

Preparing Vulnerable Populations for 2024 Heat Waves: A Speciality-Based Approach



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The Medical Society Consortium on
CLIMATE & HEALTH

Pregnant people
and children –
Implications for
clinical practice

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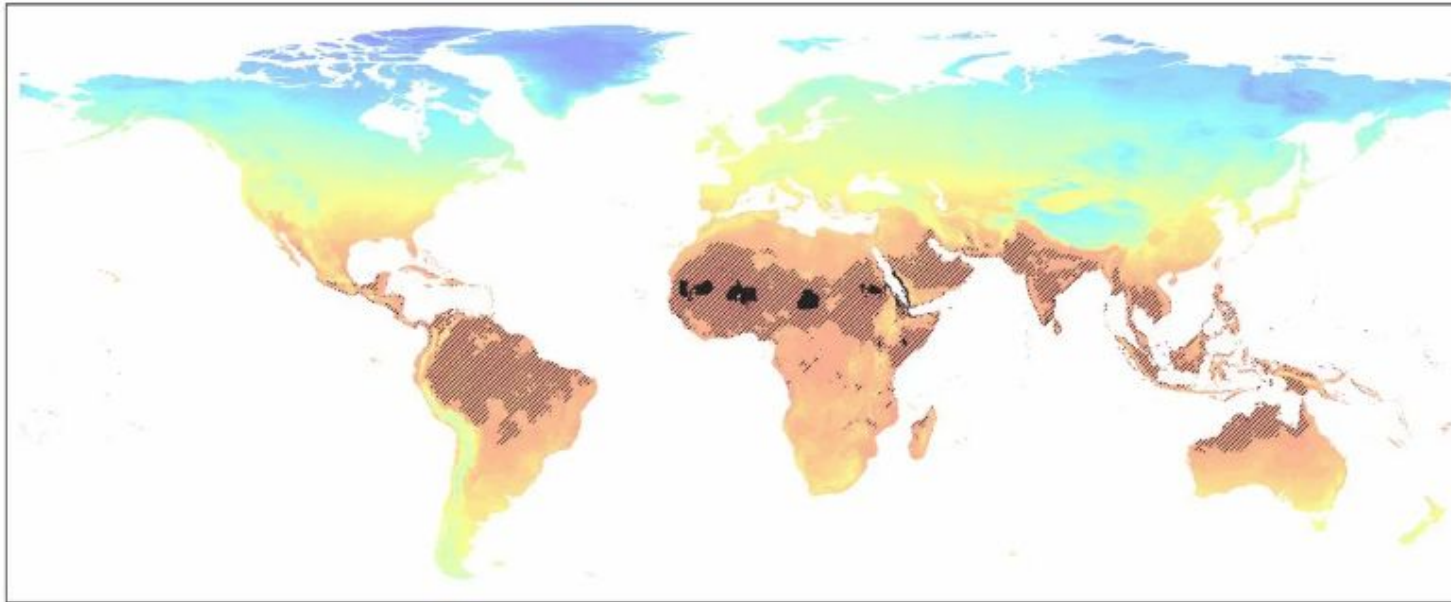
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Foundation Resilience Center

Baharav, Y., Nichols, L., Wahal, A., Gow, O., Shickman, K., Edwards, M., & Huffling, K. (2023). The Impact of Extreme Heat Exposure on Pregnant People and Neonates: A State of the Science Review. *Journal of Midwifery & Women's Health*.

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)



Mean annual temperature



A city skyline is silhouetted against a bright orange and yellow sunset sky. The sun is a large, glowing orb in the upper left quadrant. The city buildings are dark against the bright background.

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

Fetal distress

Meconium aspiration

Neonatal ventilator use

Fetal growth restriction and low birth weight

Congenital heart disease

Sudden infant death syndrome



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

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



Recommendations for pregnant patients & families

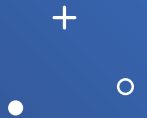
- Heat wave alerts
- Drink extra water
- Guidance for cooling home if no A/C
- Signs and symptoms of preterm labor
- Over 42 °C (107.6 °F), avoid using a fan.
- Provide guidance for patients that work outdoors
- Emergency plan for school activities
- Cooling centers
- Avoid heavy exercise during peak 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
- National Athletic Trainers Assoc – Heat Illness Guide for Parents and Coaches
<https://www.nata.org/sites/default/files/heat-illness-parent-coach-guide.pdf>



Thank you!
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Impact of Heat on Outdoor Workers

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HEALTHCARE SYSTEM

CLINICAL ASSISTANT PROFESSOR, UC IRVINE SCHOOL OF
MEDICINE AND PROGRAM IN PUBLIC HEALTH

Disclosures

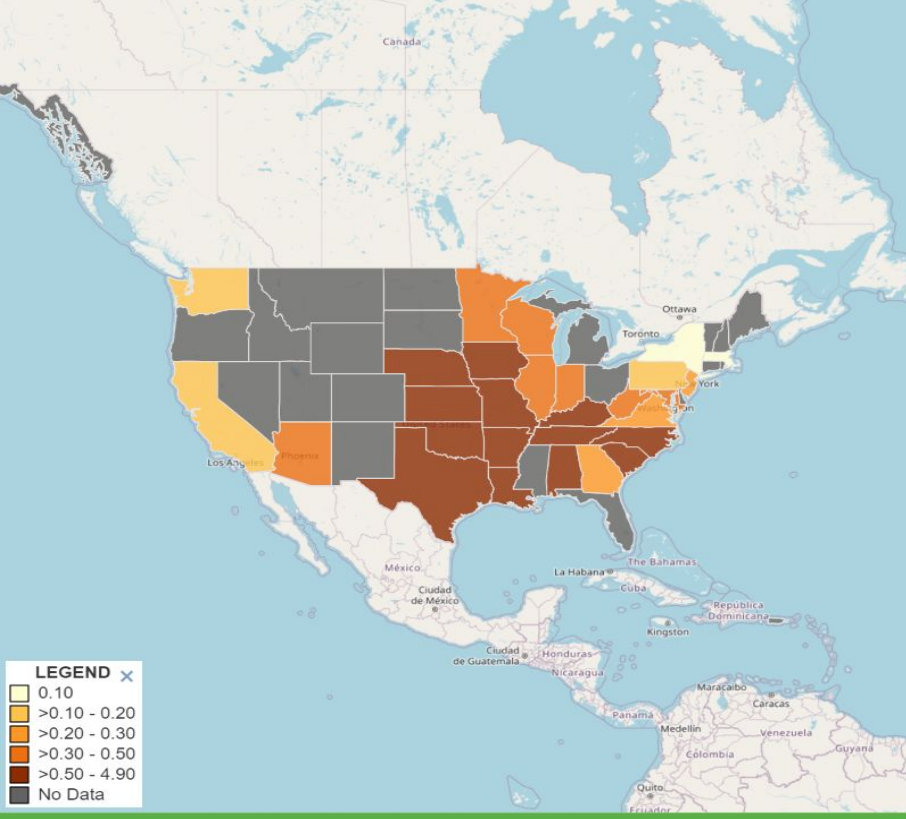
- None pertaining to the topic of this talk


