Patients
- Heat Tip Sheet – General
- Heat Tip Sheet – CKD, ESRD
- Heat Tip Sheet – COPD, Asthma
- Heat Tip Sheet – CVD
- Heat Tip Sheet – Dementia
- Heat Tip Sheet – Diabetes
- Heat Tip Sheet – Mental Health Disorders
- Heat Tip Sheet – MS
- Heat Tip Sheet – Pregnancy
- Heat Action Plan – General
- Heat Action Plan – COPD, Asthma

Administrators
- Heat Alert Plan Guidance and Checklist
- Health Center Power Outage Guidance
- Extreme Heat Operational Guidance
- Extreme Heat Year-Round Guidance
- Extreme Heat Facility Preparedness Guidance
- Extreme Heat Immediate Response Checklist
- Extreme Heat Communications Templates
- Long-Term Climate Resilience and Sustainability

8. Know the signs when your body is telling you it's too hot. See the figure below for what to do when your body gets too hot.

- **Heat Exhaustion**
  - Faint or dizzy
  - Excessive sweating
  - Cool, pale, clammy skin
  - Nausea or vomiting
  - Rapid, weak pulse
  - Muscle cramps

- **Heat Stroke**
  - Headache, confusion
  - No sweating
  - Body temperature above 103°F
  - Red, hot, dry skin
  - Nausea or vomiting
  - Rapid, strong pulse
  - Muscle cramps
  - May lose consciousness

Get to a cool air-conditioned place
Drink water if fully conscious
Take a cool shower or use cold compress

**CALL 911**
Move person to a cooler place
Cool using cool cloths or bath
If unconscious, Do NOT give

Adapted from the National Weather Service and U.S. CDC

Peer Review Workshop on Heat Toolkit

• What works well?
• What needs to be changed?
• Are there additional approaches, ideas, or information that should be included in the toolkits?
• Other ideas, reactions, or suggestions?

Starting at 5:00pm today