Climate Adaptation to Extreme Urban Heat: Application Gaps
Overview

> Heat-health risk framework and drivers
> Evidence-based adaptation practice
> Relevant gaps
> Decision horizons and decision supports
> Ways forward
Risk Framework
Based on Yu et al. 2021
Points of Leverage

> Vulnerability
  – Widespread and latent
  – Multiple drivers
  – Certain common patterns

> Exposure
  – Somewhat concentrated
  – Variable modifiability

> Hazard
  – Worsening
  – Modified by built environment

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Evidence-based Practice

Community Preferences, Needs, and Values

Practitioner Expertise and Other Resources

Best Available Research Experience

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Collaboration | Community | Equity, Diversity and Anti-Racism | Meaningful Positive Impact | Innovation | Shared Learning

CDC
Adaptation after the Heat Dome

We know enough about the risks of extreme heat, and potential solutions, to save the lives of Washingtonians when the next extreme heat event occurs.
The Challenge

• We know what, in general, drives risk, and...
• We know what, in general, protects health, but...
• Communities have specific risk profiles, priorities, and needs

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Health Canada 2011
Relevant Gaps

> Holistic approach to problems and their management
> Decision-oriented supports for communities and practitioners
> Financial resources for interventions at scale
> Implementation science-based supports to increase uptake and promote iterative management
Health protections for heat are linked and frequently contingent.

The full impact of advances in forecasting depends on connecting forecasts with effective risk reduction measures.

Short- and medium-term risk interventions need to be coordinated.
Practitioner & Community Expertise

Households
Community-based Organizations
Faith-based Organizations
City/County Health or Regional Health District

City/County Emergency Management
Legislators
Governor's and/or Mayor's Office
Municipal building code, planners

Municipal/Regional parks
Washington State Building Code Council
Washington State Department of Commerce
Washington State Department of Health

Washington State Department of Ecology
Washington State Department of Labor & Industries
Washington State Department of Natural Resources
Washington State Emergency Management Division

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Decision Support

Risk Assessment
• What places are at risk and what are primary drivers?

Management Planning
• What options do we have, and how effective are they?

Implementation
• What should we prioritize and how do we best implement?

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1 to 15 years
Our Decision Support Tool

[Image: CLIMATE HEALTH and RISK TOOL]

CLIMATE HEALTH and RISK TOOL
Explore potential climate-related impacts to community health using interactive decision-support models

GLOBAL ENVIRONMENTAL CHANGE IS IMPACTING COMMUNITY HEALTH
Decision makers and community members need information about how climate-

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https://climatesmarthealth.org
Structure

Place-based Risk & Drivers
- High resolution
- Transparent
- Comprehensive
- Multiple hazard scenarios

Risk Reduction Opportunities
- Strategies
- Effectiveness
- Cost
- Timing

Synthesis
- Many points of entry
- Insights to advance discussions

WORKER PROTECTIONS

With rising global temperatures, workers may be increasingly required to work and perform tasks in high-temperature environments that may increase their risk of injury, illness, and death. High temperatures can exacerbate existing injuries and illnesses, and workplace factors, such as exposure to heat, dust, and noise, can compound these risks. Workers with pre-existing conditions or long-standing disabilities may be particularly vulnerable. Heat-related illness, including heat stress, heat stroke, and heat exhaustion, are common in hotter environments and can lead to heat exhaustion, heat cramps, and heat stroke. Work-related injuries and illnesses can also be exacerbated by extreme temperatures. High temperatures can increase the risk of heat-related illness and injury, including respiratory illness, which is increased during physical activity. Heat and humidity can reduce workers' ability to perform tasks, and the risk of injury and illness can be higher in hotter environments. Workers who are exposed to high temperatures are at risk of heat-related illness and injury, and it is important to protect workers from exposure to high-temperature environments. Workers who are exposed to high temperatures are at risk of heat-related illness and injury, and it is important to protect workers from exposure to high-temperature environments.
Fuzzy modeling is a tool for combining logical propositions using a hierarchical structure. For example, a proposition such as "Where is the weather most unpleasant" can be evaluated using the combination of other logical propositions, such as "Where is temperature the hottest?" and "Where is it most windy?".

Fuzzy modeling starts by transforming each characteristic that impacts each proposition in the model from its absolute value range, such as raw population count, to its fuzzy value range, such as Falsest to Truest for the proposition "population is high".