The Population: Outdoor Workers



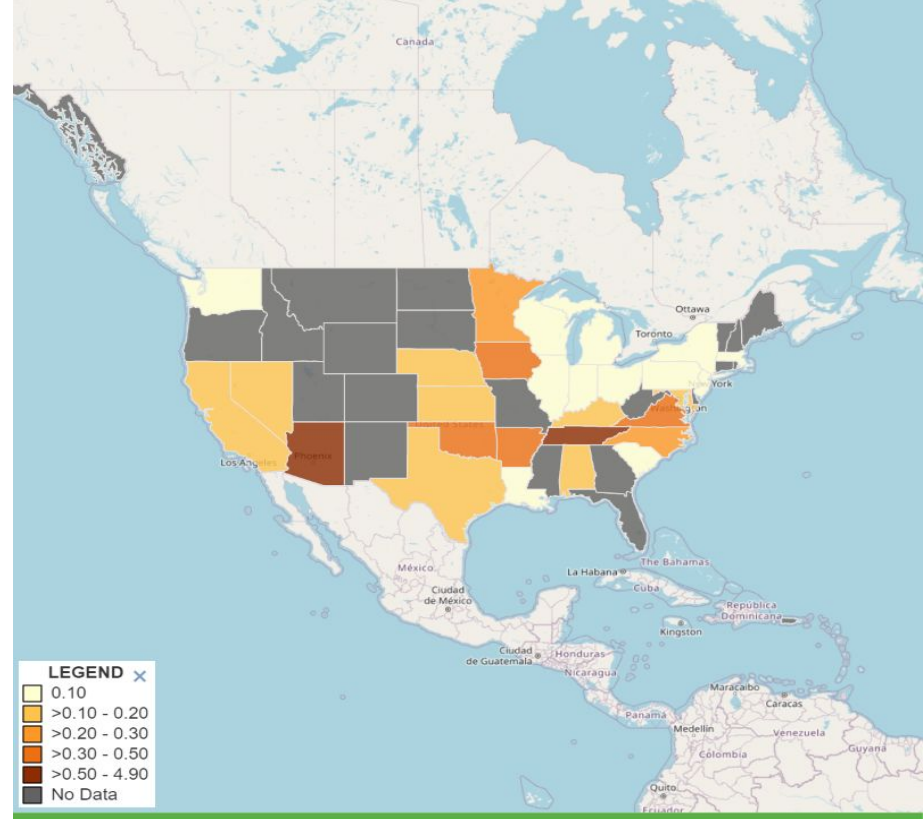
Outdoor Workers


- 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 & HEAT-RELATED ILLNESS (HRI) | WORKER HEALTH | ANNUAL RATE OF NON-FATAL WORKER HEAT-RELATED ILLNESS WITH DAYS AWAY FROM WORK BY YEAR PER 10,000 FULL-TIME WORKERS | ALL STATES | **2011**

Explore more data at ephtracking.cdc.gov/DataExplorer



 HEAT & HEAT-RELATED ILLNESS (HRI) | WORKER HEALTH | ANNUAL RATE OF NON-FATAL WORKER HEAT-RELATED ILLNESS WITH DAYS AWAY FROM WORK BY YEAR PER 10,000 FULL-TIME WORKERS | ALL STATES | **2020**

Explore more data at ephtracking.cdc.gov/DataExplorer

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.

OPEN

How Does Environmental Temperature Affect Farmworkers' Work Rates in the California Heat Illness Prevention Study?

Chelsea E. Langer, PhD, Tracey L. Armitage, MS, Stella Beckman, PhD, Daniel J. Tancredi, PhD, Diane C. Mitchell, PhD, and Marc B. Schenker, MD

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 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

LEARNING OUTCOMES

1. Outline the importance of farmworkers' risk of heat-related illness.
2. Summarize the factors associated with changes in 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.^{1,2,3} In an analysis of California Workers' Compensation claims during 2000 to 2017 data, 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.⁴ 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.⁵ 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.⁶ 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.^{4,5,6} In addition to HRI morbidity and mortality, heat exposure is associated with increased injuries⁷ and acute kidney injury⁸ 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.⁹ In addition to increasing the risk for HRI, agricultural

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

Aaron Tustin, MD, MPH, Yusef Sayeed, MD, MPH, MEng, Manijeh Berenji, MD, MPH, Kathleen Fagan, MD, MPH, Ronda B. McCarthy, MD, MPH, Judith Green-McKenzie, MD, MPH, James McNicholas, DO, MC, (FS), USN, Charles Babajide Onigbogi, MD, MPH, William Brett Perkison, MD, MPH, and James W. Butler, MD, MPH, ACOEM Work Group on Occupational Heat-Related Illness

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.

High ambient temperatures and strenuous physical activity put workers at risk for a variety of heat-related illnesses and injuries (HRIs). According to the United States (US) Bureau of Labor Statistics (BLS), each year thousands of American workers experience serious heat-related illnesses, many of which result in fatality.¹ Heat exposure directly caused more than 350 US worker deaths between 2000 and 2011.^{2,3} More recently, dozens of workers

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 recommendations¹⁰; reviewing that article will be of benefit in understanding this document.

Description of Occupational Heat-Related Illnesses

through history to rule out other causes and to document antecedent exposure to heat stress. Heat exhaustion is distinguished from heat stroke by the lack of severe CNS abnormalities and the lack of extreme hyperthermia. There is no objective temperature threshold for the diagnosis of heat exhaustion. Heat exhaustion can progress quickly to heat stroke if the heat exposure continues.

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.

ORIGINAL ARTICLE

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 

Journal of Occupational and Environmental Medicine ():10.1097/JOM.0000000000003051, January 19, 2024. | DOI: 10.1097/JOM.0000000000003051

PAP

 Metrics

Abstract



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Heat Illness Prevention

[Heat](#) | [Employer Responsibilities](#) | [Information for Workers](#) | [More Resources](#) | [National Heat Contest](#)

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

OCCUPATIONAL HEAT SAFETY STANDARDS IN THE UNITED STATES

1. Select State or Federal

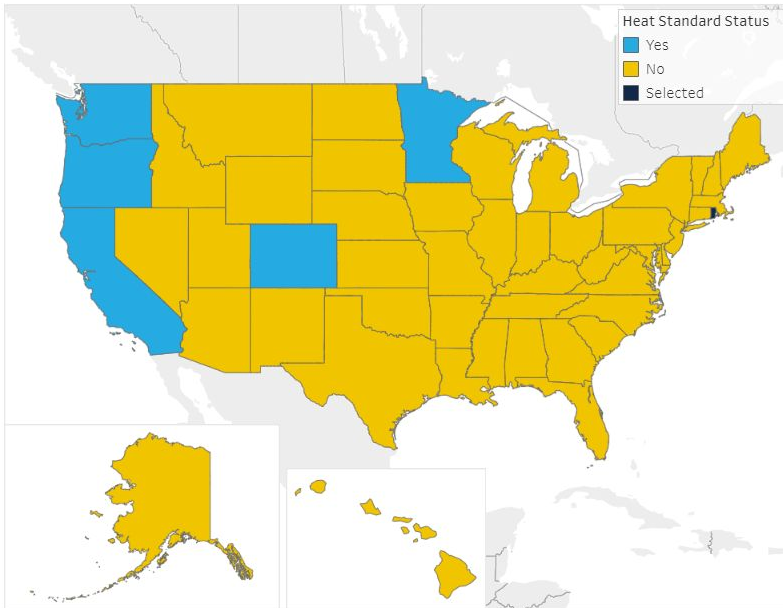
State

1a. If "State" is chosen, click a state

Rhode Island

2. Select a Heat Standard Status

Existing



Rhode Island

137,016
workers in high risk industries

Existing Heat Standard:
No

Covered Workers:
N/A

Notes:
N/A

The estimated number of high risk workers in each state is total employment in 2021 from six industries with the highest average heat-related deaths per year: Agriculture, Mining, Quarrying, and Oil and Gas Extraction; Construction; Manufacturing; Administrative and Support and Waste Management and Remediation Services; and Transportation and Warehousing. Data sources: BEA¹ and OSHA². Infographic designed by Mycelium Strategies.

[1_GDP and Personal Income data, BEA.gov.](#)

[2_Heat Initiative: Inspection Guidance, OSHA.gov.](#)





SEPTEMBER 20, 2021

FACT SHEET: Biden Administration Mobilizes to Protect Workers and Communities from Extreme Heat



[BRIEFING ROOM](#)

[STATEMENTS AND RELEASES](#)

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



OSHA National News Release

U.S. Department of Labor

April 12, 2022

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



▶ SEE ALL ACCELERATORS

SHARE



SCIENCE POLICY

DAY ONE PROJECT

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)

Video

“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](#)

Date of release:

2023 [?](#)

Keywords

heat, heat stress, occupational health and safety

Climate impacts

Extreme Temperatures

Adaptation elements

Adaptation Measures and Actions, Adaptation Plans and Strategies, Vulnerability Assessment

Sectors

Agriculture, Health

Geographic characterization

Global

Thank you!

