

The State of Climate Adaptation in Public Health

An Assessment of 16 U.S. States

Rachel M. Gregg, Kathryn N. Braddock, and Jessi M.
Kershner

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P.O. Box 11195
Bainbridge Island, WA 98110

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For more information about this report, please contact Rachel M. Gregg at Rachel@EcoAdapt.org.

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Executive Summary

Climate change poses significant threats to the health of individuals and communities, as well as the delivery of healthcare services. Human morbidity and mortality rates are rising due to extreme heat events and changing patterns of water-borne and vector-borne diseases, and healthcare infrastructure is at risk from extreme events. Climate adaptation actions are taken to either avoid or take advantage of climate change impacts either by decreasing vulnerability or increasing resilience.

As part of EcoAdapt's State of Adaptation Program,¹ we partnered with the Natural Resources Defense Council to assess the state of climate adaptation planning and implementation for climate-related threats to public health in 16 U.S. states. Our objectives were to:

1. assess understanding among public health officials of climate change impacts;
2. document activities – planned and underway – to prepare for and respond to climate-related challenges;
3. synthesize findings in case studies to inform adaptation planning in other states; and
4. create a public health topic page on the Climate Adaptation Knowledge Exchange (CAKE; www.CAKEx.org) to share relevant resources, tools, and case studies.²

The 16 states chosen for the analysis – Colorado, Florida, Illinois, Iowa, Michigan, Missouri, Nevada, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, Virginia, Washington, and Wisconsin – include a cross-section of areas in which the Natural Resources Defense Council is engaged in climate and clean energy advocacy work, states included in the Strong, Prosperous, and Resilient Communities Challenge program, and a subset of those in which the Building Resilience Against Climate Effects framework is being operationalized.

We categorized states as those with:

1. A statewide climate action or adaptation plan but no standalone public health department plan (Washington, Colorado, New York, Pennsylvania, Virginia, Florida);
2. A public health department climate action or adaptation plan but no statewide plan (Wisconsin, Michigan, North Carolina);
3. Neither a statewide nor public health department plan (Nevada, Iowa, Missouri, Illinois, Ohio, New Jersey); and
4. Both a statewide and public health department plan (Oregon).

We examined if and how climate change is being integrated into activities at state public health departments. The majority of initiatives at the state health departments we surveyed are focused on capacity building, primarily environmental health monitoring; vulnerability assessment and adaptation planning efforts; public awareness outreach and communication campaigns related to climate change; and collaborating with local health departments, tribal agencies, and nongovernmental organizations. Eighteen full-length case studies are presented on how various practitioners are integrating climate change into public health.

¹ EcoAdapt State of Adaptation Program: <http://ecoadapt.org/programs/state-of-adaptation>

² CAKE Public Health Topic Page: <https://www.cakex.org/resources/sector/public-health-492>

Project Background

Climate change poses significant threats to the health of individuals and communities, as well as the delivery of healthcare services. Human morbidity and mortality rates are expected to rise due to extreme heat events and changing patterns of water- and vector-borne diseases, and health care infrastructure is at risk from extreme events. EcoAdapt partnered with the Natural Resources Defense Council to assess the state of climate adaptation planning and implementation for climate-related threats to public health in 16 U.S. states. Using a four-step process (Figure 1), our objectives were to (1) assess understanding among public health officials of climate change impacts; (2) document activities – planned and underway – to prepare for and respond to climate-related challenges; (3) synthesize findings in case studies to inform adaptation planning in other states; and (4) create a public health topic page on the Climate Adaptation Knowledge Exchange (CAKE; www.CAKEx.org) to share relevant resources, tools, and case studies.²

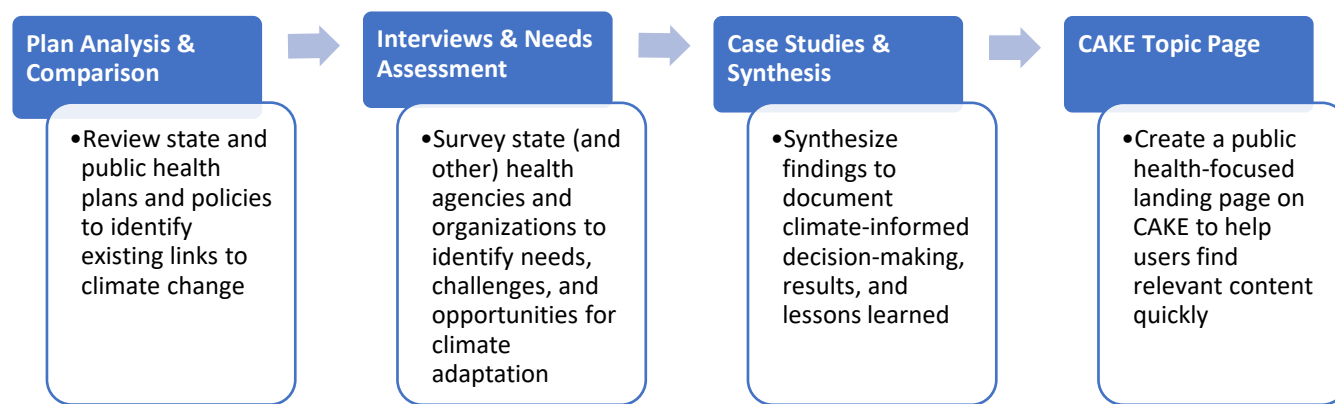


Figure 1. Four-step project process.

The 16 states chosen for the analysis included those in the West (Colorado, Nevada, Oregon, Washington), Midwest/Great Lakes (Illinois, Iowa, Michigan, Missouri, Ohio, Wisconsin), Northeast (New Jersey, New York, Pennsylvania), and Southeast (North Carolina, Virginia, Florida). These states include a cross-section of areas in which the Natural Resources Defense Council is engaged in climate and clean energy advocacy work, states included in the Strong, Prosperous, and Resilient Communities Challenge (SPARCC) program, and a subset of those in which the Centers for Disease Control and Prevention (CDC) Building Resilience Against Climate Effects (BRACE) framework is being operationalized.

Research questions guiding the project included:

- Is there a mandate for climate adaptation planning in the state?
- What is the status of adaptation planning in the public health department?
- What are the specific barriers to developing health-related adaptation plans, implementing the plans, or merging adaptation and mitigation plans?
- Are there key nongovernmental actors working to advance health-related climate adaptation?
- What are the core lessons learned that can inform other climate-informed public health processes?

Climate Change Impacts on Public Health

Climate change affects public health in a number of ways. The complex interactions between climatic and non-climatic stressors such as increasing air temperatures, changes in precipitation regimes, air and water pollution, and social and economic inequities drive myriad health responses in individuals and communities. Over the last 35+ years, the 16 states included in this project have been affected by over 790 weather-related disasters, including droughts, wildfires, flooding, and severe storms.³

Climate-driven changes are contributing to decreased air quality; increased ground level ozone and particulate matter; increased asthma attacks and premature deaths; prolonged pollen and allergy seasons; increased mold growth and persistence due to increased temperatures and precipitation; heat-related illnesses (e.g., heat exhaustion, heat stroke) and death; and susceptibility to water-, food-, and vector-borne diseases. Additional information on observed and projected future climatic changes in the United States⁴ and effects on public health^{5,6} have been well-documented elsewhere.

