

Green Heart – Cardiorespiratory Health in Extreme Heat

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Objectives:

Upon completion of this educational activity, you will be able to:

1. Describe the effects of extreme heat on cardiorespiratory health
2. Describe the role primary care teams can play to educate and guide patients about heat-related cardiovascular risk and risk mitigation
3. Describe public health and community health approaches to prepare for and respond to extreme heat events.

Faculty Disclosure

No financial disclosures

- First generation US citizen
- Parents from the Dominican Republic
- Undergraduate and graduate degrees in biomedical engineering
- **Family medicine residency trained**
- Public health trained
- **CHC/FQHC experienced**



Heat-related Deaths are Probably Undercounted.

- Official government records show that heat contributes to some **1,700 deaths every year** in the United States.
- Since 2018, heat is probably contributing to about **9,000 – 10,000 deaths annually**.

Circulation

AHA SCIENTIFIC STATEMENT

Nonoptimal Temperature and Cardiovascular Health: A Scientific Statement From the American Heart Association

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Nonoptimal Temperature and Cardiovascular Health: A Scientific Statement From the American Heart Association.

Despite growing epidemiological and mechanistic evidence, the cardiovascular **impact of HEAT remains insufficiently addressed** in clinical practice, public health planning, and policy development. The overarching goal of the statement is to synthesize the state of knowledge of the cardiovascular effects of ambient temperature with the following aims:

- 1. To review the evidence linking HEAT and the association with cardiovascular disease (CVD)**, including epidemiology, biological mechanisms, inequities in exposure and outcomes, and implications for clinical care;
- 2. To characterize interventions** to prevent HEAT-related cardiovascular morbidity and mortality at the individual, community, health system, and public health levels; and
- 3. To identify knowledge gaps** to guide future research and support climate-resilient health policies.

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Connection Between Temperature and Air Pollution

- Rising temperatures and air pollution both adversely affect cardiovascular health and often co-occur.
- Co-exposure to HEAT and air pollution may have synergistic effects, amplifying cardiovascular risks beyond the individual impact of each exposure alone.
- Together, these exposures heighten cardiovascular risk through oxidative stress, inflammation, changes in blood viscosity, and endothelial dysfunction.
- Higher temperatures promote ground-level ozone formation, exacerbate wildfire-related fine particulate matter of 2.5- μm diameter or less ($\text{PM}_{2.5}$), increase dust and sandstorm risk through drought, and reduce pollutant dispersion in cities.

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Heat-Associated Cardiovascular Health Risks (note 1° C = 1.8° F)

- A meta-analysis of 266 studies found that for a 1° C rise in temperature above optimal temperature, CVD-related mortality increased by 2.1% and morbidity by 0.5%.
- Heat-related risk depends on the intensity, duration, timing, and rate of temperature change.
- Heat waves that are more intense, are longer, or occur earlier in the summer are associated with the highest mortality risk.
- In one analysis, heat waves increased cardiovascular mortality by 17%, with greater intensity correlating with higher risk.
- Prolonged and lagged effects are particularly evident for stroke and ischemic heart disease resulting from the combined effects of dehydration, blood viscosity, and thermoregulatory strain

Cardiovascular Health Risks Associated with Heat Exposure

Cardiovascular Outcome	Heat Exposure Effects
Ischemic heart disease	↑ 7% Ischemic heart disease–related mortality associated with extreme heat (99th percentile vs MMT) ↑ Ischemic heart disease–related mortality and morbidity by 2.8% and 0.5% per 1° C rise above reference temperature, respectively
Stroke (ischemic and hemorrhagic)	↑ 10% stroke–related death associated with extreme heat (99th percentile vs MMT) ↑ Stroke–related mortality and morbidity by 3.8% and 0.4% per 1° C rise in temperature, respectively ↑ Stroke risk on days with extreme nighttime heat (odds ratio, 1.07)
HF	↑ 12% HF–related death associated with extreme heat (99th percentile vs MMT) ↑ 2.5 % HF–related mortality and morbidity by 2.5% and 1.0% per 1° C rise in temperature, respectively
Arrhythmia	↑ 1% risk arrhythmia–related emergency department visits per 1° C rise in temperature ↑ 5% Arrhythmia–related death associated with extreme heat (99th percentile vs MMT)
Cardiovascular mortality	↑ Cardiovascular mortality and morbidity by 2.1% and 0.5% per 1° C heat rise, respectively ↑ Cardiovascular mortality by 11.7% due to heat waves

Source: Hanneman K, Alahmad B, Ghosh A, Khatana SAM, Huang M, Liu J, Abadi A, Khraishah H, Beckie T, Rajagopalan S, Angell S; Circulation. 2026 Apr 21;153(16):e1130–e1150. doi: 10.1161/CIR.0000000000001419. Epub 2026 Mar 26. PMID: 41884891.