These propositions are then combined within a model to get to progressively higher-order propositions and eventually contribute toward the overall conclusion of the model.
Top Level Risk Estimates

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Population Exposure

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Risk Without Population Weighting

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Zooming In

Heat Health Risk on 2021-06-28
for Washington State

Overview
Census Tract 260.02, King County, Washington

Model node:
- **Heat Health Risk is High** 0.78
- Unweighted Heat Health Risk is High 0.78
- Adjusted Vulnerability is High 0.84
- Heat Hazard is High 0.78
- Population Exposure is High 0.87
- Population 331.6

Let Show histogram Show calculation details
Vulnerability
Diving Deeper

Heat Health Risk on 2021-06-28 for Washington State

- Vulnerability is High: 0.94
- Health Vulnerability is High: 0.51
- Socioeconomic Vulnerability is High: 1
- Local Environment is not Protective: 0.87

Heat Health Risk is High

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Areas for Potential Intervention
Landscape Amplifies Heat
Decision Guidance

Heat Health Risk on 2021-06-28 for Washington State

Overview
- Mobile Homes is High
- AC is Low
- Landscape Amplifies Heat
- Tree Canopy Cover is Low

About
Land use and land cover have profound influence on heat. Areas with less greenspace and tree cover heat more quickly, are not cooled by plant evapotranspiration, and retain more heat. Increasing tree cover, covering vacant lots with plants, and covering roofs with greenery can also reduce the urban heat island effect.

CHaRT Guidance
- Albedo Management Using Cooling Materials
- Tree Cover and Greenspace

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Albedo Management & Tree Cover

RISK REDUCTION GUIDANCE

ALBEDO MANAGEMENT USING COOL MATERIALS

Alan Wang, BA; Jeremy J. Hess, MD, MPH

ABSTRACT
Albedo is a measure that quantifies the proportion of incoming radiation reflected from a surface. Trees and cooler materials reflect more incoming radiation. In the built environment, particularly roofing and paving, these materials reduce heat island intensity and thus health impacts. Most urban environments have albedos between 0.15 and 0.20. There are no studies that have directly observed impacts of albedo management on health care utilization or mortality. On average, in simulation studies, increasing urban environment albedos by 1% drops temperatures by 0.04°F (0.02°C) and heat-related mortality by 1%. Albedo management is more effective when combined with other strategies, particularly increasing urban vegetation. The literature regarding the timing and cost of implementation is limited. Materials for increasing pavement albedo are approximately $7 per square meter (m²) or $35.79 per city block. Approximate installation costs for a new high albedo flat roof are $68/m² and $68/m² for a new high albedo residential pitched roof.

Last updated 13 June 2022

What is the intervention?

How effective is it at protecting people's health?

How long does it take to implement?

How much does it cost?

Are there downsides to consider?

What other strategies should be considered?

What are some good sources of additional information?

Risk Reduction Guidance

RISK REDUCTION GUIDANCE

TREE COVER AND GREENSPACE

Alan Wang, BA; Jeremy J. Hess, MD, MPH

ABSTRACT
Increasing urban tree cover has multiple health benefits, one of the most dramatic of which is reduced heat health risks. Trees reduce urban heat islands and thereby reduce heat island intensity and thus advance health effects of heat exposure. Tree canopy cover of at least 30% to 40% is optimal for health protection, and simulation studies have found that increasing tree canopy cover to this level results in reductions of hundreds of heat-related premature deaths annually in midsize to large cities in Europe and the U.S. There are few reports of the implementation time or cost of large scale tree planting campaigns. Planning and implementation may be complicated by local and state health regulations, should be considered in tandem with tree planting and reforestation in highly impacted communities, in order to provide maximum benefits while tree canopy interventions reach their maximum impact over several decades.

Last updated 19 June 2023

What is the intervention?

How effective is the intervention at protecting people’s health?

How long does this intervention take to implement?

How much does the intervention cost?

Are there downsides to consider?

What other strategies should be considered?

What are some good sources of additional information?

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Guidance

What is the intervention?
How effective is the intervention at protecting people’s health?
How long does the intervention take to implement?
How much does the intervention cost?
Are there downsides to consider?
What other strategies should be considered?
What are some good sources of additional information?
Planning at Other Levels
Linkage to Guidance

About

People who work outdoors often have particularly high heat exposure. They are commonly exerting themselves, and the heat load from this physical activity combines with the heat load from the environment to worsen heat exposure. Some outdoor work requires specialized protective equipment that can limit the ability to cool off. In situations where outdoor workers do not have adequate access to shade, water, and regular breaks, they can become dangerously dehydrated and suffer dehydration and heat-related illness. Heat can impair cognition and lead outdoor workers to make riskier decisions and incur more injuries as a result.

CHaRT Guidance

- Worker Protections
- Heat Early Warning Systems and Action Plans
Evidence-based Practice

Community Preferences, Needs, and Values

Practitioner Expertise and Other Resources

Best Available Research Experience
Opportunities for Enhancement

> **Upstream supports**
  - Linkage between heat mapping and vulnerability and risk assessment
  - Linkage with seasonal outlooks and forecasts
  - Development and integration of regional and local sociodemographic projections

> **Internal supports**
  - Leadership positions for managing climate-sensitive hazards and adaptations
  - Linkage with climate mitigation investments and infrastructure investments
  - Facilitated development of heat action plans and other policies

> **Downstream supports**
  - Investments to support implementation at scale
  - Support for interventions related to social determinants of health
  - Standardized surveillance and effectiveness measures
Thank You!

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