Data and Surveillance:

*How can we measure and monitor climate-related health effects?*

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Why surveillance matters

Maine Asthma ED visits 2001: daily percent change associated with ozone by age and sex groups, adjusted model.
Environmental Health Indicators of Climate Change for the United States: Findings from the State Environmental Health Indicator Collaborative

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OBJECTIVE: To develop public health adaptation strategies and to project the impacts of climate change on human health, indicators of vulnerability and preparedness along with accurate surveillance data on climate-sensitive health outcomes are needed. We researched and developed environmental health indicators for inputs into human health vulnerability assessments for climate change and to propose public health preventative actions.

DATA SOURCES: We conducted a review of the scientific literature to identify outcomes and actions that were related to climate change. Data sources included governmental and nongovernmental agencies and the published literature.

DATA EXTRACTION: Sources were identified and assessed for completeness, usability, and accuracy. Priority was then given to identifying longitudinal data sets that were applicable at the state and community level.

DATA SYNTHESIS: We present a list of surveillance indicators for practitioners and policy makers that include climate-sensitive health outcomes and environmental and vulnerability indicators, as well as mitigation, adaptation, and policy indicators of climate change.

CONCLUSIONS: A review of environmental health indicators for climate change shows that data exist for many of these measures, but more evaluation of their sensitivity and usefulness is needed. Further attention is necessary to increase data quality and availability and to develop new surveillance databases, especially for climate-sensitive morbidity.


established the State Environmental Health Indicators Collaborative (SEHIC) in 2004. SEHIC comprises a group of state-level environmental health practitioners interested in developing environmental public health indicators for use within environmental health surveillance and practice. The SEHIC first focused on developing indicators for air quality, asthma, and drinking water. Last year, it established a workgroup on climate change. This article presents the initial findings of that workgroup.

Materials and Methods
Indicators are quantitative summary measures that can be used to track changes in conditions by person, place, and time. The purpose of environmental health indicators as established by the SEHIC is to describe elements of environmental sources, hazards, exposures, health effects, and intervention and prevention activities. Indicators can be used to assess
CSTE SEHIC
Proposed indicators

• Environmental indicators
  – Greenhouse gases, temperature, etc.
• Morbidity/mortality indicators
  – Morbidity/mortality from heat, extreme weather, etc.
• Vulnerability indicators
  – Poverty, elderly living alone, vulnerability to sea level rise, etc.
• Mitigation indicators
  – Energy efficiencies, no. of vehicle miles traveled, etc.
• Adaptation indicators
  – Access to cooling centers, no. of heat wave warning systems, etc.
• Policy indicators
  – No. of states/cities participating in climate change initiatives, etc.
The Role of Environmental Public Health Tracking

Environmental causes of chronic diseases are hard to identify. Measuring amounts of hazardous substances in our environment in a standard way, tracking the spread of these over time and area, seeing how they show up in human tissues, and understanding how they may cause illness is critical. The National Environmental Public Health Tracking Network is the start of that system.

The National Environmental Public Health Tracking Network is a system of integrated health, exposure, and hazard information and data from a variety of national, state, and city sources. On the Tracking Network, you can explore information and view maps, tables, and charts about health and environment across the country.
The Role of Environmental Public Health Tracking

https://tracking.publichealth.maine.gov
Quick Facts: Asthma

What is asthma?
Asthma is a disease that affects the airways that carry oxygen in and out of the lungs. If you have asthma, the insides of those airways can be irritated and swollen. The airways for someone with asthma are more likely to react strongly to infections, allergens like pollen in the air, or irritants, like smoke and air pollution.

What can cause asthma or make it worse?
What causes asthma is not well known. Asthma can be made worse by environmental triggers like air pollution, pollen and other allergens. Two key air pollutants can affect asthma. One is ozone (found in smog). The other is particle pollution (found in haze, smoke, and dust). When ozone and particle pollution are in the air at higher levels, adults and children with asthma are more likely to have asthma-related health symptoms.

