Staying Cool on a Hot Planet: Dealing with Extreme Heat

Local Solutions:
Eastern Climate Preparedness Conference
May 1, 2018 | Manchester, NH

Matt Cahillane
Climate and Health
NH DHHS DPHS
603-271-4072
matthew.cahillane@dhhs.nh.gov

Katie Bush
Environmental Public Health Tracking
NH DHHS DPHS
603-271-1106
kathleen.bush@dhhs.nh.gov
Educational Objectives

• Identify challenges and opportunities in addressing rising temperatures, heat stress and actions to stay cool

• Report on findings of Heat and Health Study, and emphasize impact of moderate heat

• Report on findings of community-level interventions, and emphasize the need for evidence-based actions

• Discuss heat-related activities within our agency or community
Impact of Climate Change on Human Health

- Heat stress, cardiovascular failure
- Malnutrition, diarrhea, harmful algal blooms
- Anxiety, despair, depression, post-traumatic stress
- Injuries, fatalities
- Severe Weather
- Air Pollution
- Vector-borne Diseases
- Allergies
- Respiratory allergies, poison ivy
- Malaria, dengue, encephalitis, hantavirus, Rift Valley fever
- Asthma, cardiovascular disease
- Water and Food Supply
- Mental Health
- Environmental Refugees
- Forced migration, civil conflict
- Water-borne Diseases
- Cholera, cryptosporidiosis, campylobacter, leptospirosis

Adapted from J. Patz
Weather Fatalities 2016

- Flood: 126 (N/A), 84 (N/A)
- Lightning: 91 (N/A), 38 (N/A)
- Tornado: 105 (N/A), 18 (N/A)
- Hurricane: 70 (N/A), 11 (N/A)
- Heat: 131 (N/A), 94 (N/A), 97 (N/A)
- Winter: 30 (N/A), 30 (N/A)
- Cold: 39 (N/A), 31 (N/A)
- Wind: 57 (N/A), 46 (N/A)
- Rip Currents: 58 (N/A), 56 (N/A)

Legend:
- Gray: 10-Year Average (2007-2016)
- Yellow: 30-Year Average (1987-2016)
Intro to the BRACE Process

• Our charge: Building Resilience Against Climate Effects, so they can ‘bounce back’ or adapt to health threats
• Our peers: The framework is being tested in 16 states, 2 cities, and 3 tribal nations
• Our framework for action:
  A 5-step process
The Framework

01 Forecasting Climate Impacts and Assessing Vulnerabilities
02 Projecting the Disease Burden
03 Assessing Public Health Interventions
04 Developing and Implementing a Climate and Health Adaptation Plan
05 Evaluating Impact and Improving Quality of Activities

BRACE: Building Resilience Against Climate Effects
Intro to EPHT
Climate Trends in the Northeast

- The Northeast is getting warmer, wetter, with more extreme weather, and sea level rise.

Phase II – Health Trends. Explored adverse health outcome variables to identify trends, seasonality, and relation to exposure variables from 2001 – 2009

Phase III – Correlations. Evaluated the relationships between all exposure variables and all health outcome variables.
Data & Methodology

New Hampshire Limited Use Hospital Discharge Dataset (2001-2009)

- All-Cause Injury
- Vehicle Accidents
- Accidental Falls
- Accidents due to Natural or Environmental Causes
- Accidental Drowning
- Carbon Monoxide Poisoning

Methodology

- Created 10 mile buffers
- Ran descriptive statistics
- Calculated Injury Rates
- Calculated Correlations
- Ran Regression Analyses
Risk Estimates: Max Temp & All-Cause Injury

Risk Estimates Related to All-Cause Injuries

- Colebrook
- Berlin
- North Conway
- Hanover
- Lakeport
- Concord
- Durham
- Keene
- Nashua
- New Hampshire
**Overall Findings**

**TEMPERATURE:** The lowest annual minimum temperature is increasing (less very cold days). The number of days below freezing are increasing (more moderate cold days); No change in number of hot days.

**VEHICLE ACCIDENTS:** MVAs are decreasing at a statistically significant rate (with the exception of Keene);

**ACCIDENTAL FALLS:** Slips and falls are increasing at a statistically significant rate (with the exception of Berlin, Hanover, and North Conway).