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HEAT
AND THE
PSYCHIATRIC
PATIENT



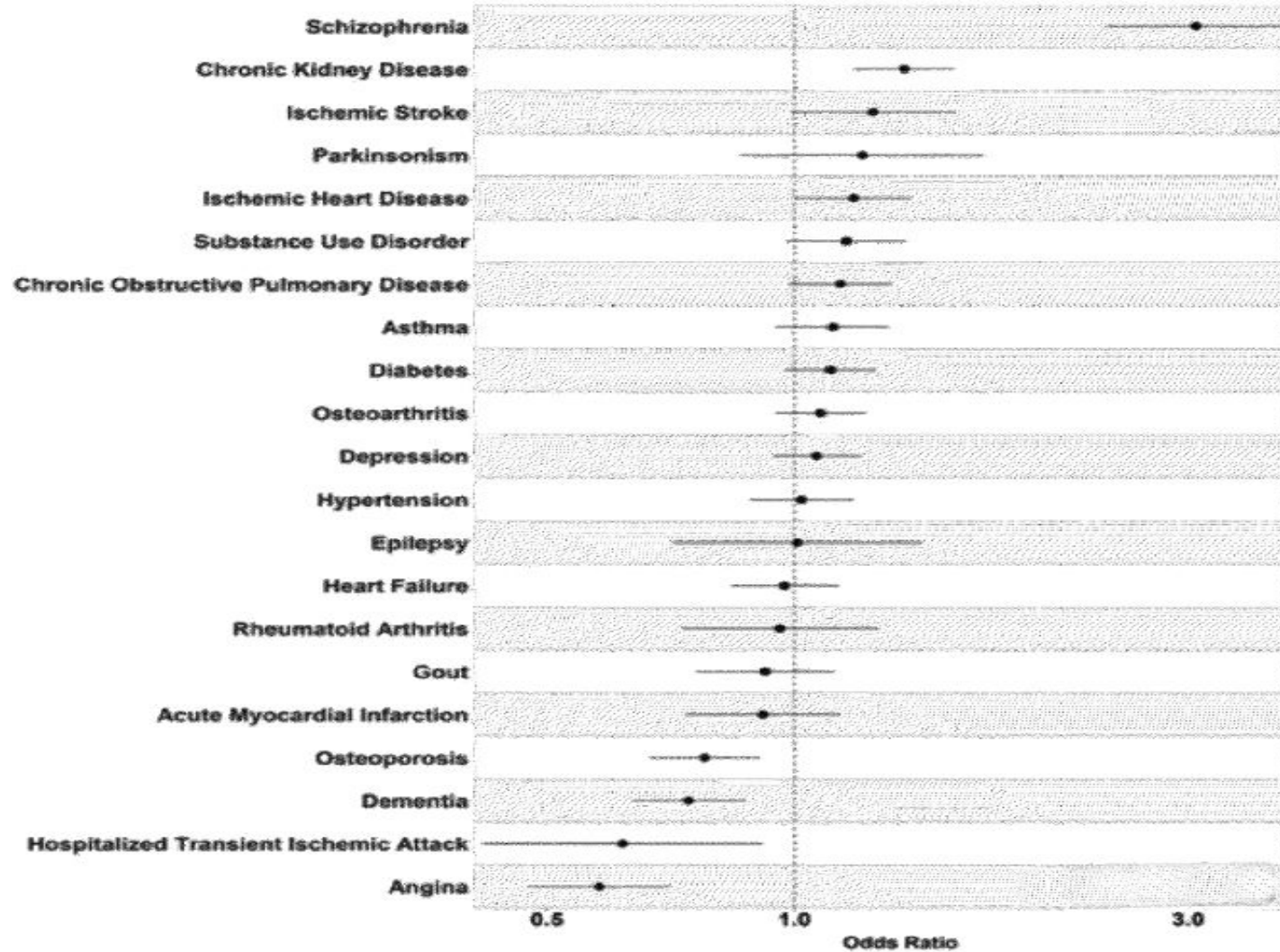
Robert Feder, M.D.

- **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 Gas**

SCHIZOPHRENIA



**Lee, et al. Chronic Diseases Associated with Mortality in British Columbia, Canada During the 2021 Western North America Extreme Heat Event. *GeoHealth* March 15, 2023
<https://doi.org/10.1029/2022GH000729>**



**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**

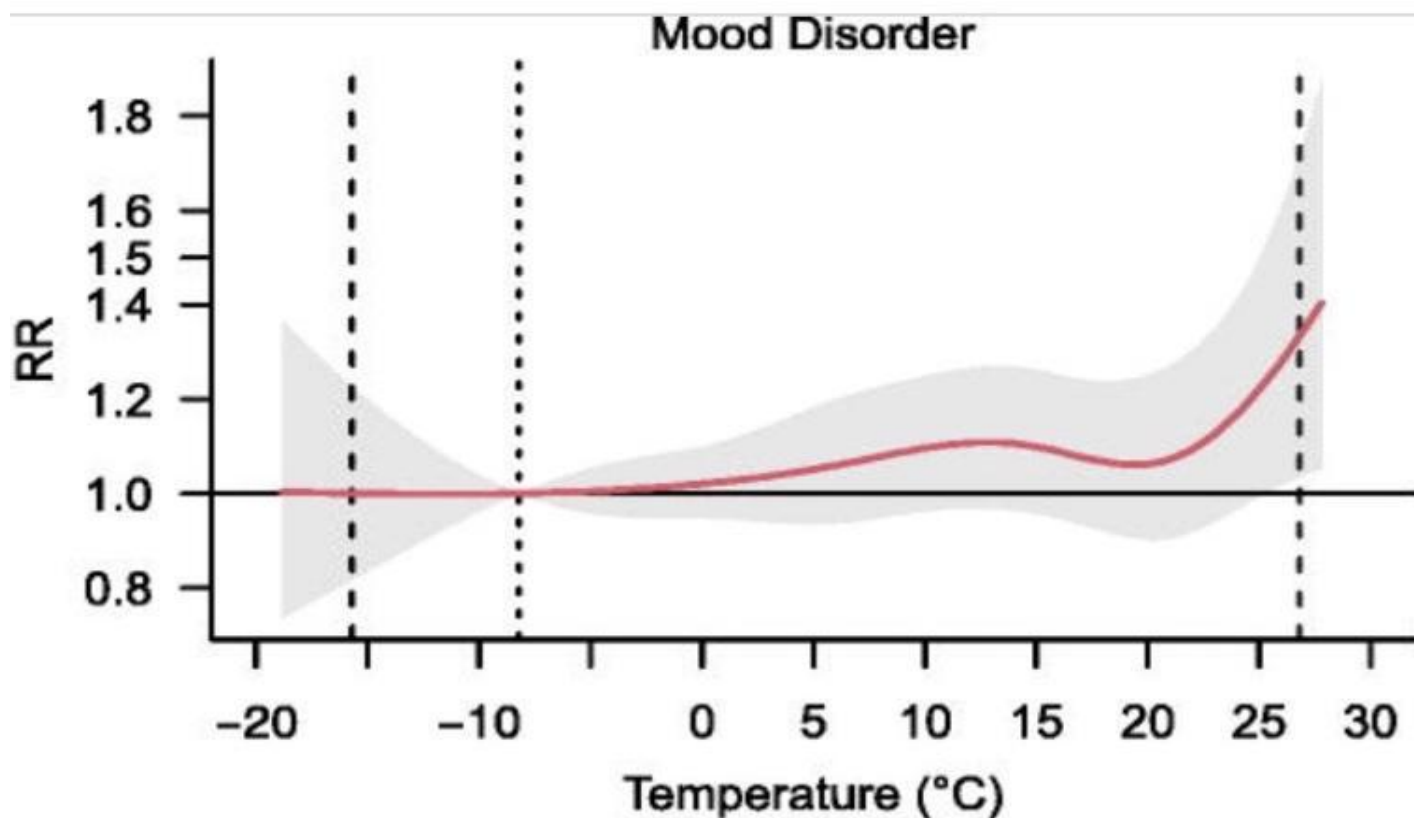
“Heat’s Hidden Risk”

Washington Post/December 18, 2023.