How is asthma tracked in Maine?
Asthma health symptoms can be serious enough to cause a person to seek medical care. In many cases, this is the hospital emergency room, but sometimes requiring a hospital stay. Tracking asthma hospital emergency room visits and hospital admissions allow for monitoring trends over time and identifying high risk groups. Tracking these measures can also inform prevention, evaluation and program planning efforts. To view tracked asthma data, use the “View Asthma Data” link under the Related Resources menu on the right.
The Role of Environmental Public Health Tracking

Asthma Hospitalizations by Public Health District

Customize (1):
- Measure: Rate
- Year(s): 2002-2006
- Sex: Female
- Age Group: 5-14 years

Customize (2):
- Measure: Rate
- Year(s): 2002-2006
- Sex: Male
- Age Group: 5-14 years
Surveillance of Heat Related Mortality

Why start with heat waves?

- More deaths from heat wave than all other weather events combined (CDC)
- Predicted to increase
- Currently ~700 U.S. heat-related deaths per year…
- If greenhouse gas emissions remain steady, estimated heat-related deaths in 2050 between 3,000 and 5,000 (CDC)
Heat waves in Maine??
Cooler climates are more vulnerable

Vulnerable to heat waves:
- Elderly living alone
- Those with chronic diseases
- Rural?

Maine is:
- 3rd nationwide for % of elderly residents living alone
- 5th nationwide for % of adults with asthma
- 2nd nationwide for % of population living outside urban areas
Example: Chicago heat wave of 1995

**July 12-16, 1995**

- Daily Max T: 93-106 F
- Record humidity
- Nightly Min T: high 70s/low 80s
- ~700 excess deaths
  - 85% increase over the same time period in 1994
Characteristics of Heat-Related Mortality

Figure: US Global Change Research Program
How to measure mortality?

Problem: How to determine whether a death is heat-related?

→ One solution: Count all-cause mortality during heat wave and compare to non-heat wave periods
How to measure heat waves?

- Problem: There is **no consistent, universal definition**
  - Best working definition is a ‘prolonged period of excessively hot weather’ – but workgroup is still determining what this means

- Problem: Many different ways to measure *heat*
Heat Waves - Augusta, ME - 2006

- Heat Waves identified using common definition (2 or more days with heat index ≥ 105)
- Heat Wave identified from news

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Daily maximum heat index

- Daily max HI >=105
- Daily max HI >=100
- Daily max HI >=95
- Hourly paired HI >=100
- Hourly paired HI >=95
- Hourly paired HI >=90

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Daily maximum apparent temperature

- Max AT >= 99th %ile
- Max AT >=95th %ile
- Max AT >=90th %ile

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Daily maximum temperature

- Max temp >=99th %ile
- Max temp >=95th %ile
- Max temp >=90th %ile

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Max temp >=90th %ile

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Heat Wave in Maine?
Mortality rate ratio example

Temperature and Deaths, Central Maine, 2006

1. Define a ‘heat wave’ period
2. Define a ‘reference’ period
3. Calculate the ratio of deaths in the heat wave period to deaths in the reference period
Temperature and Deaths, Central Maine, 2006

Heat wave deaths = 54
Reference period deaths = 42

Rate ratio = 54/42 = 1.29 → 29% more deaths than expected
95% Confidence Interval = 0.86-1.93
What comes next
Mortality rate ratio example: All ME

Reference period deaths = 224
Heat wave deaths = 220

Rate ratio = 220/224 = 0.98 \rightarrow 2\% \text{ fewer deaths than expected}

95\% \text{ Confidence Interval} = 0.82-1.18
European heat wave of 2003

Late July-August, 2003

• Daily maximum temperatures 10°C (18°F) higher than average

• Nightly minimum temperatures also elevated

• Between 35,000 and 55,000 excess deaths (~15,000 in France alone).
European heat wave of 2003

Daily temperature and deaths, France, 2003. Figure: Kalkstein et al., 2008. B Am Meteorol Soc, 89(1):75-85
Heat Waves in Maine?

- Cooler temperatures
- Smaller, more dispersed population

BUT…

Population: 1.3 million
Population: 2.8 million