Human health is a product of interactions between the natural, built, and social environments. However, climate-driven health risks are not equally distributed across communities. The state of human health depends on interactions between exposure to the physical environment, vulnerability to threats, and human behavior. For example, inequitable living conditions may lead to increased risk from flooding or high levels of exposure to air pollution. The vulnerability of a population to climate-related public health impacts is influenced by social determinants that shape the degree to which they are able to resist, promote resilience, and respond to threats. Social determinants of health (SDOH) greatly affect health inequalities as they influence both the ways in which people function in society and the distributions of wealth, power, and resources.⁷ The U.S. Office of Disease Prevention and Health Promotion developed five SDOH categories as part of the Healthy People 2020 initiative: economic stability, education, social and community context, health and health care, and neighborhood and built environment.⁸ Variables within these categories include living wage income, gender, race, location, current health and healthcare status, age, food insecurity, transportation options, safe drinking water and water supply, and air quality. Through investigating determinants of health and vulnerabilities impacting exposure and adaptive capacity, the needs of communities can better be addressed in response to climate-related threats to environmental and public health, health services, and social justice. Key stressors and effects on public health and healthcare services are presented in Table 1. This list is not meant to be comprehensive as more detailed analyses on climatic effects on public health and healthcare services are presented elsewhere.

³ U.S. Billion-Dollar Weather and Climate Disasters: <https://www.ncdc.noaa.gov/billions>

⁴ Fourth National Climate Assessment: <https://nca2018.globalchange.gov>

⁵ The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment: <https://health2016.globalchange.gov>

⁶ CDC Climate Effects on Health: <https://www.cdc.gov/climateandhealth/effects/default.htm>

⁷ World Health Organization Social determinants of health: https://www.who.int/social_determinants/sdh_definition/en

⁸ HealthyPeople Social determinants of health: <https://www.healthypeople.gov/2020/topics-objectives/topic/social-determinants-of-health>

Table 1. Examples of climate and non-climate factors that affect public health and healthcare services.

Exposure Pathways	Climatic and Non-Climatic Drivers and Stressors	Social Determinants	Examples of Effects on Health and Healthcare Services
Air Quality	<ul style="list-style-type: none"> • Increasing air temperatures and heat waves 	<ul style="list-style-type: none"> • Race and ethnicity 	<ul style="list-style-type: none"> • Respiratory and cardiovascular illnesses
Extreme Heat	<ul style="list-style-type: none"> • Increasing water temperatures 	<ul style="list-style-type: none"> • Age and gender 	<ul style="list-style-type: none"> • Heat-related illnesses and mortality
Flooding	<ul style="list-style-type: none"> • Changes in precipitation amount and timing 	<ul style="list-style-type: none"> • Economic stability (e.g., living wage income) 	<ul style="list-style-type: none"> • Injuries and fatalities • Neurological diseases
Water Quality and Supply	<ul style="list-style-type: none"> • Increasing ground-level ozone and particulate matter • Wildfire • Drought 	<ul style="list-style-type: none"> • Housing and transportation options 	<ul style="list-style-type: none"> • Vector-borne diseases (e.g., Lyme disease, West Nile virus, Zika, hantavirus, leptospirosis, etc.) • Emotional and psychological illnesses and grief • Negative birth outcomes
Vector Ecology	<ul style="list-style-type: none"> • Sea level rise and saltwater intrusion • Frequency and severity of storms 	<ul style="list-style-type: none"> • Poverty • Education • Access to services 	<ul style="list-style-type: none"> • Displacement of individuals and communities • Food and water contamination (e.g., <i>Salmonella</i>, gastrointestinal illnesses, mercury contamination in seafood)
Food Quality and Supply	<ul style="list-style-type: none"> • Harmful algal blooms • Range shifts of pests • Airborne allergens (e.g., ragweed), toxins, and particulate matter • Flooding and land-based runoff of pollutants and pathogens • Urban heat islands 	<ul style="list-style-type: none"> • Pre-existing health conditions • Geographic location 	<ul style="list-style-type: none"> • Food security and nutrition issues (e.g., disruption in food supply chain due to inaccessible transportation routes from extreme events) • Disruption or damage to healthcare infrastructure • Stress on energy systems that may lead to power outages

Climate and Health Plan Comparison

The first step of this project was to analyze existing plans and policies that may enable climate action on public health. Our first effort was focused on determining if each state and the state's health department had a climate action or adaptation plan (Figure 2) and to categorize states as those with:

1. A statewide climate action or adaptation plan but no standalone public health department plan (6 states – Washington, Colorado, New York, Pennsylvania, Virginia, Florida);
2. A public health department climate action or adaptation plan but no statewide plan (3 states – Wisconsin, Michigan, North Carolina);
3. Neither a statewide nor public health department plan (6 states – Nevada, Iowa, Missouri, Illinois, Ohio, New Jersey); and
4. Both a statewide and public health department plan (1 state – Oregon).

We used these categories to identify interviewees and guide the interview questions.

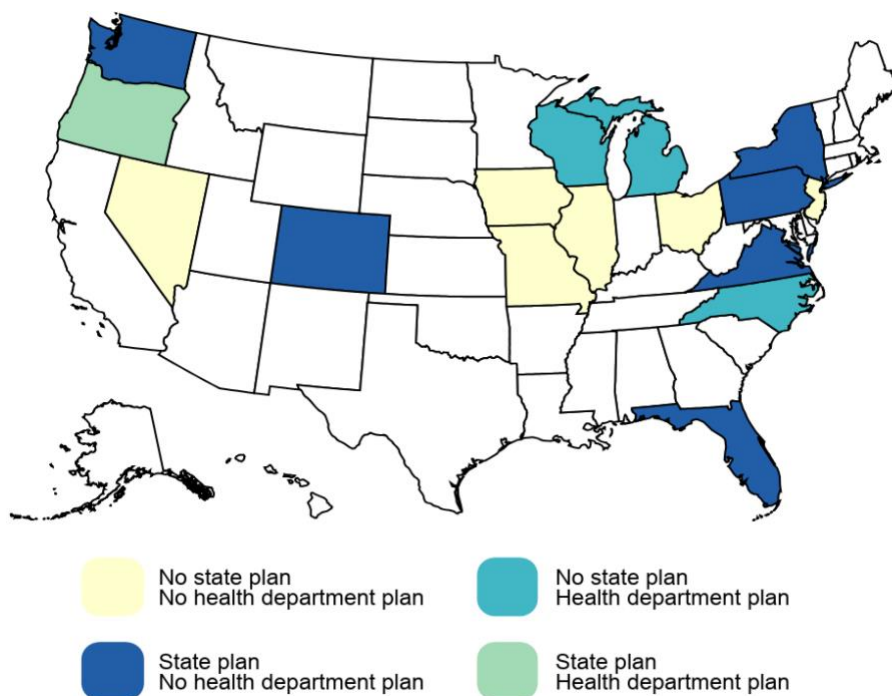


Figure 2. State-by-state plan comparison.

- **Category 1 states (state plan, no health department plan):** How is health included in the state climate plan? Are planning activities at the public health department underway and at what stage is the planning (e.g., forecasting impacts, assessing vulnerability, identifying interventions, prioritizing actions for implementation)?
- **Category 2 states (no state plan, health department plan):** Does the health department plan address most of or all the major climate-related health threats? Is the plan being implemented and monitored? Are there any results or lessons learned that can be shared?
- **Category 3 states (neither state nor health department plan):** Is there any climate change planning underway? If so, how? Is there action occurring at other state agencies or at the tribal, county, or city level?
- **Category 4 states (both a state and health department plan):** How is public health incorporated into state agency and health department planning and implementation?