Story of Stephen Goodwin

**MAJOR
DEPRESSIVE
DISORDER**

Emergency Room Visits in New York State



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**

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 range¹
Real-world studies often indicate acceptable stability at higher temps, but often don't examine effects of packaging, tablet splitting, humidity, and other common factors²
- Products of concern:
Refrigerated medications: insulin, biologics, vaccines²⁻³
Emergency medications: epinephrine, naloxone⁴
Delivery devices: metered-dose inhalers⁵
- 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 values⁶

1. Funk OG. *Innov Pharm*. 2021.

2. De Winter S, *Annals of Emergency Medicine*. 2013.

3. Richter B, *Cochrane Database of Systematic Reviews*. 2023.

Heat Effects on Medication Kinetics

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

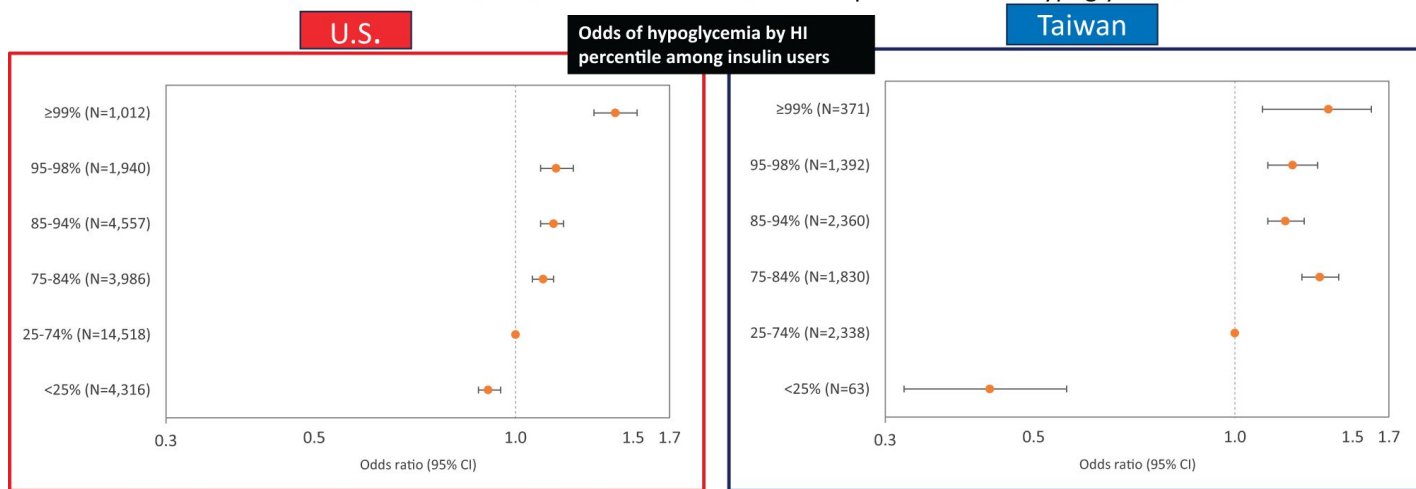
Indirect: Dehydration leading to alterations in drug distribution and elimination

1. Hao J. Expert Opin Drug Deliv. 2016.
2. Westaway K. *J Clin Pharm Ther.* 2015.

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 **~40% higher** on days with a HI ≥99th percentile vs days with HI in 25–74th percentile in both US and Taiwan

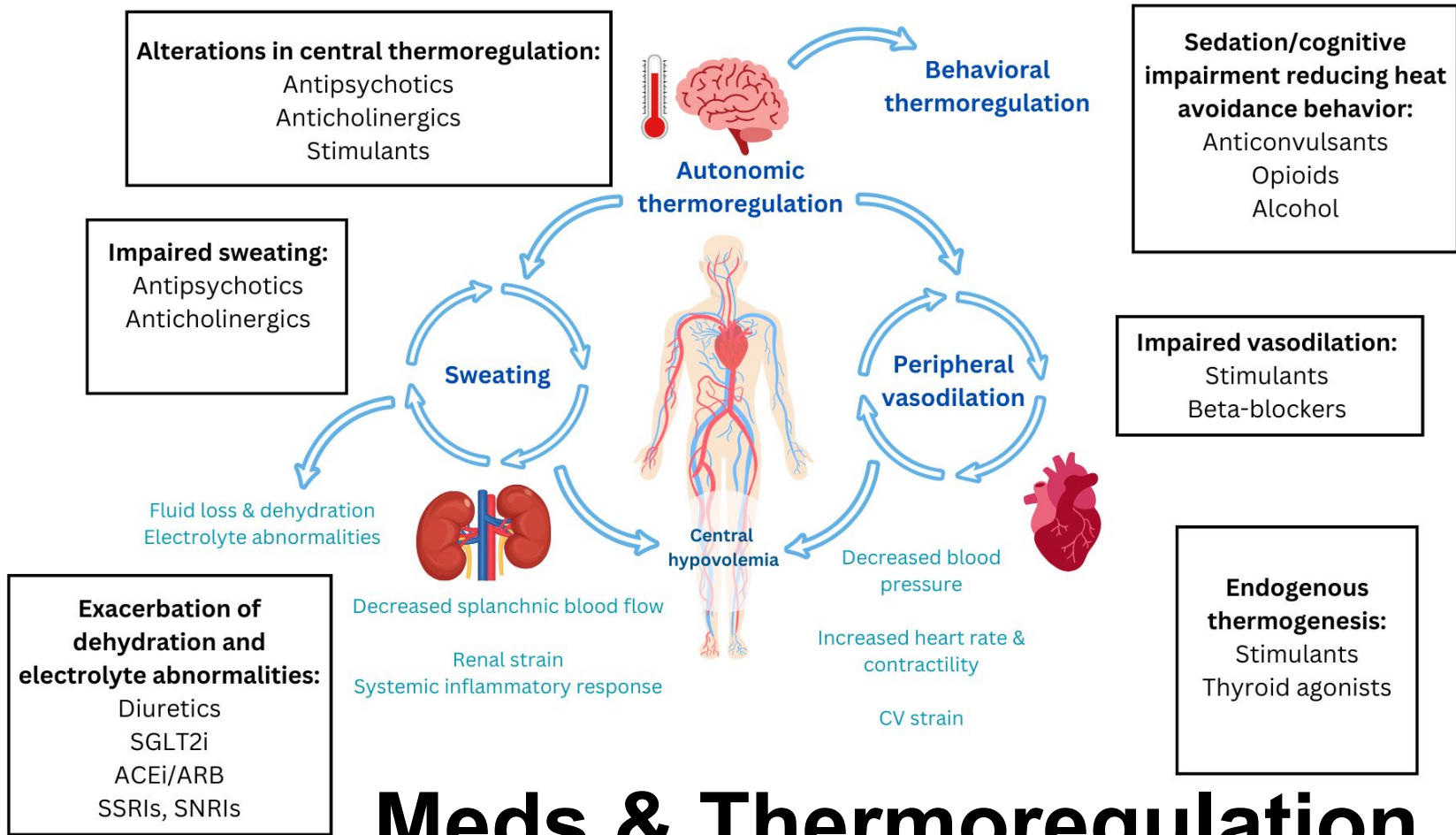
Study design: Retrospective, time-stratified, case-crossover study of adults ≥65 years using insulin during summer 2016-2019

Exposure: Heat index (HI), categorized into percentile categories (HI ≥99, 95-98, 85-94, 75-84, 25-74, <25th %tiles) based on ZIP 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

1. Westaway K, *J Clin Pharm Ther.* 2015.
2. Wee J, *Pharmacol Rev.* 2023.
3. Ebi KL. *The Lancet.* 2021.

Vulnerable Populations & Medication Use

Older age

Mental health disorders

Cardiovascular disease

Chronic kidney disease

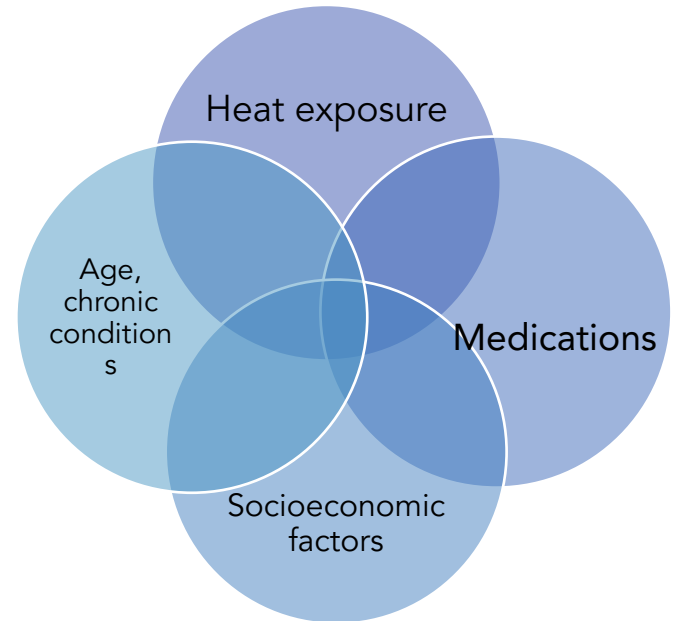
Diabetes

Dementia

Parkinson's Disease

Multiple Sclerosis

Drug use



1. Kalisch Ellett LM, *J Clin Pharm Ther.* 2016.
2. Layton JB. *PLoS ONE.* 2020
3. Bongers KSJ *Clin Pharm Ther.* 2020.

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/hospitalization³
- Short-term associations between elevated temps greater than 17 °C 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}

1. Kalisch Ellett LM, J Clin Pharm Ther. 2016.

2. Layton JB. PLoS ONE. 2020

3. Bongers KSJ Clin Pharm Ther. 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 Recommendations¹⁻³



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



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



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



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

1. Westaway K, *J Clin Pharm Ther.* 2015.
2. Wee J, *Pharmacol Rev.* 2023.
3. Gamboa L. *Eur J Clin Pharmacol.* 2023.

Recommendations for Heat Adaptations:¹⁻⁵

Medication Management

Medication review	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)
Patient screening	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)
Patient education	Individualized plans for heat response, hydration, self-monitoring and self-management at strategic time points (prescribing, summer refills, discharge/TOC); medication & medical supply storage
Patient access	Pharmacies/pharmacists as access points for more regular patient contact
Interprofessional practice	Pharmacy partnerships for public health planning, referrals for medication review, development of effective clinical response protocols & guidelines

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3. Jay O. *The Lancet*. 2021.
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5. Patel L, *NEJM Catalystr*. 2022.