Pathophysiological Mechanisms of Cardiovascular Risk Modification by Heat

Mechanism	Impact
Myocardial ischemia	Heat exposure increase myocardial blood flow, potentially leading to myocardial ischemia in patients with coronary artery disease.
Blood pressure variability	Heat exposure can lead to hypotension and orthostatic instability, especially in individuals on antihypertensives.
Heart rate modulation	Heat induces tachycardia to compensate for vasodilation.
Neurohormonal activation	Heat activates the sympathetic nervous system, contributing to cardiovascular stress.
Inflammatory activation	Heat stress may trigger inflammatory cascades (eg, IL-6, TNF- α), coagulation activation, and endothelial dysfunction.
Electrolyte imbalance	Heat exposure may result in hypokalemia or hyperkalemia, increasing the risk of arrhythmias. Cold can prolong QT intervals and promote ventricular arrhythmias.
Psychological stress	Climate-related events heighten stress and anxiety, worsening cardiovascular outcomes and exacerbating health disparities, especially in marginalized populations.

CDC Heat & Health Tracker

Heat & Health Trends

- Extreme summer heat is increasing in the United States.
- **Climate projections indicate that extreme heat events will be more frequent and intense in coming decades.**
- While better forecasting, early heat warning systems, and increased access to air conditioning has helped to prevent some heat-related illness and death in recent decades, **extreme heat events still remain a cause of preventable death nationwide.**

CDC Heat & Health Tracker

Heat-Related Illness & Deaths

- Hot weather is associated with an increase in heat-related illnesses, including cardiovascular and respiratory complications, renal failure, electrolyte imbalance, kidney stones, negative impacts on fetal health, and preterm birth. Specifically, death rates are noted to rise during and after heat waves.

Deaths result from:

- Heat stroke and related conditions,
- Cardiovascular disease,
- Respiratory disease, and
- Cerebrovascular disease.

CDC Heat & Health Tracker

Heat Vulnerabilities

- Anyone can be at risk to the health effects of heat, but some are more vulnerable, including **pregnant women, people with heart or lung conditions, young children, older adults, athletes, and outdoor workers.**
- Additionally, urban heat islands, combined with an aging population and increased urbanization, are projected to increase the vulnerability of urban populations to heat-related health impacts in the future.

Population-Level Approaches to Address Extreme Heat

- Communicate this Heat Season – more than temperature advisories
- Ensure Availability of Cool Spaces for All
 - Air conditioning for all
 - Cooling stations
 - Greening
- Create Extreme Heat Event Response Plans to Protect At-Risk Communities and Workers

Primary Care's Preparedness for Extreme Weather Events

- Primary care teams are at the forefront of addressing extreme weather events.
- This demands a shift in mindset, recognizing the implications on patient health, community resilience, and healthcare delivery.
- Primary care practices and their teams should not only prepare for the immediate health issues associated with such events but should also act as champions of resilience and preparedness.
- Sooner or later, they may be called upon to play a vital role in addressing the needs of patients affected by extreme weather events, promoting resilience, and facilitating recovery.
- The imperative for primary care is clear — to be not only a responder but also an agent of change in the face of extreme weather events.

Extreme Heat and Chronic Disease: Improving Patient Outcomes

- Primary care plays a crucial role in understanding and addressing the impacts of climate change on chronic diseases and patient outcomes.
- Collaboration with patients, community leaders, and policymakers can bring about change and improve the quality of care all patients need.
- Providers must be empowered with this knowledge and take responsibility for the health of their patients and the planet.
- It is crucial for nurse practitioners to address environmental factors, chronic disease management, transportation, health care access, and financial strain when caring for such patients.

Climate-Smart Health Care: Role of Family Physicians

IMPACT Framework: Systems level and Exam Room level

- Identify risks – create a heat-vulnerable patient registry
- Manage heat-related medical issues
- Preventive measures – participate or advocate for “greening”
- Anticipate and reduce environmental exposures – clinical protocols and heat plans
- Cut low-value care – practice high value, evidence-based care to be good stewards of financial and environmental resources
- Telehealth maximization – an option during extreme events




Make a Heat Action Plan with Your Health Care Team



U.S. CENTERS FOR DISEASE CONTROL AND PREVENTION

1 Stay Cool

Try One Or More Of These:



Stay in the shade



Cooling Aids



Use a fan



Use an air conditioner

2 Stay Hydrated



3 Know the Symptoms

There are signs that your body may be getting too hot:



Sweating a lot



Very tired and weak



Dizzy, lightheaded, nauseated

 Call 911 if you have chest pain that is not going away, severe shortness of breath, or confusion. These may be signs your body is *already* too hot.

4 Check Air Quality



AQI (use to check air quality)

Heat Risk (use to check if it's too hot)

Clear Day



AQI (use to check air quality)

Heat Risk (use to check if it's too hot)

Poor Air Quality Day

Hot weather can make air quality worse.

5 Have a Medication Plan for Hot Weather

Some medications may make it harder for your body to cool down.
Some medications may not work well when they get hot.



Review your medications with your doctor



Store your medications in a cool place



Prepare for power outages

Protect Your Heart in the Heat

1. Check with your healthcare professional before starting an exercise routine if you are experiencing symptoms or have a specific medical question or chronic disease.
2. Choose well-ventilated shoes and socks that repel perspiration
3. Wear lightweight, light-colored clothing in breathable fabrics such as cotton or a synthetic fabric
4. Apply a water-resistant sunscreen with at least SPF 30 and reapply it every two hours
5. Stay hydrated
6. Take regular breaks
7. Watch for signs of heat stroke, heat exhaustion, heat cramps, and sunburn

Conclusion

- Heat can be dangerous
- Individuals can take measures to protect themselves.
- Primary care teams can take measures to protect their patients.
- Communities can enact policies and programs to protect the public's health.