**HEAT RELATED VISITS** have the highest cumulative relative risk of all exposure outcome pairs, highest risk in Hanover;

**ALL CAUSE & VEHICLE ACCIDENTS** have comparable relative risks, highest risk in Keene;

**ACCIDENTAL FALLS** indicates decreasing risk as temperatures increase, highest risk in North Conway.
## Climate Projections

### Northern New Hampshire

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Historical* 1980-2009</th>
<th>Change from historical (+ or -)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Short Term 2010-2039</strong></td>
<td><strong>Medium Term 2040-2069</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low Emissions</td>
<td>High Emissions</td>
</tr>
<tr>
<td>Temperature Extreme (days per year)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;32°F</td>
<td>178.0</td>
<td>-9.7</td>
<td>-11.3</td>
</tr>
<tr>
<td>&lt;0°F</td>
<td>28.0</td>
<td>-7.1</td>
<td>-7.0</td>
</tr>
<tr>
<td>&gt;90°F</td>
<td>3.4</td>
<td><strong>2.3</strong></td>
<td><strong>3.0</strong></td>
</tr>
<tr>
<td>&gt;95°F</td>
<td>0.4</td>
<td>0.3</td>
<td>0.6</td>
</tr>
</tbody>
</table>

### Southern New Hampshire

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Historical* 1980-2009</th>
<th>Change from historical (+ or -)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>Short Term 2010-2039</strong></td>
<td><strong>Medium Term 2040-2069</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Low Emissions</td>
<td>High Emissions</td>
</tr>
<tr>
<td>Temperature Extreme (days per year)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;32°F</td>
<td>164.0</td>
<td>-9.5</td>
<td>-10.9</td>
</tr>
<tr>
<td>&lt;0°F</td>
<td>16.0</td>
<td>-5.0</td>
<td>-5.1</td>
</tr>
<tr>
<td>&gt;90°F</td>
<td>6.7</td>
<td><strong>4.2</strong></td>
<td><strong>5.2</strong></td>
</tr>
<tr>
<td>&gt;95°F</td>
<td>1.0</td>
<td>0.8</td>
<td>1.2</td>
</tr>
</tbody>
</table>
Impact of Heat on Health

• The Northeast Regional Heat Collaborative

Lowering Our Heat Advisory Threshold to Protect Public Health
Rationale

Heat is a major threat to public health.

Limited information on:

• risk of ED visits,
• effects in the Northeast,
• impacts outside of large metropolitan areas.

Hypothesis: We can reduce heat-related illness and death by lowering the NWS heat advisory threshold and taking action sooner.
Key Questions

- How does heat index impact health?
- Are current Heat Advisories optimal for protecting public health in the Northeast?
- What can state and local health agencies do to reduce risk?
# Meteorological Characteristics

<table>
<thead>
<tr>
<th>Study Site</th>
<th>Maximum Daily Heat Index (F)</th>
<th>Average Annual Number of Days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median</td>
<td>75th Percentile</td>
</tr>
<tr>
<td>Concord</td>
<td>76</td>
<td>83</td>
</tr>
<tr>
<td>Keene</td>
<td>75</td>
<td>82</td>
</tr>
<tr>
<td>Laconia</td>
<td>74</td>
<td>81</td>
</tr>
<tr>
<td>Lebanon</td>
<td>75</td>
<td>81</td>
</tr>
<tr>
<td>Manchester</td>
<td>76</td>
<td>83</td>
</tr>
<tr>
<td>Nashua</td>
<td>78</td>
<td>85</td>
</tr>
<tr>
<td>Portsmouth</td>
<td>74</td>
<td>82</td>
</tr>
</tbody>
</table>
# Patient Characteristics

<table>
<thead>
<tr>
<th>Study Site</th>
<th>Emergency Dept Visits</th>
<th>Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median Age</td>
<td>Age ≥ 65 (%)</td>
</tr>
<tr>
<td>Concord</td>
<td>36</td>
<td>14.7</td>
</tr>
<tr>
<td>Keene</td>
<td>38</td>
<td>21</td>
</tr>
<tr>
<td>Laconia</td>
<td>38</td>
<td>20.6</td>
</tr>
<tr>
<td>Lebanon</td>
<td>39</td>
<td>19.2</td>
</tr>
<tr>
<td>Manchester</td>
<td>34</td>
<td>12.5</td>
</tr>
<tr>
<td>Nashua</td>
<td>36</td>
<td>14</td>
</tr>
<tr>
<td>Portsmouth</td>
<td>37</td>
<td>17.8</td>
</tr>
</tbody>
</table>
Heat and Health – Estimating risk

Risk of All-Cause ED Visits Over 1-week Lag
95F vs. 75F

Risk increases by 6.6% at 95F vs. 75F

Risk of all-cause ED visits increases with heat index.