Healthcare Access & Pharmacy Programs

Pharmacy Type

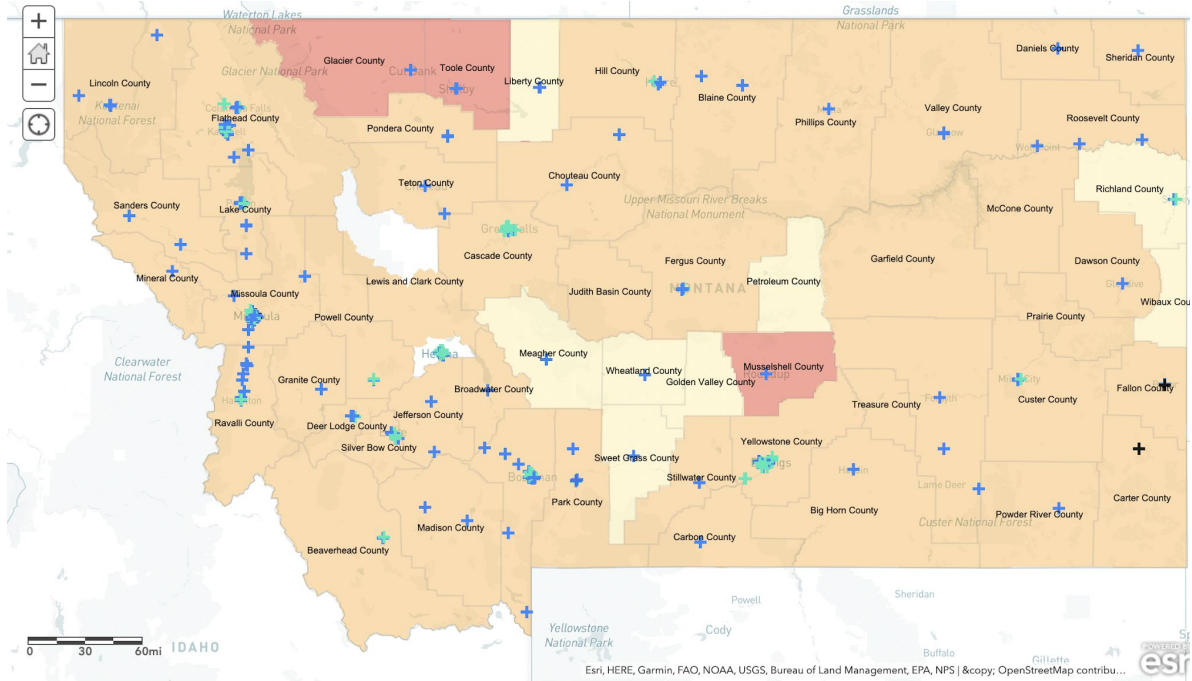
- + Independent
- + Independent - Clinic Affiliated
- + Independent - Hospital Affiliated
- + Independent - LTC Affiliated
- + Chain
- + Chain - Clinic Affiliated
- + Chain - LTC

HPSAs in Primary Care Designation Boundaries



HPSA Priority

- Red square: Highest priority for assignment of Clinicians
- Orange square: Medium priority for assignment of Clinicians
- Light orange square: Lowest priority for assignment of Clinicians



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

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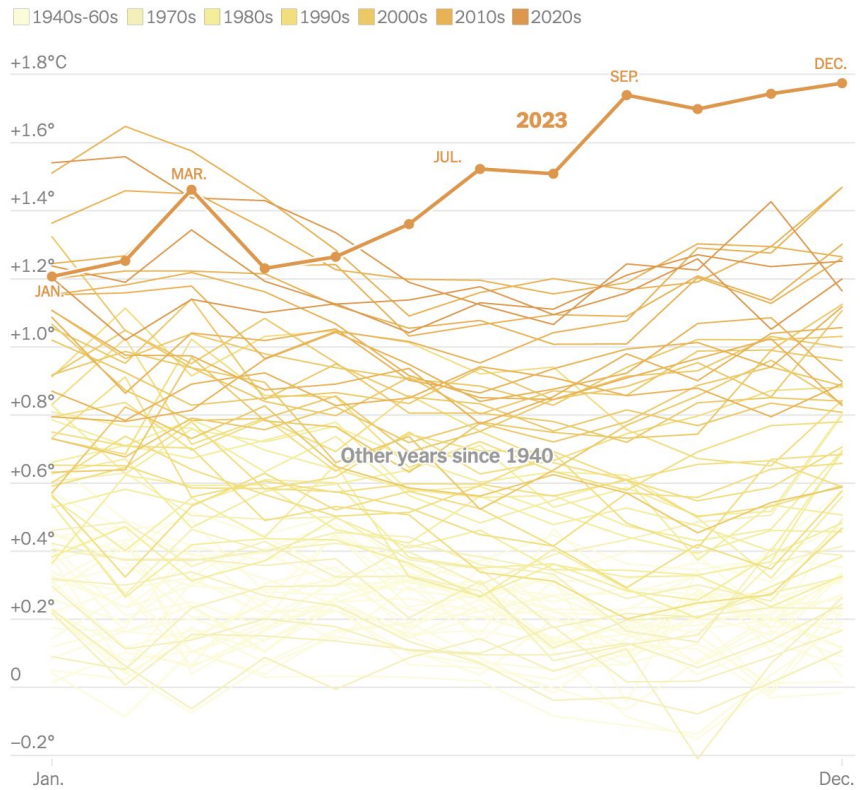
Heat and the Health of the Elderly

Gaurab Basu, MD, MPH

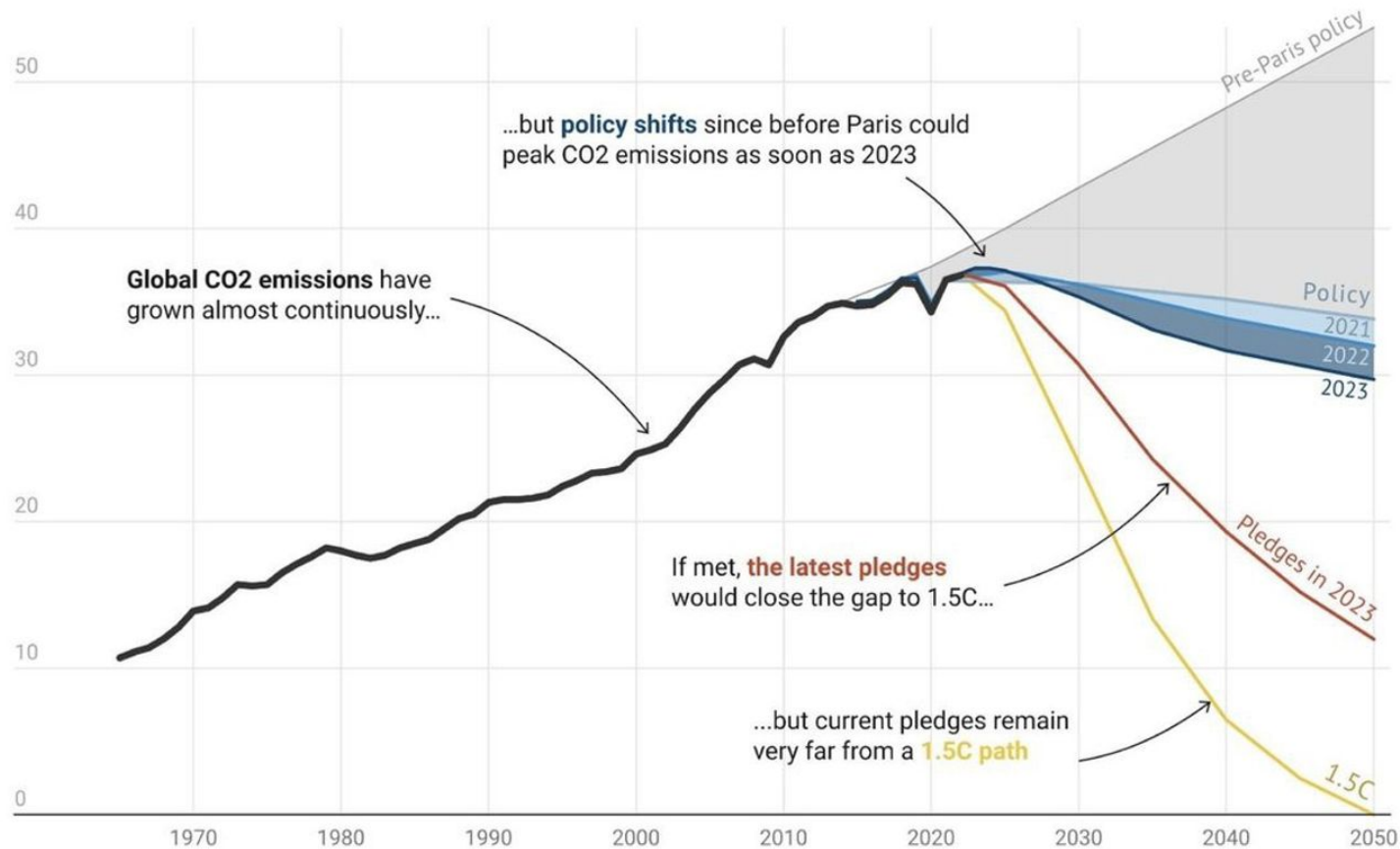
Director of Education & Policy
Center for Climate, Health & the Global Environment
Harvard T.H. Chan School of Public Health