We also examined state hazard mitigation plans for links to public health and safety as part of emergency preparedness and disaster response concerns. Table 2 presents the comparison of all three plan types – statewide climate plan, public health department plan, statewide hazard mitigation plan – in each state by major climate change impacts and public health concerns included in each plan. Some states do not have a formal climate action or adaptation plan but have completed reports on greenhouse gas emissions and potential impacts, such as Illinois, Iowa, Michigan, Nevada, New Jersey, North Carolina, and Wisconsin, whereas all 16 states have completed formal hazard mitigation plans. Finally, it is important to note that as of May 2019, 12 of the 16 states have formally joined the U.S. Climate Alliance, a collaboration between states seeking to take climate adaptation and mitigation action, particularly by meeting the goals of the Paris Agreement to reduce greenhouse gas emissions by 26-28% below 2005 levels by 2025.⁹ These states include Colorado, Illinois, Michigan, Nevada, New Jersey, New York, North Carolina, Oregon, Pennsylvania, Virginia, Washington, and Wisconsin.

⁹ U.S. Climate Alliance: <https://www.usclimatealliance.org/>

Table 2. Major climate impacts and public health concerns noted in each state's climate action or adaptation plans, public health department plans, and hazard mitigation plans.

All health department plans are available on the CAKE public health topic page at

<https://www.cakex.org/resources/sector/public-health-492>. The state climate and hazard mitigation plans are also available on CAKE; links may be found in Appendix A.

State	State Climate Action/Adaptation Plan	Health Department Climate Plan	State Hazard Mitigation Plan
<i>Colorado</i>	Colorado Climate Plan (2015) <ul style="list-style-type: none"> • Extreme Weather • Air Quality • Food Impacts: Disease and Security • Zoonotic & Vector-borne Disease • Greenhouse Gas Emissions 	No plan	Colorado Natural Hazard Mitigation Plan (2018) <ul style="list-style-type: none"> • Extreme Temperatures • Drought • Wildfire • Extreme Weather • Inland Flooding • Air Quality • Ecological Impacts: Threats to Biodiversity, Pests, Invasive Species • Zoonotic & Vector-borne Disease
<i>Florida</i>	Florida's Energy and Climate Change Action Plan (2008) <ul style="list-style-type: none"> • Sea Level Rise • Extreme Weather • Air Quality • Food Impacts: Disease and Security • Zoonotic & Vector-borne Disease • Greenhouse Gas Emissions 	No plan	State Hazard Mitigation Plan 2018 Update (2018) <ul style="list-style-type: none"> • Extreme Temperatures • Drought • Wildfire • Sea Level Rise • Extreme Weather • Coastal & Inland Flooding • Ecological Impacts: Threats to Biodiversity, Pests, Invasive Species
<i>Illinois</i>	No plan Report of the Illinois Climate Change Advisory Group (2007) <ul style="list-style-type: none"> • Air Quality • Greenhouse Gas Emissions 	No plan	Illinois Natural Hazard Mitigation Plan (2018) <ul style="list-style-type: none"> • Extreme Temperatures • Precipitation Changes • Drought • Extreme Weather • Coastal & Inland Flooding
<i>Iowa</i>	No plan Iowa Climate Change Advisory Council Report (2008) <ul style="list-style-type: none"> • Water Quality & Supply • Air Quality • Greenhouse Gas Emissions 	No plan	Iowa Hazard Mitigation Plan (2013) <ul style="list-style-type: none"> • Precipitation Changes • Extreme Weather
<i>Michigan</i>	No plan Michigan Climate Action Council Plan (2009) <ul style="list-style-type: none"> • Air Quality • Food Impacts: Disease and Security • Greenhouse Gas Emissions 	Michigan Climate Adaptation Program Strategic Plan (2016) <ul style="list-style-type: none"> • Extreme Temperatures • Extreme Weather • Air Quality • Water-borne Disease • Zoonotic & Vector-borne Disease 	Michigan Hazard Mitigation Plan (2019) <ul style="list-style-type: none"> • Extreme Temperatures • Drought • Extreme Weather • Coastal & Inland Flooding • Air Quality • Ecological Impacts: Threats to Biodiversity, Pests, Invasive Species

State	State Climate Action/Adaptation Plan	Health Department Climate Plan	State Hazard Mitigation Plan
<i>Missouri</i>	No plan	No plan	Missouri State Hazard Mitigation Plan (2018) <ul style="list-style-type: none"> • Extreme Temperatures • Precipitation Changes • Drought • Wildfire • Extreme Weather • Coastal & Inland Flooding • Water Quality & Supply
<i>Nevada</i>	No plan Nevada Climate Change Advisory Committee Final Report (2008) <ul style="list-style-type: none"> • Extreme Temperatures • Drought • Wildfire • Inland Flooding • Water Quality & Supply • Air Quality • Greenhouse Gas Emissions 	No plan	Nevada Enhanced Hazard Mitigation Plan (2018) <ul style="list-style-type: none"> • Extreme Temperatures • Drought • Wildfire
<i>New Jersey</i>	No plan New Jersey's Global Warming Response Act Recommendations Report (2009) <ul style="list-style-type: none"> • Water Quality & Supply • Air Quality • Greenhouse Gas Emissions 	No plan	New Jersey State Hazard Mitigation Plan (2014) <ul style="list-style-type: none"> • Extreme Temperatures • Wildfire • Sea Level Rise • Extreme Weather • Coastal & Inland Flooding • Coastal Erosion • Air Quality
<i>New York</i>	New York State Climate Action Plan (2010) <ul style="list-style-type: none"> • Extreme Temperatures • Extreme Weather • Coastal & Inland Flooding • Water Quality & Supply • Air Quality • Zoonotic & Vector-borne Disease • Greenhouse Gas Emissions 	No plan	New York State Hazard Mitigation Plan (2019) <ul style="list-style-type: none"> • Drought • Wildfire • Extreme Weather • Coastal & Inland Flooding • Coastal Erosion
<i>North Carolina</i>	No plan Recommended Mitigation Options for Controlling Greenhouse Gas Emissions (2008) <ul style="list-style-type: none"> • Greenhouse Gas Emissions 	Climate and Health Adaptation Plan (2016) <ul style="list-style-type: none"> • Extreme Temperatures • Wildfire • Air Quality 	North Carolina Hazard Mitigation Plan (2018) <ul style="list-style-type: none"> • Extreme Temperatures • Drought • Wildfire • Extreme Weather • Coastal & Inland Flooding • Zoonotic & Vector-borne Disease
<i>Ohio</i>	No plan	No plan	Ohio Standard Hazard Mitigation Plan (2014) <ul style="list-style-type: none"> • Extreme Temperatures • Drought • Coastal & Inland Flooding • Water Quality & Supply • Ecological Impacts: Threats to Biodiversity, Pests, Invasive Species