If RR < 1 = negative association
If RR = 1 no association
If RR > 1 = positive association

Heat Index (°F)

Rate Ratio

1.15
1.10
1.05
1.00
0.95
0.90
Risk of All-Cause ED Visits by Study Location
Risk of All-Cause ED Visits by Cause, Season and Demographics
Summary of Results

For a day when the max heat index was 95°F (compared to 75°F):

- All-cause ED visits ↑ 6.6% over the following 7 days
- Heat-related ED visits ↑ 89% over the following 7 days
- Deaths ↑ 5.8% on the same day

Key point: Health effects occur at ‘moderate’ heat index below the current NWS threshold for a Heat Advisory.
Policy Change

OLD NWS THRESHOLDS FOR NORTHEAST

<table>
<thead>
<tr>
<th>HEAT ADVISORY</th>
<th>HEAT WARNING</th>
<th>HEAT WAVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>100°C - 104°F*</td>
<td>105°F and above</td>
<td>3 consecutive days 90°F or higher</td>
</tr>
</tbody>
</table>

*For 2 or more hours

NEW NWS THRESHOLDS FOR NORTHEAST

<table>
<thead>
<tr>
<th>HEAT ADVISORY</th>
<th>HEAT WARNING</th>
<th>HEAT WAVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>95-104°F*</td>
<td>105°F and above</td>
<td>3 consecutive days 90°F or higher</td>
</tr>
</tbody>
</table>

*For 2 or more days, or 100-104°F for any length of time*
## Taking Action in New Hampshire

### Updating the NH State Heat Plan

<table>
<thead>
<tr>
<th>Excessive Heat Outlook</th>
<th>Issued when the potential exists for a Heat Event in the next 3-7 days. An Excessive Heat Outlook provides information to those who need considerable lead time to prepare for the event.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Excessive Heat Advisory</strong></td>
<td>A Heat Advisory is issued within 12 hours of the onset of extremely dangerous heat conditions. Issued when the Heat Index (HI) is forecast to be at least 100°F for any length of time or 95°F for 2 consecutive days.</td>
</tr>
<tr>
<td><strong>Excessive Heat Warning</strong></td>
<td>An Excessive Heat Warning is issued within 12 hours of the onset of extremely dangerous heat conditions. Issued when the HI is forecast to be 105°F or higher for any length of time.</td>
</tr>
</tbody>
</table>
# Taking Action in New Hampshire

<table>
<thead>
<tr>
<th>Federal</th>
<th>National Weather Service Northeast Region</th>
</tr>
</thead>
<tbody>
<tr>
<td>State</td>
<td>Health and Human Services</td>
</tr>
<tr>
<td></td>
<td>• Health Alert Network</td>
</tr>
<tr>
<td></td>
<td>• Emergency Services Unit</td>
</tr>
<tr>
<td></td>
<td>• Public Information Office</td>
</tr>
<tr>
<td></td>
<td>• Bureau of Elderly and Adult Services</td>
</tr>
<tr>
<td></td>
<td>Homeland Security and Emergency Management</td>
</tr>
<tr>
<td></td>
<td>• State Emergency Operations Center</td>
</tr>
<tr>
<td></td>
<td>• ReadyNH</td>
</tr>
<tr>
<td></td>
<td>• Occupational health</td>
</tr>
<tr>
<td></td>
<td>Non-Governmental Orgs</td>
</tr>
<tr>
<td></td>
<td>• New Hampshire 211</td>
</tr>
<tr>
<td></td>
<td>• Home Care Association of New Hampshire</td>
</tr>
<tr>
<td></td>
<td>• New Hampshire Hospital Association</td>
</tr>
<tr>
<td></td>
<td>• New Hampshire Senior Center Association</td>
</tr>
<tr>
<td>Regional</td>
<td>Regional Public Health Networks</td>
</tr>
<tr>
<td></td>
<td>• Regional media</td>
</tr>
<tr>
<td></td>
<td>• ServiceLink</td>
</tr>
<tr>
<td></td>
<td>• Hospitals</td>
</tr>
<tr>
<td>Local</td>
<td>Emergency Management Directors</td>
</tr>
<tr>
<td></td>
<td>• Community organizations</td>
</tr>
<tr>
<td></td>
<td>• Local health departments</td>
</tr>
</tbody>
</table>