Faculty Director, Climate Change, Environment & Health Curricular Theme
Assistant Professor
Harvard Medical School

Monthly global temperature compared with preindustrial levels

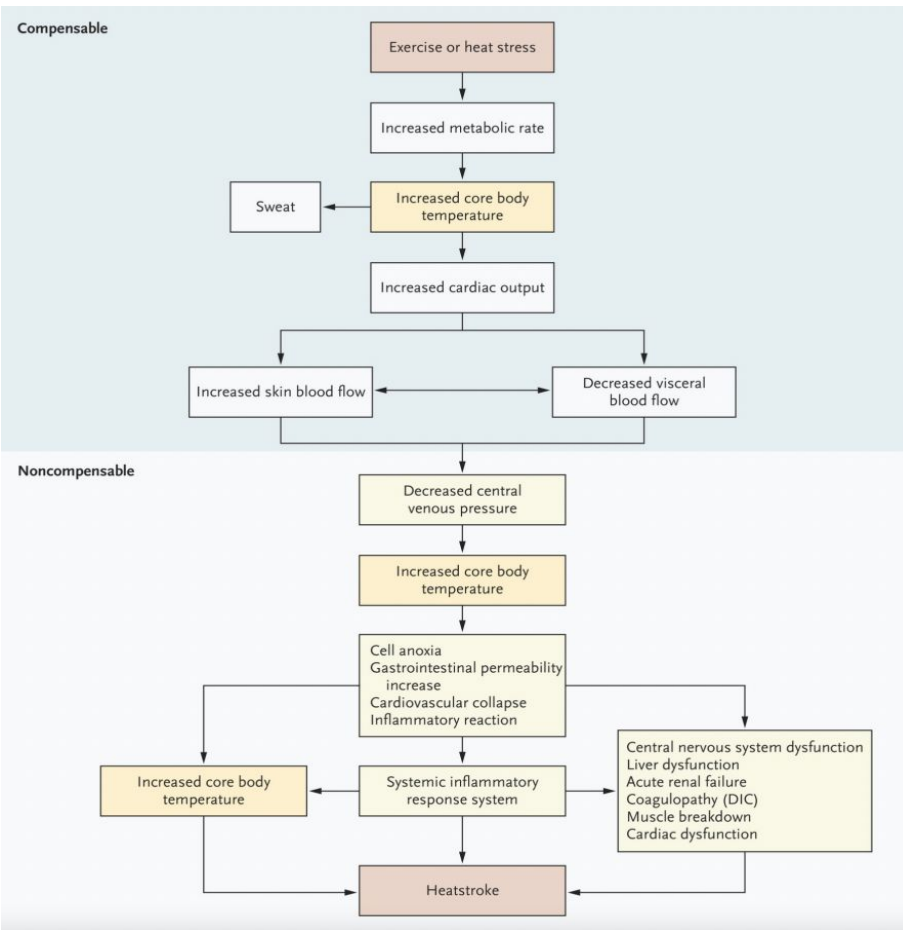


Source: Copernicus/ECMWF



Source: IEA World Energy Outlooks

Heat

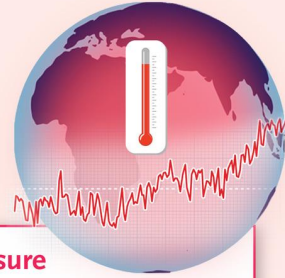


**NEJM,
Epstein &
Yanovich,
2019**

Key Factors Affecting the Risk of Heat-Related Illness

Individual Susceptibility

Age
Coexisting conditions
Pregnancy
Medications or drugs
Cognitive impairments
Disabilities
Social isolation
Immobility



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

Sociocultural Factors



Poverty
Structural and environmental racism
Social cohesion
Housing status
Literacy
Limited worker protections



[nature](#) > [nature climate change](#) > [articles](#) > [article](#)

Article | [Published: 31 May 2021](#)

The burden of heat-related mortality attributable to recent human-induced climate change

[A. M. Vicedo-Cabrera](#) , [N. Scovronick](#), [F. Sera](#), [D. Royé](#), [R. Schneider](#), [A. Tobias](#), [C. Astrom](#), [Y. Guo](#), [Y. Honda](#), [D. M. Hondula](#), [R. Abrutzky](#), [S. Tong](#), [M. de Sousa Zanotti Stagliorio Coelho](#), [P. H. Nascimento](#), [S. Saldiva](#), [E. Lavigne](#), [P. Matus Correa](#), [N. Valdes Ortega](#), [H. Kan](#), [S. Osorio](#), [J. Kyselý](#), [A. Urban](#), [H. Orru](#), [E. Indermitte](#), [J. J. K. Jaakkola](#), ... [A. Gasparrini](#)  [+ Show authors](#)

[Nature Climate Change](#) **11**, 492–500 (2021) | [Cite this article](#)

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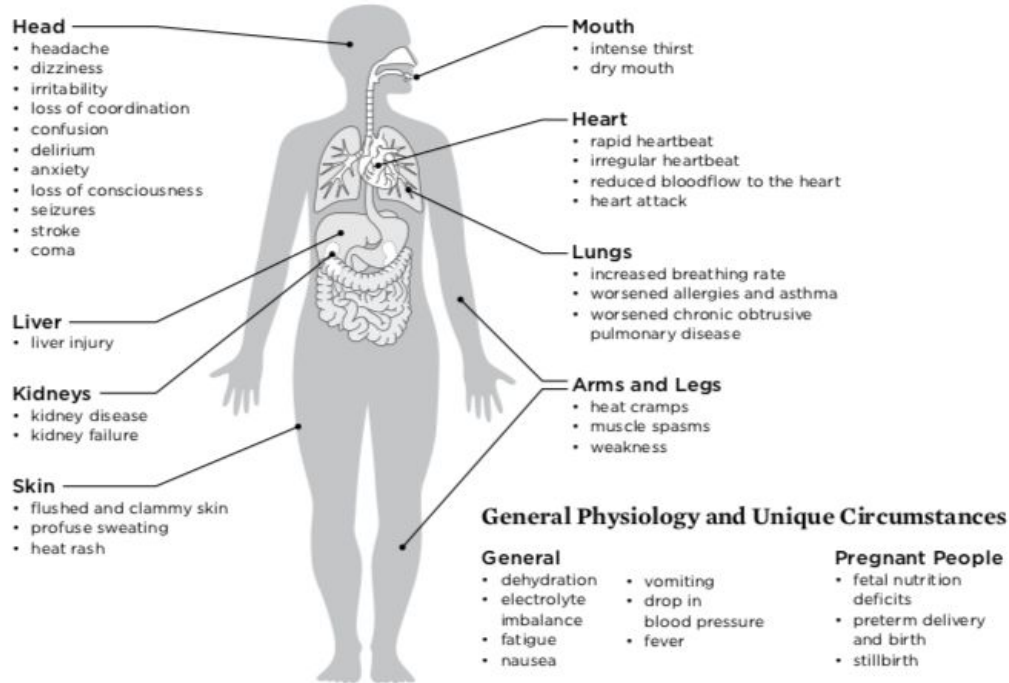
More Than a Third of Heat Deaths Are Tied to Climate Change, Study Says

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



Union of Concerned Scientists,
Killer Heat in the United States

July 2019

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

1971 - 2000

(Baseline)

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

2015 - 2044

(2030)

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

2055 - 2084

(2070)

Above 90°F - Low Scenario
 Above 90°F - High Scenario
 Above 100°F - Low Scenario
 High 100°F - High Scenario

*Summer is considered to be the 91 days of June through August

City of
Cambridge,
Kleinfelder

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

CLIMATE CHANGE IN MASS.