State	State Climate Action/Adaptation Plan	Health Department Climate Plan	State Hazard Mitigation Plan
<i>Oregon</i>	Oregon Climate Change Adaptation Framework (2010) <ul style="list-style-type: none"> • Extreme Temperatures • Wildfire • Water Quality & Supply • Air Quality • Zoonotic & Vector-borne Disease • Greenhouse Gas Emissions 	Climate and Health Resilience Plan (2016) <ul style="list-style-type: none"> • Drought • Wildfire • Extreme Weather • Coastal & Inland Flooding • Water Quality & Supply • Air Quality 	Oregon Natural Hazards Mitigation Plan (2015) <ul style="list-style-type: none"> • Drought • Wildfire • Extreme Weather • Coastal & Inland Flooding
<i>Pennsylvania</i>	Pennsylvania Climate Change Action Plan (2019) <ul style="list-style-type: none"> • Extreme Temperatures • Extreme Weather • Coastal & Inland Flooding • Water Quality & Supply • Air Quality • Water-borne Disease • Greenhouse Gas Emissions • Ecological Impacts: Threats to Biodiversity, Pests, Invasive Species • Zoonotic & Vector-borne Disease 	No plan	Pennsylvania State Hazard Mitigation Plan (2018) <ul style="list-style-type: none"> • Extreme Temperatures • Drought • Wildfire • Extreme Weather • Coastal & Inland Flooding • Ecological Impacts: Threats to Biodiversity, Pests, Invasive Species • Zoonotic & Vector-borne Disease
<i>Virginia</i>	Virginia Governor's Commission on Climate Change: A Climate Change Action Plan (2008) <ul style="list-style-type: none"> • Sea Level Rise • Extreme Weather • Coastal & Inland Flooding • Air Quality • Greenhouse Gas Emissions 	No plan	Commonwealth of Virginia Hazard Mitigation Plan (2018) <ul style="list-style-type: none"> • Extreme Temperatures • Drought
<i>Washington</i>	Washington State's Integrated Climate Response Strategy (2012) <ul style="list-style-type: none"> • Extreme Temperatures • Drought • Wildfire • Sea Level Rise • Extreme Weather • Coastal & Inland Flooding • Water Quality & Supply • Air Quality • Zoonotic & Vector-borne Disease • Greenhouse Gas Emissions 	No plan	Washington State Enhanced Hazard Mitigation Plan (2016) <ul style="list-style-type: none"> • Wildfire • Sea Level Rise • Extreme Weather • Coastal & Inland Flooding
<i>Wisconsin</i>	No plan Strategy for Reducing Global Warming (2008) <ul style="list-style-type: none"> • Greenhouse Gas Emissions 	Climate and Health Adaptation Plan (2016) <ul style="list-style-type: none"> • Extreme Temperatures • Drought • Extreme Weather • Coastal & Inland Flooding • Water Quality & Supply • Zoonotic & Vector-borne Disease 	Wisconsin Hazard Mitigation Plan (2016) <ul style="list-style-type: none"> • Extreme Temperatures • Precipitation Changes • Drought • Wildfire • Extreme Weather • Coastal & Inland Flooding • Coastal Erosion • Zoonotic & Vector-borne Disease

Interview and Survey Results

In order to identify climate-informed public health activities underway and to better understand the needs of public health professionals, we conducted interviews and released a complementary online survey. A contact list was compiled of individuals from state public health departments and other agencies and organizations likely to know about climate-related public health efforts within the 16 states. The Social Vulnerability Index (SVI) of cities and counties within the 16 states examined for this study were taken into consideration when identifying interview and survey participants.¹⁰ For example, when selecting local agencies or organizations to interview, the project team looked at SVI scores to select areas that are acutely vulnerable (e.g., Philadelphia). A unified set of questions and interview guide were created and a coding scheme for answers was designed in order to make tracking and cross-referencing possible. The online survey used a structured approach with multiple choice options provided from which respondents could select (Appendix B). Survey responses were collected through SurveyMonkey, a web-based survey company, between October 2018 and January 2019. The survey was sent to a list of 50 individuals and we collected 38 complete responses. The results presented below include the responses from 54 unique individuals (combined 38 survey and 16 interview responses; n=54).

Respondents

Participants in the interviews and surveys primarily included public health officials (30%) (Table 3). The largest number of participants overall represent state health agencies (31%), followed by county (20%), nongovernmental (19%), and city (17%) agencies (Figure 3). Respondents represented one or more of the following aspects of public health – physical (80%), mental (42%), behavioral (35%), and healthcare infrastructure (e.g., hospitals, clinics) (28%).

Table 3. Interviewee and survey participants' position types (n=54).

Type of Position	Percentage
Public Health Official	30%
Scientist/Researcher	19%
Manager	10%
Epidemiologist	9%
Physician/Nurse/Assistant	7%
Emergency Planner/Manager	7%
Communications/Education	6%
Environmental Consultant	6%
Government Official	6%

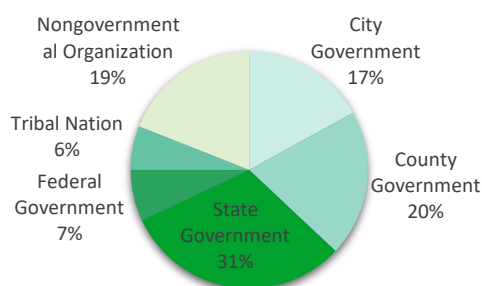


Figure 3. Professional affiliations of interviewees and survey respondents (n=54).

¹⁰ Social Vulnerability Index: <https://svi.cdc.gov/map.html>

Respondents were also asked to indicate the state(s) in which they work (Figure 4). Most respondents represent Oregon (10%), Washington (9%), Illinois (8%), and Virginia (8%).

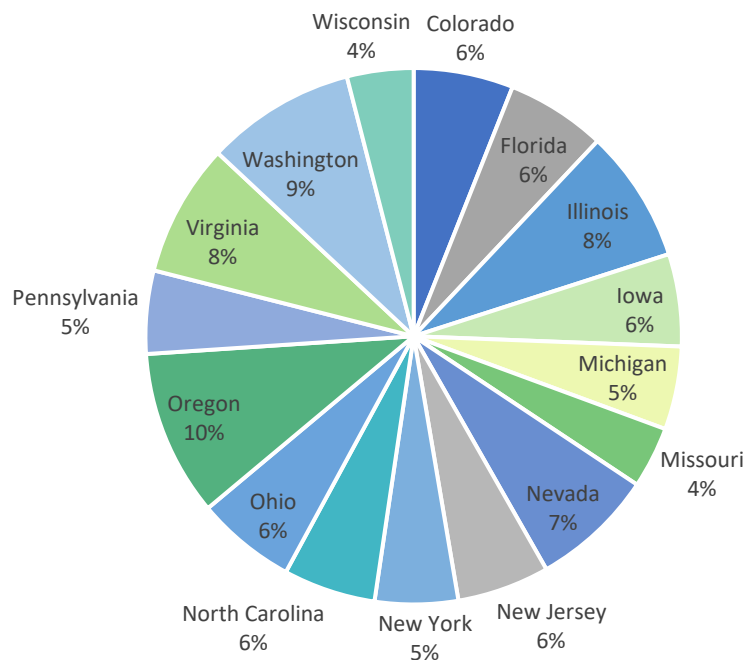


Figure 4. States in which respondents work (n=54).

Ninety-eight percent of participants agree that climate change is having or is likely to have a significant effect on public health (Figure 5). Overall, respondents indicate that they are very (58%) or moderately (36%) knowledgeable about climate change (Figure 6).

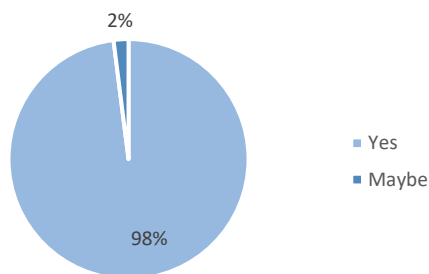


Figure 5. Percentage of respondents who believe climate change is affecting public health (n=54).

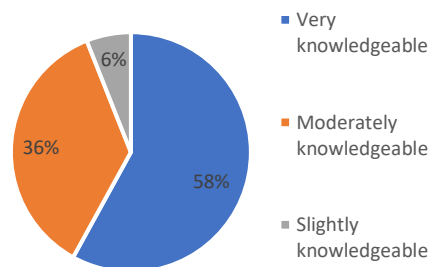


Figure 6. Climate change knowledge level as identified by respondents (n=54).

Threats to Public Health

More than half of participants indicate that extreme heat events, storms, flooding, and increasing air temperatures are of the biggest concern with respect to climate change (Figure 7). Among state public health officials, changes in precipitation amount and timing, extreme heat events, and wildfire rank as the highest concerns.