**Emergency Response Partners**
Taking Action in New Hampshire

Phases of Response

- Readiness: Excessive Heat Outlook or Watch
- Alert: Excessive Heat Advisory
- Emergency: Excessive Heat Warning
- Recovery: Removal of Advisory or Warning
Taking Action in New Hampshire

Activation Thresholds

### Single Day Events

<table>
<thead>
<tr>
<th>Forecast Lead Time (hours)</th>
<th>Heat Index (°F)</th>
<th>95</th>
<th>100</th>
<th>105</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Alert</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>Readiness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>72</td>
<td>Readiness</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>96</td>
<td>Readiness</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NWS issues a Heat Warning when the HI is forecast to be 105°F or above for any length of time.

NWS issues a Heat Advisory when the HI is forecast to be 100°F or above for any length of time, or 95°F for two consecutive days.

### Multi-Day Events

<table>
<thead>
<tr>
<th>Forecast Lead Time (hours)</th>
<th>Heat Index (°F)</th>
<th>90</th>
<th>95</th>
<th>100</th>
<th>105</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>90</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Readiness</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>72</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>96</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NWS issues a Heat Warning when the HI is forecast to be 105°F or above for any length of time.

NWS issues a Heat Advisory when the HI is forecast to be 100°F or above for any length of time, or 95°F for two consecutive days.
Heat-Vulnerable Populations

Extreme heat affects everyone, but some populations may be exceptionally vulnerable.

- CHILDREN
- EMERGENCY RESPONDERS
- THE ELDERLY
- OUTDOOR WORKERS
- ATHLETES
- PETS
## Evidence for Heat Interventions

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Description</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Heat Alert System</strong></td>
<td><em>Heat alert system</em> refers to a city preparing a comprehensive plan that is activated when temperatures exceed a threshold. The systems often have levels of incremental activities based on heat advisories by an agency that provides weather forecasts.</td>
<td>Sufficient</td>
</tr>
<tr>
<td><strong>Education &amp; Information</strong></td>
<td><em>Education and information</em> is when entities provide information about heat-related illness, and how to prevent, identify, and treat it.</td>
<td>Some</td>
</tr>
<tr>
<td><strong>Access to Cooling</strong></td>
<td><em>Access to cooling</em> refers to making air conditioned places publicly available for those who do not have access to air conditioning.</td>
<td>Some</td>
</tr>
<tr>
<td><strong>Real-Time Surveillance</strong></td>
<td><em>Real-Time Data Surveillance and Warnings</em> consists of monitoring ambient heat-related hospital visits, 9-11 calls, and weather data.</td>
<td>Little</td>
</tr>
<tr>
<td><strong>Built Environment</strong></td>
<td><em>Built environment</em> refers buildings &amp; public spaces designed to reduce outdoor and indoor temperatures.</td>
<td>Insufficient</td>
</tr>
<tr>
<td><strong>Zoning/Building Regulations</strong></td>
<td><em>Zoning/Building Regulations</em> are city codes to reduce ambient and indoor heat in residential or commercial development plans.</td>
<td>Insufficient</td>
</tr>
</tbody>
</table>

4 Climate Adaptation Projects

- Communities funded to plan & act via BRACE framework
- Focused on regional hazards, at-risk pops, and likely health impacts
  - Rural heat stress
  - Urban heat stress
  - Tickborne disease
  - Severe precipitation/flood
Resources Invested $

- Our community-level climate adaptation projects received $20k per year for 2-3 years

- Vendors needed significant training, tech support, and templates from state agency, DoH labor estimated at >30 hours per project

- Budget also included technical assistance from a project evaluation consultant at >20 hours per project

- Total investment of $40-60k per project

- Projects required a timeline of 4 years to raise funds, develop contract, implement interventions, and report on the impact
Heat Stress in Older Adults

- Target audience was caregivers & volunteers
- At-risk population was identified as older adults (65+) living alone
- Found access to elders via activity events & existing meal delivery service
Upper Valley Education Project

- Engaged with a focus group of local advisors to assess climate hazards & community wants/needs
- Prioritized areas of rising temps, heat stress and injury among older adults, especially those living alone (shut-ins)
- Intervened via education lecture to target audience of 39 caregivers to teach risk factors, then they reached out to older adults
Preliminary Results