06:41
🔊 </>

No Tropical Paradise: Urban 'Heat Islands' Are Hotbeds For Health Problems

July 05, 2017 Updated Jul 07, 2017 11:12 AM

By [Martha Bebinger](#)




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. Toulon School of Urban Studies and Planning, Portland State University, Portland, OR 97201, USA; vshandas@pdx.edu

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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**



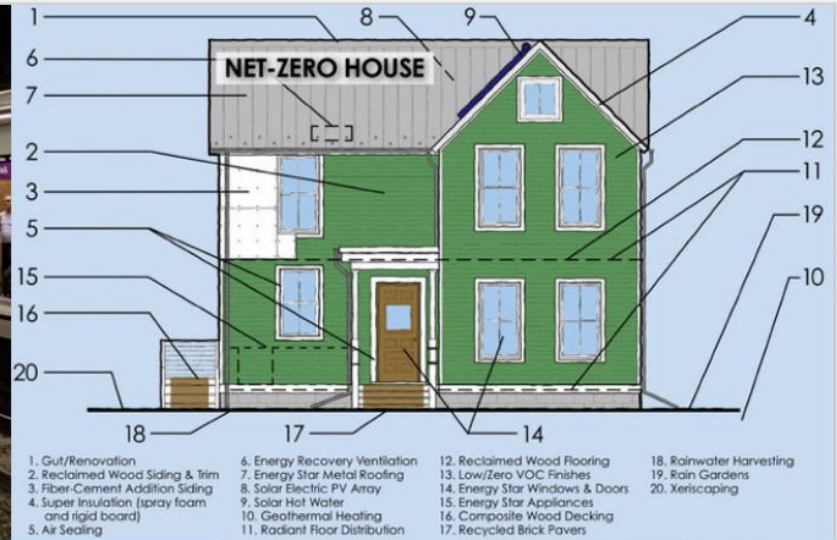
and **prevent 1/3 of premature deaths** attributable to urban heat islands in summer

Source: Iungman 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

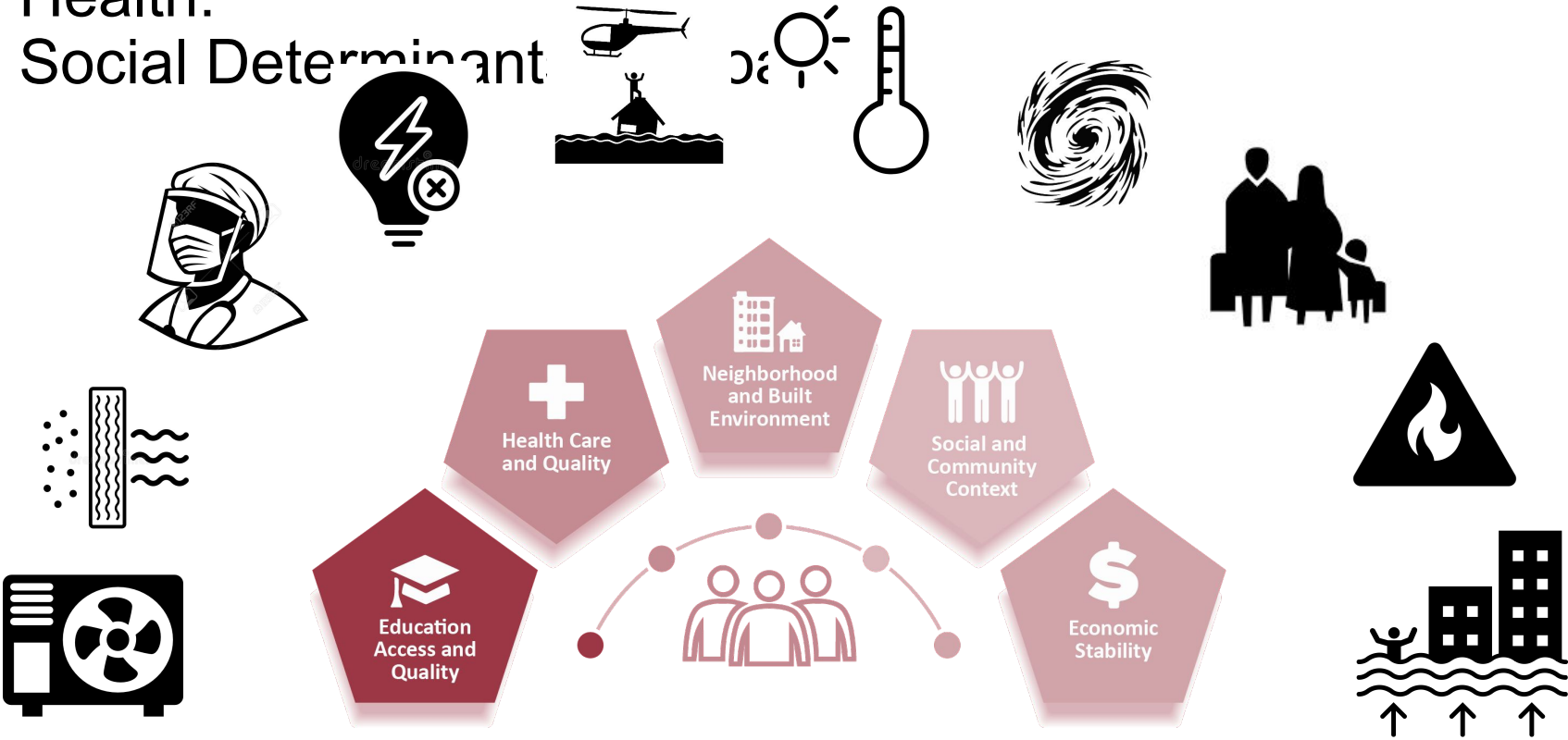
Caleb Dresser MD MPH

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 Determinant



Climate-Related Health Risk Modification

Risk = Hazard x Exposure x Vulnerability / Capacity

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

“painting roofs white means less urban heat”

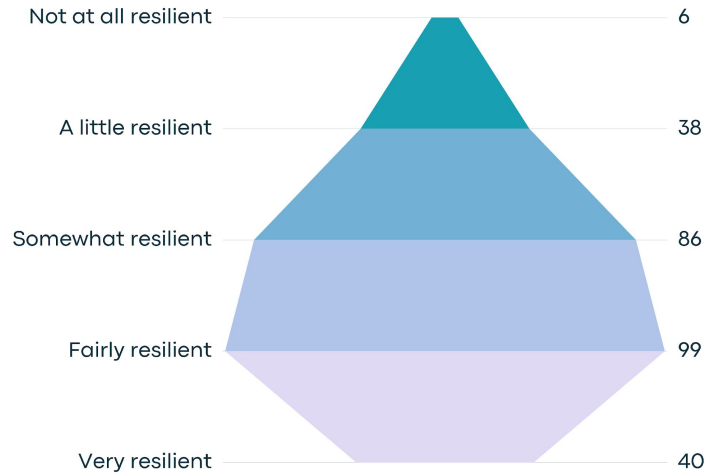
“residential cooling keeps people cool during a heat wave”