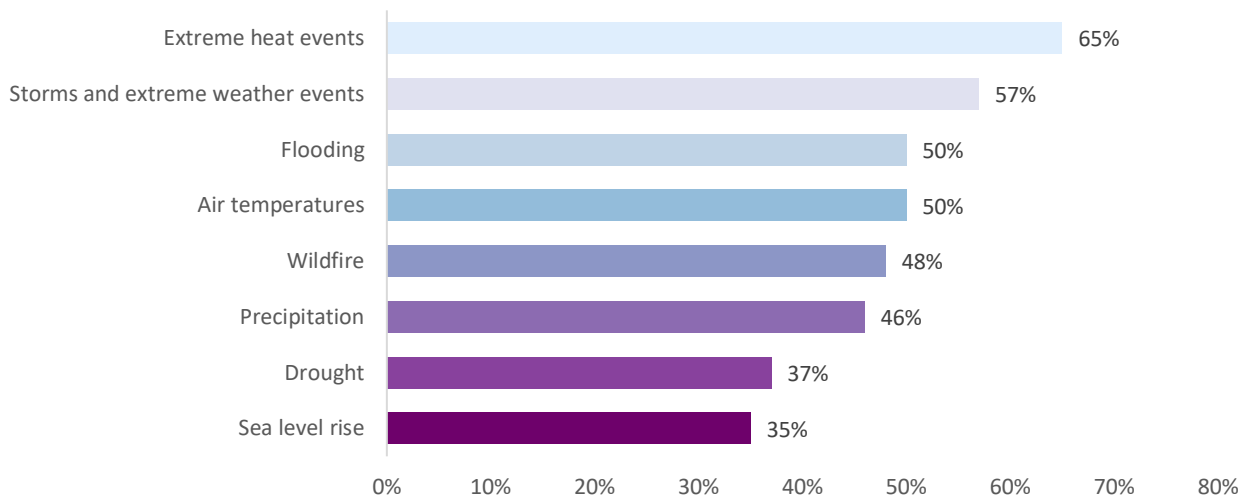


Figure 7. Climatic changes of concern (n=54).

Of the most likely impacts on public health and healthcare services, illnesses and fatalities related to air quality, heat, and vector- and water-borne diseases are most frequently expressed by health professionals (Figure 8). Among state public health officials, air quality, heat-related illness and/or death, vector-borne disease, and displacement of individuals and communities rank as the highest concerns.

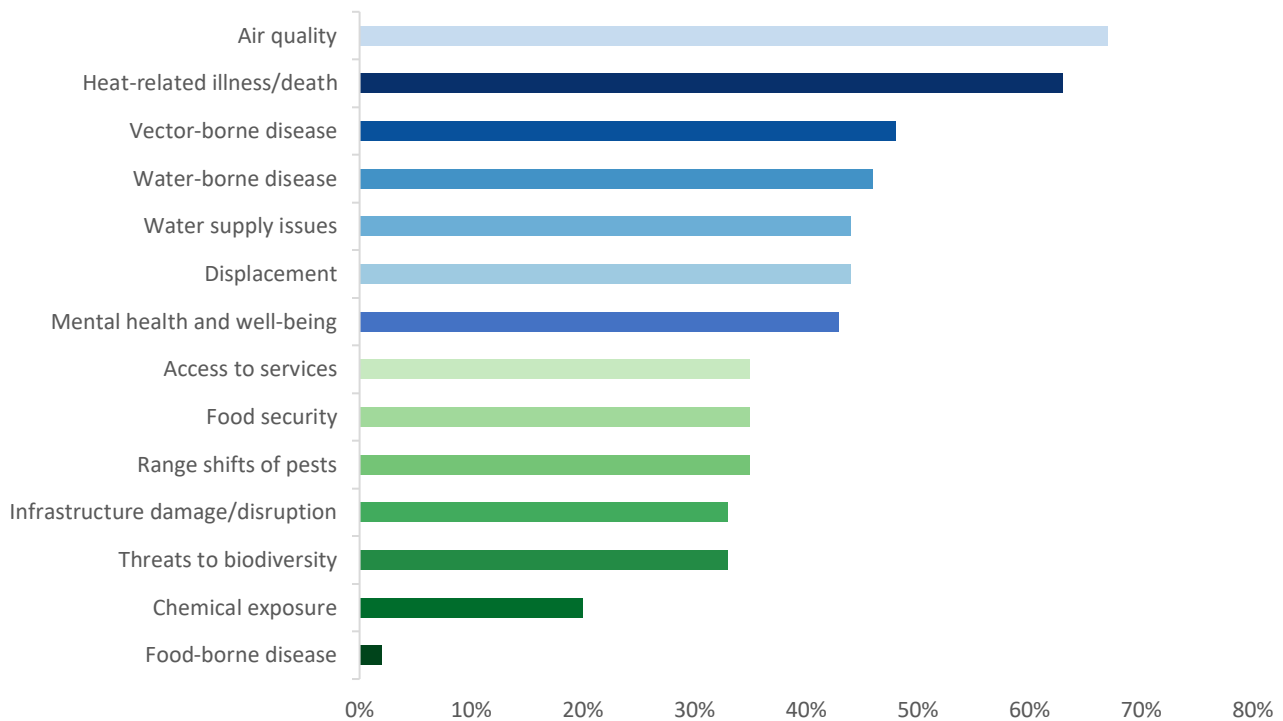


Figure 8. Climate-related public health impacts of concern (n=54).

Adaptation Barriers and Opportunities

About 85% of interviewees and survey respondents report adjusting their health-related activities in some way to address climate change. Participants were asked to identify specific barriers and opportunities (e.g., strategies or actions) with respect to managing public health in a changing climate. The top two barriers to climate-informed public health efforts noted by respondents who are both

engaged in climate adaptation and those who are not include lack of funding and insufficient staff resources and capacity (Figure 9). Other more pressing issues such as general economic prosperity and a lack of options for effective management of climate-related health impacts are shared perceived barriers for both sets of respondents.