Training

- Train the Trainer
  - Trained 4 people from 3 organizations, then these people trained 26 volunteers and 13 staff in direct contact with older adults (39 total)

- Educational materials
  - Toolkit
  - Information Card
  - Tumbler
  - Magnets

Evaluation

- Pre-test Surveys (39)
- Post-test Surveys (12)
- Demonstrated small increases in knowledge (5-10%), large loss to follow up (70%)

Contact Results

- 156 Contacts, and 29 Follow Ups
- 129 at Senior Lunches
Factsheet for Older Adults

Simple content and format:
• Stay Cool
• Stay Hydrated
• Stay Informed

IT'S HOT OUTSIDE!
STAY COOL.
STAY HYDRATED.
STAY INFORMED.

Hot weather can be a serious health risk for seniors! When the temperature rises above 80 degrees, take action to stay cool, hydrated, informed, and healthy.

Stay cool
- Spend time in an air conditioned place on hot days when the temperature rises above 80 degrees.
- Make a plan to spend time somewhere air conditioned in your community if your home is too hot, like your senior center or library.
  If you cannot get to air conditioning:
- Use a fan, but fans may not help you cool off if temperatures rise above 90 degrees (A/C is best on very hot days).
- Take a cool bath or shower, or cool your skin with a damp washcloth or ice pack.

Stay hydrated
- Drink more water than usual during hot weather. Don’t wait until you’re thirsty to drink.

Stay informed
- Keep track of your local weather report. Watch for when the temperature rises above 80 degrees, and keep an eye out for information about heat safety.
- Check in with a friend or relative twice a day to let them know that you’re staying cool, hydrated and healthy.
Nashua Heat Stress Training and Awareness

- Target audience was municipal emergency managers who were in charge of preparedness and response.
- At-risk population was defined as urban and sub-urban residents, some affected by heat island effect.
- Created access to emergency managers via an existing training event.

Heat map of urban hot spots in the Greater Nashua region.
Nashua Area Education Project

- Engage with local advisors to assess climate hazards & community wants/needs
- Prioritized areas of rising temps, heat stress and injury among all residents, with a focus on low-income neighborhoods
- Intervened via education lecture to target audience of 20 emergency managers
- Evaluation showed small increase in knowledge on a quiz, no loss to follow up as pre-post tested on same day
Factsheet for Urban Area

Simple content and format:
• What to do
• Who’s at risk
• Warning signs
Lessons Learned

• Planning and choosing climate hazards took a lot of time and energy, which delayed the intervention process

• Interventions produced modest change in knowledge

• Agency capacity building and partnerships may be worth more than the change in knowledge or behavior

• In the future, fund fewer projects with more focused attention on methods, taking action and support for evaluating success

• In the future, limit the # hazard types in order to maximize intervention efforts
Developing an Action Plan

1. What ideas do you have for next steps / future work?
2. What heat-related work are you doing in your community?
3. How will you incorporate what you learned today into your work?
4. What is one concrete thing you will implement this Heat Season?
5. Who is the target audience?
6. How will you measure your impact?
Additional Discussion

**Establishing Communication Channels**
- How does your jurisdiction/organization receive weather alerts?
- How do you share this information with others?
- How can you increase community awareness of heat events?
- What are the key messages?

**Identifying Vulnerable Populations**
- Who are the most vulnerable populations in your jurisdiction/organization?
- How do you reach vulnerable populations during a heat event?

**Implementing Heat Response Plans**
- What are the triggers for action in your jurisdiction/organization?
- How and when are key messages disseminated?
- What are the most important actions to take during a heat event?
Thank you.

Questions? Comments? Feedback?

Matt Cahillane
Climate and Health
NH DHHS DPHS
603-271-4072
matthew.cahillane@dhhs.nh.gov

Katie Bush
Environmental Public Health Tracking
NH DHHS DPHS
603-271-1106
kathleen.bush@dhhs.nh.gov
CDC Acknowledgements

• This work was supported by the Centers for Disease Control and Prevention (CDC) - Climate Ready States and Cities Initiative Cooperative Agreement (CDC-RFA-EH16-1602).

• Contents of this presentation are the views of the authors and do not reflect the official views of the CDC or their respective health agencies.

• Please visit and support the CDC at:
  https://www.cdc.gov/climateandhealth/default.htm