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

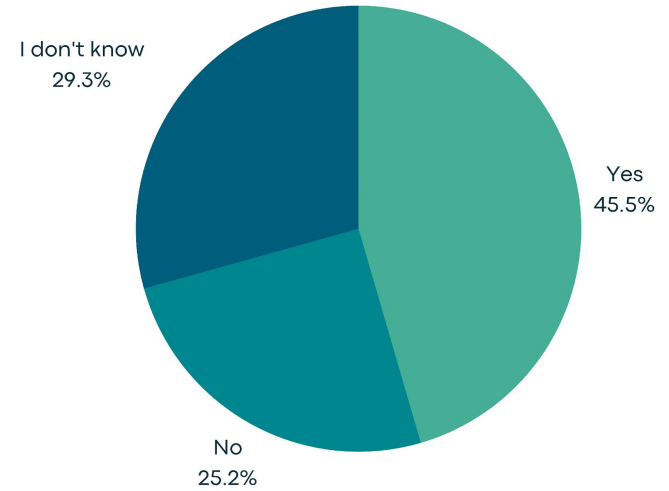


Business Insider

Climate Readiness Self-Assessment: US Clinics

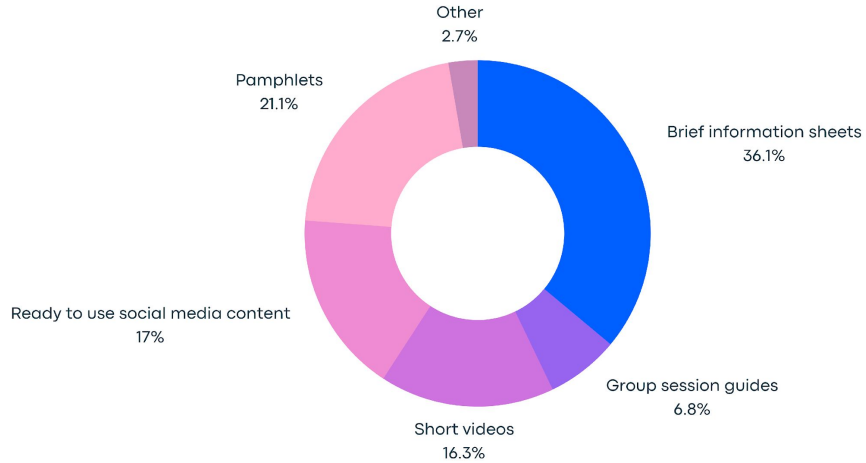


Question: How resilient is your clinic to extreme weather events?
(Sample size: 269)

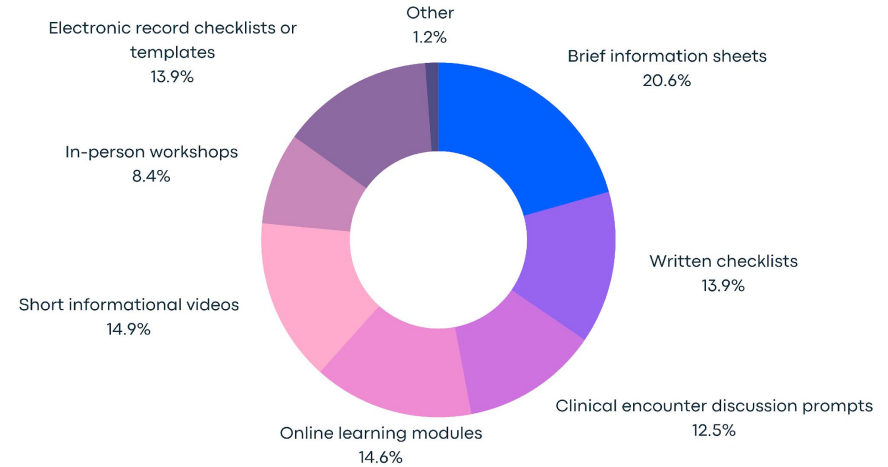


Question: Has the potential risk or actual impact of extreme weather events on your clinic increased operational expenses?
(Sample size: 266)

Climate Readiness Education Needs: US Clinics



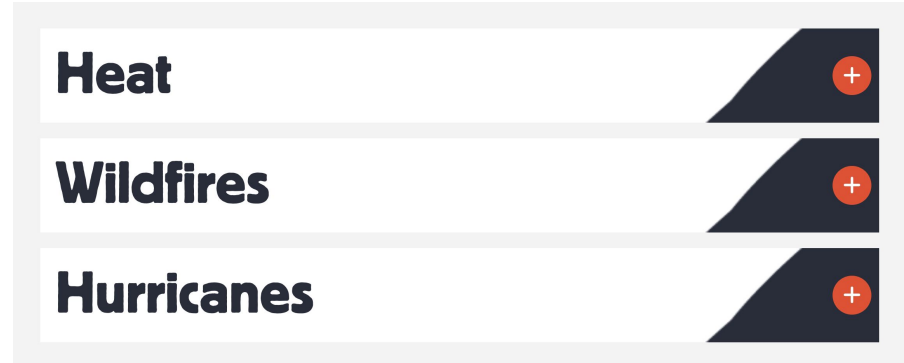
Question: For climate and health education, which of these tools will be most useful for patients?
(Sample size: 130)



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

Climate Readiness Pilot Intervention: Toolkits for Clinics **americares**

- 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



Providers

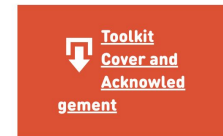
- 📄 [Establishing a Hurricane Action Plan](#)
- 📄 [Hurricanes and Health](#)

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 Toolkit

Providers

- PROVIDER Floods and Health
- PROVIDER Establishing a Flood Action Plan

Patients

- PATIENT Flood Tip Sheet
- PATIENT Flood Action Plan

Administrators

- ADMIN Flood Immediate Actions Checklist
- ADMIN Flood Alert Plan
- ADMIN Facility Repair and Re-Entry After Hurricanes
- ADMIN Flood Communications Templates



Flood Immediate Actions Checklist Administrators

Flooding

Floods 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. <input type="checkbox"/> Test pumps.	
✓	Clear all exterior drains and gutter systems to prevent large pools of water from forming.	
✓	Lock and seal any low-lying windows.	

Notes:

Heat Toolkit

Providers

- [PDF](#) CKD, ESRD, and Heat
- [PDF](#) COPD, Asthma, and Heat
- [PDF](#) CVD and Heat
- [PDF](#) Dementia and Heat
- [PDF](#) Diabetes and Heat
- [PDF](#) Mental Health Disorders and Heat
- [PDF](#) MS and Heat
- [PDF](#) Pregnancy and Heat
- [PDF](#) How to Establish a Heat Action Plan
- [PDF](#) How to Access Weather Alerts

Patients

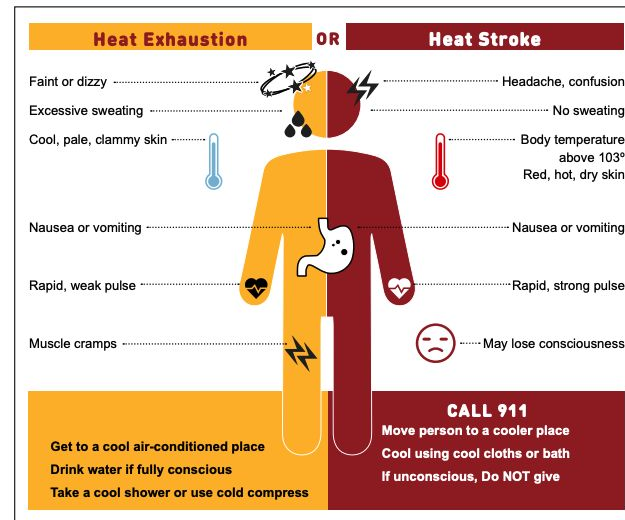
- [PDF](#) Heat Tip Sheet – General
- [PDF](#) Heat Tip Sheet – CKD, ESRD
- [PDF](#) Heat Tip Sheet – COPD, Asthma
- [PDF](#) Heat Tip Sheet – CVD
- [PDF](#) Heat Tip Sheet – Dementia
- [PDF](#) Heat Tip Sheet – Diabetes
- [PDF](#) Heat Tip Sheet – Mental Health Disorders
- [PDF](#) Heat Tip Sheet – MS
- [PDF](#) Heat Tip Sheet – Pregnancy
- [PDF](#) Heat Action Plan – General
- [PDF](#) Heat Action Plan – COPD, Asthma

Administrators

- [PDF](#) Heat Alert Plan Guidance and Checklist
- [PDF](#) Health Center Power Outage Guidance
- [PDF](#) Extreme Heat Operational Guidance
- [PDF](#) Extreme Heat Year-Round Guidance
- [PDF](#) Extreme Heat Facility Preparedness Guidance
- [PDF](#) Extreme Heat Immediate Response Checklist
- [PDF](#) Extreme Heat Communications Templates
- [PDF](#) 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.



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

9. Complete a Heat Action Plan before the weather gets hot outside. Ask your provider to review the Heat Action Plan handout at your next appointment.



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