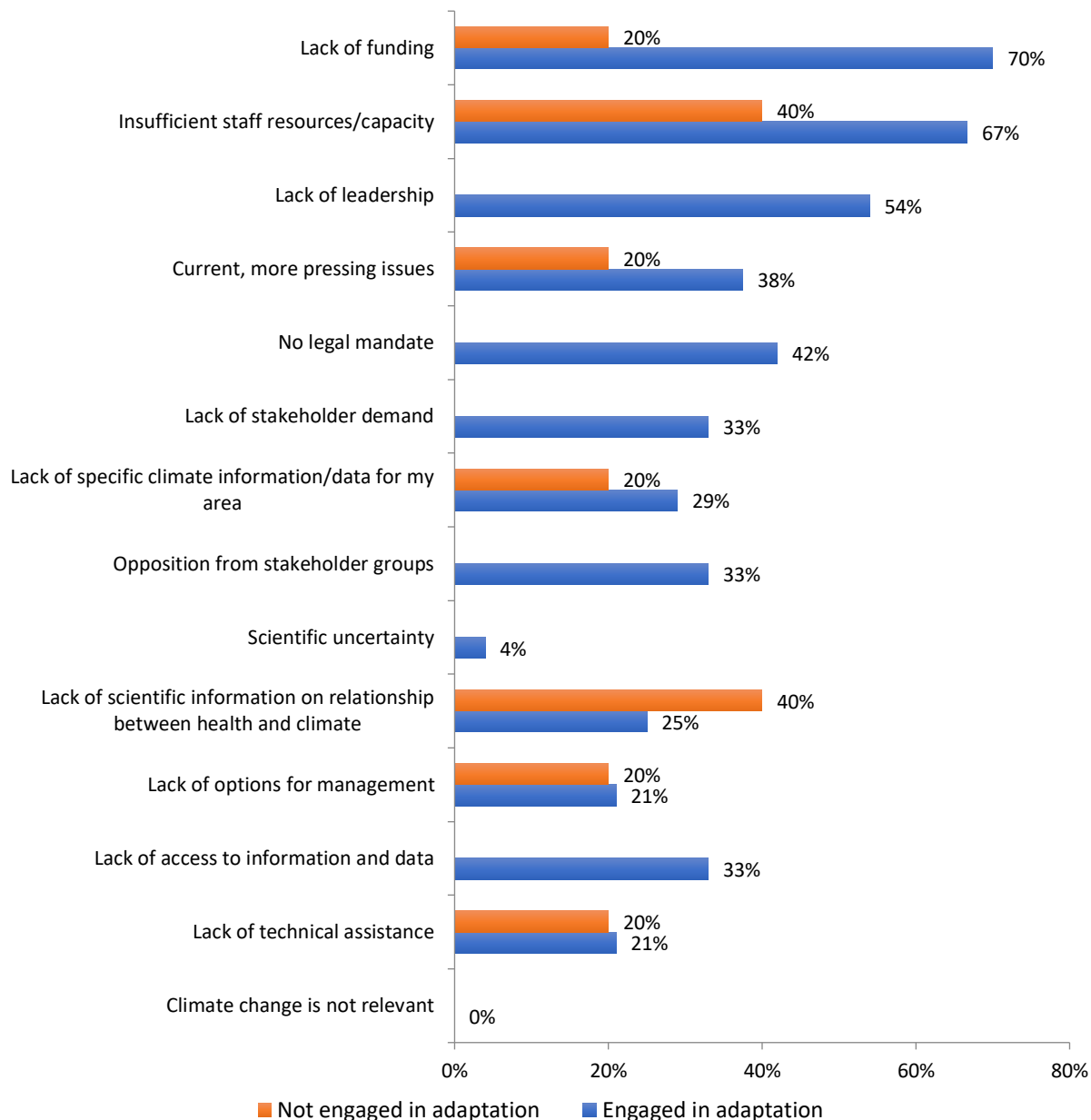


Figure 9. Key barriers noted by respondents who are currently engaged in climate adaptation (n= 46; blue) and those who are not (n=8; red).

Additional challenges noted by state public health officials engaged in adaptation include communicating the connections between current extreme events (e.g., floods, fires, hurricanes) and climate change; finding simple, straightforward ways to communicate the health effects of climate change to the general public; and a lack of evidence-supported interventions that can be easily applied by health officials. Factors that have facilitated the integration of climate change into public health efforts include leadership support within health departments; recent extreme events that have brought attention to the need for preparedness and response measures; and emerging funding

opportunities (e.g., Kresge Foundation, Robert Wood Johnson Foundation). For example, the Kresge Foundation funded the 2016-2017 Climate Change and Health Learning Collaborative to facilitate peer-to-peer networking and learning between urban local health departments, including King County (WA), Multnomah County (OR), Los Angeles County (CA), Maricopa (AZ), Pima (AZ), Denver (CO), Tulsa (OK), Minneapolis (MN), Macomb County (MI), Columbus (OH), Philadelphia (PA), and New Orleans (LA).

Of the more general strategies associated with climate adaptation (Figure 10), respondents who are currently engaged in adaptation efforts are prioritizing capacity building activities such as enhancing coordination and collaboration between individuals, communities, departments, and service providers (78%), increasing and improving public awareness and outreach efforts related to climate impacts (77%), and monitoring environmental and climatic conditions and impacts (73%).

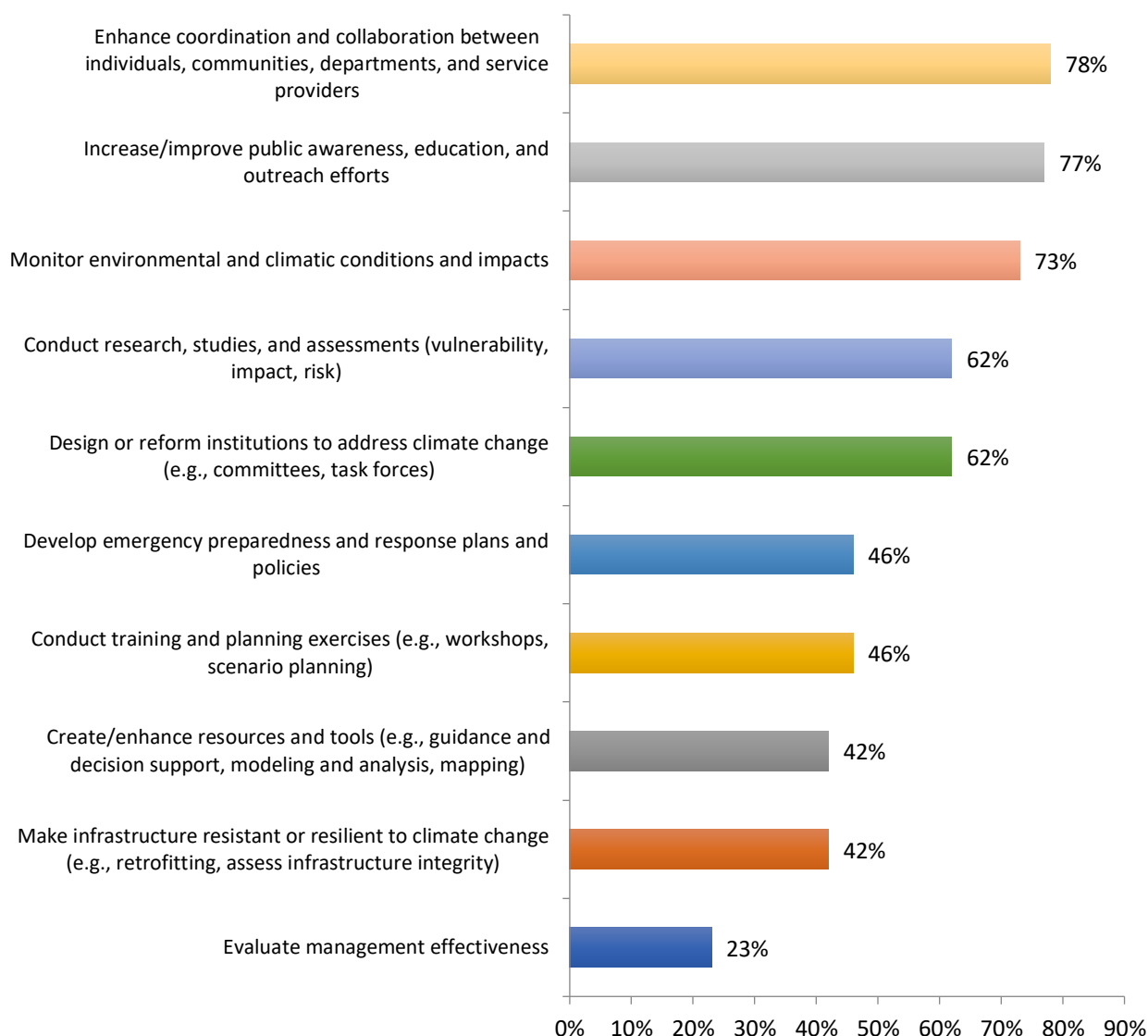


Figure 10. General strategies prioritized by respondents engaged in adaptation (n=46).

Knowledge, Products, and Services

Participants were also asked what information they currently use to make decisions on climate change. Most frequently mentioned types of resources used include grey literature (e.g., agency reports, frameworks), best practices and lessons learned from other public health professionals, and scientific literature and data (e.g., models, maps) (Table 4).

Table 4. Resources currently used to make decisions by interviewees and survey respondents (n=54).

Grey literature (e.g., agency plans)	61%
Best practices/lessons learned	57%
Scientific literature	46%
Models (e.g., atmospheric, ecosystem, economic)	44%
Spatial data	33%
Traditional knowledge	31%

Additional resources needed to better address climate change in public health include case study examples from on-the-ground initiatives, trainings and webinars, and information on how to better communicate climate-related health impacts to the public (Table 5).

Table 5. Resources needed to more effectively take action on climate change as expressed by interviewees and survey respondents (n=54).

Best practices/case studies	50%
Trainings or webinars	44%
Information on how to communicate climate change to the public and engage stakeholders	41%
Decision support tools for the purpose of integrating climate change and other stressors	37%
Guidance on how to integrate climate change into planning and management	35%
Expert networks/associations	20%

Participants were also asked to identify specific resources and tools they use to make decisions on climate change (Table 6).

Table 6. Resources and tools used by respondents.

Tool/Resource	Developer/Website
National Climate Assessment (2014, 2018)	U.S. Global Change Research Program, https://nca2014.globalchange.gov and https://nca2018.globalchange.gov
Climate Change, Health, and Equity: A Guide For Local Health Departments	American Public Health Association and Public Health Institute Center for Climate Change and Health https://www.apha.org/-/media/files/pdf/topics/climate/climate_health_equity.ashx?la=en&hash=14D2F64530F1505EAE7AB16A9F9827250EAD6C79
BRACE framework, webinars, and tools	CDC, https://www.cdc.gov/climateandhealth/brace.htm
Intergovernmental Panel on Climate Change Assessment reports	Intergovernmental Panel on Climate Change, https://www.ipcc.ch/

Tool/Resource	Developer/Website
Global Warming's Six Americas, October 2014: Perceptions of the Health Consequences of Global Warming and Update on Key Beliefs	Yale Program on Climate Change and Communication, https://climatecommunication.yale.edu/wp-content/uploads/2015/03/Six-Americas-October-2014.pdf
2016 Climate and Health Assessment	U.S. Global Change Research Program, https://health2016.globalchange.gov
Sustainable and Climate Resilient Health Care Facilities Toolkit	U.S. Department of Health and Human Services, https://toolkit.climate.gov/topics/human-health/building-climate-resilience-health-sector
National Integrated Heat Health Information System	National Oceanic and Atmospheric Administration, CDC, Environmental Protection Agency, http://toolkit.climate.gov/nihhis/
Emergency Preparedness and Response: Natural Disasters and Severe Weather	CDC, https://www.cdc.gov/disasters/index.html
Assessing Health Vulnerability to Climate Change: A Guide for Health Departments	CDC, https://www.cdc.gov/climateandhealth/pubs/AssessingHealthVulnerabilitytoClimateChange.pdf
Excessive Heat Events Guidebook	Environmental Protection Agency, https://www.epa.gov/heat-islands/excessive-heat-events-guidebook
Climate Change and Human Health Literature Portal	National Institute of Environmental Health Sciences, https://tools.niehs.nih.gov/cchhl/index.cfm
Communicating the Health Effects of Climate Change	CDC, https://www.cdc.gov/climateandhealth/docs/ClimateandHealthPresentationGRANTEES.pptx

Adaptation in Practice

This section presents examples of climate adaptation in public health initiatives throughout the 16 U.S. states uncovered in this survey; eighteen initiatives are presented as full case studies. Readers should refer to the full-length case studies for more details.

The majority of initiatives at the state health departments we surveyed are focused on capacity building. Primary strategies include monitoring environmental and climatic conditions and impacts; assessing vulnerabilities and developing adaptation options; increasing public awareness through outreach and communication efforts related to climate change; creating resources and tools; and enhancing collaboration between state health departments and others. Additional strategies include tribal climate and health assessments and infrastructure retrofits.

Monitoring environmental and climatic conditions and impacts

Monitoring programs can track environmental and climatic changes and detect trends in human health. Many state health departments are integrating climate change into existing environmental health tracking tools, such as those associated with the National Environmental Public Health Tracking Program, and syndromic surveillance systems.

The National Environmental Public Health Tracking Program, funded by the CDC, is a network of state and local health departments collecting and sharing environmental and non-infectious disease data. Ten states and one city in our survey participate in the program, including Colorado, Florida, Iowa, Michigan, Missouri, New Jersey, New York, New York City, Oregon, Washington, and Wisconsin. For example, the Missouri Department of Health & Senior Services hosts the Environmental Public Health Tracking Data Portal, which collects and provides data to support decision-making to improve prevention and response measures.¹¹ The site is used to analyze trends over time through hazard and disease surveillance, identify effective interventions, and to support public health research. The portal provides observed weather and climate data (1990-2015) on factors such as temperatures, winds, and humidity, and links to resources on extreme heat and cold events, heavy precipitation and flooding, vector-borne diseases, and harmful algal blooms. The Washington Tracking Network (WTN) includes data on air and water quality, drought, flooding, snowpack, heat events, weather extremes, wildfire, and disease.¹² WTN also includes an Environmental Health Disparities Map that provides a way to compare broader environmental health risks between communities depending on exposure and social determinants of health. For example, users can compare particulate matter concentrations, toxic releases from industrial facilities, percentage of disabled population, and cancer deaths between an urban area such as Seattle and Mo clips on the remote outer coast.

Syndromic surveillance is a rapid monitoring system to detect symptoms, track outbreaks and emergent disease occurrence (e.g., tracking clinical and emergency room visits), and provide early alerts that signal a need for immediate public health response. Several health departments are engaged in syndromic surveillance programs, including New Jersey, Nevada, Washington, and Philadelphia. For example:

- The New Jersey Department of Health uses the Hippocrates online system to capture and share critical health information and support day-to-day operations and rapid response and recovery

¹¹ Missouri EPHT Portal: https://ephtn.dhss.mo.gov/EPHTN_Data_Portal/index.php

¹² WTN: <https://www.doh.wa.gov/DataandStatisticalReports/EnvironmentalHealth/WashingtonTrackingNetworkWTN>

for emergency situations.¹³ The system integrates data from the state Medical Coordination Centers, local health departments, clinics, and other healthcare facilities, combining real-time feeds of weather events (e.g., fires, floods), incidents, and medical assets (e.g., hospitals, command centers, blood banks) with basic GIS map layers on a closed system only accessible by public health practitioners.

- The Nevada Health Alert Network (NVHAN) is a statewide alert system that supports rapid connection between healthcare facilities and providers, first responders, law enforcement, and critical services (e.g., communications, water, energy) during public health emergencies. HAvBED (Hospital Available Beds for Emergencies and Disasters) tracks bed availability and hospital capacity and its system features multiple backup servers containing critical health and emergency preparedness documents that are useful during crises (e.g., Nevada's Public Information and Communications Plan).¹⁴
- The Washington Department of Health runs the Rapid Health Information NetWoRk (RHINO), which collects real-time data on symptoms, diagnoses, and demographic data from clinical and emergency room visits. Public health practitioners and officials have access to these records to compare trends across communities, regions, and the country.
- The Philadelphia Department of Public Health used 10+ years of syndromic surveillance data to identify trends in heat-related visits to emergency departments and compared the data with weather conditions during those times. Through this analysis, the department developed a health-focused system for issuing excessive heat declarations.

Assessing vulnerabilities and developing adaptation options

The CDC created the BRACE framework to guide public health officials through a structured climate-informed decision-making process. The steps include identifying impacts and assessing vulnerabilities, quantifying projected health outcomes, determining the most suitable interventions or adaptation options, developing and implementing an adaptation plan, and evaluating the impact of the implemented strategies.¹⁵ Seven states and one city in this study have been funded through the CDC's Climate-Ready States and Cities Initiative to apply the BRACE framework, including Florida, Illinois, Michigan, New York, New York City, North Carolina, Oregon, and Wisconsin. While the process used by these states was similar, some approaches were unique. For example, the North Carolina Department of Health and Human Services first identified a range of possible actions vetted in the scientific literature, which were then presented to and evaluated by stakeholders according to a variety of criteria, such as ease of implementation, cost, and timeliness. Stakeholders then ultimately selected health interventions based on a combination of evaluation scores and the needs of local communities. Other state and local health departments have used the BRACE framework to guide assessment and planning efforts, including health departments and organizations in New Jersey, Ohio, Virginia, and Philadelphia. For example, the New Jersey Climate Change Alliance (formerly the Climate Adaptation Alliance) used the initial steps of the BRACE framework to create a Climate and Health Profile Report.¹⁶

¹³ Hippocrates: <https://hippocrates.nj.gov/>

¹⁴ U.S. Department of Health and Human Services (DHHS). 2011. From Hospitals to Healthcare Coalitions: Transforming Health Preparedness and Response in Our Communities. U.S. DHHS Assistant Secretary for Preparedness and Response Report on the Hospital Preparedness Program. End-of-year 2007-2009 Reporting Periods. <http://www.phe.gov/Preparedness/planning/hpp/Documents/hpp-healthcare-coalitions.pdf>

¹⁵ Marinucci GD, Lubet G, Uejio CK, Saha S, Hess JJ. 2014. Building Resilience Against Climate Effects: A novel framework to facilitate climate readiness in public health agencies. *International Journal of Environmental Research and Public Health* 11(6): 6433-6458.

¹⁶ New Jersey Climate and Health Profile Report: <https://njadapt.rutgers.edu/docman-lister/njcaa-meetings/199-chpr-final-12-6-2017/file>

Increasing awareness through education and outreach campaigns

Many of the states surveyed are working to increase awareness of climate-related health risks for the general public, health professionals, and emergency responders. Examples from our survey include:

- North Carolina's heat health alert system in southeast North Carolina, which is tailored to residents most at risk for heat-related illness, including farm workers, older adults, low-income families, and youths. This pilot system will alert target populations when heat levels become dangerous, and provide residents with actions they can take to reduce their risk.
- New Jersey's Clean Air NJ campaign to raise public awareness about the negative effects of ground-level ozone and measures that can reduce the likelihood of smog. Clean Air NJ provides details about the health and environmental effects of smog, access to daily air quality data via the Air Quality Index, and tips on how the public can reduce ozone formation and avoid exposure.
- The New York City Department of Health and Mental Hygiene's "Be A Buddy" outreach campaign, which encourages healthcare providers and community members to check on at-risk individuals and neighbors, particularly during extreme weather events.
- The Washington Department of Health's efforts to effectively communicate public health risks associated with wildfire smoke to local health departments and communities. Department epidemiologists have prioritized public messaging on wildfire smoke and preparedness as wildfires have increased in severity over the last few years, including online air quality advisories and recommendations for preventative measures (e.g., masks, air filters) in multiple languages.

Enhancing resources and tools

Many states have created various resources and tools to support climate-informed action in public health. For example:

- The Colorado Department of Public Health and Environment has created disaster recovery guides, which detail human health concerns that arise from emergencies and disasters such as issues related to sanitation, disease, pollution, and shelter availability.¹⁷
- The Illinois BRACE Program created an online heat toolkit for local health departments, including social vulnerability and heat health data for each county, and templates (e.g., press releases, social media) for community outreach during extreme heat events.¹⁸
- The Missouri Department of Health & Senior Services' Disaster and Emergency Planning program created the online *Ready in 3* toolkit to help residents prepare by (1) creating a plan for different situations (e.g., evacuation vs. staying home), (2) preparing an emergency kit, and (3) listening for information from city, county, and state officials. Other resources included in the toolkit are guidelines for schools, adult care facilities, healthcare facilities, and emotional preparedness.
- The New York State Department of Health partnered with the New York State Office for the Aging to develop materials for senior citizens, including adding a link to the Cooling Center Mapping Application¹⁹ on their Aging Services mobile app, which connects older adults with information on health, housing, and transportation options.

¹⁷ Colorado Disaster Recovery Guide for Local Public Health Agencies: <https://www.colorado.gov/pacific/cdphe/cdphe-disaster-recovery-guide-local-public-health-agencies>

¹⁸ Illinois Summer Heat Toolkit: <https://braceillinois.uic.edu/summer-heat-toolkit/>

¹⁹ New York Cooling Center Mapping Application: https://apps.health.ny.gov/statistics/environmental/public_health_tracking/tracker/#/CCMap

Enhancing collaboration between public health officials and other stakeholders

Several of the state health departments support efforts at local health departments to address the climate-related impacts on public health. Examples include:

- The Florida BRACE program is collaborating with county health departments to implement and evaluate the effectiveness of extreme heat education campaigns and hurricane evacuation and shelter procedures.
- The Michigan Climate and Health Adaptation Program is working with Marquette County to integrate climate and health into existing plans. Activities have included one-on-one conversations with vulnerable populations (e.g., homeless, veterans, aging) and convening charrettes with the community to increase awareness about climate, health, and equity issues.
- The Oregon Health Authority collaborated with five local health departments—Benton, Crook, Jackson, and Multnomah Counties, and the North Central Public Health District—to develop local climate and health adaptation plans.

Within the study area, there are several key nongovernmental actors working to advance health-related climate adaptation action. Examples include:

- The Florida Institute for Health Innovation, which has evaluated the health-related effects of the climate change strategies recommended by the Southeast Florida Regional Climate Change Compact, and recently partnered with Florida Atlantic University and the South Florida Regional Planning Council to identify the effects of sea level rise on health and map the most at-risk communities in Palm Beach, Broward, Miami-Dade, and Monroe counties.
- The Iowa Public Health Association, which released a statement that the health-related effects of extreme events (e.g., extreme heat and precipitation) were the most obvious and immediate threats to the state, and called for the adoption of strong climate policies to ensure human health and well-being.²⁰
- The Southern Nevada Water Authority, which conducted a vulnerability assessment of its service area in Clark County to evaluate risks associated with extreme heat, drought, and harmful algal blooms.
- Clean Air Carolina's Medical Advocates for Healthy Air program, which is a statewide network of over 400 medical and health professionals in North Carolina focused on improving air quality for all residents. Climate change is a priority issue for MAHA and action has focused primarily on education and outreach (e.g., climate training for pediatric residents at Levine Children's Hospital) and advocacy efforts (e.g., testifying at air quality hearings, sign-on letters to reduce carbon emissions and invest in renewable energy sources, participating in the Southeast Climate and Energy Network).
- The Ohio Clinicians for Climate Action network, which is working to raise awareness of the links between climate and public health policies, and provides a space for health professionals to exchange knowledge on how to best address Ohio's climate and health issues.

Tribal climate and health assessments

Several tribes in the study area have prioritized planning for climate change impacts on public health. Examples include:

²⁰ Iowa Climate Statement 2014: https://www.iowapha.org/Resources/Documents/Iowa_Climate_Statement_2014-Impacts_on_the_Health_of_Iowans_FINAL_with_references.pdf

- The Inter-Tribal Member Council of Michigan led a process to assess climate change impacts, vulnerabilities, and adaptation options for nine federally-recognized Tribes in Michigan, including the Bay Mills Indian Community, Lac Vieux Desert Band of Lake Superior Chippewa, Grand Traverse Band of Ottawa and Chippewa Indians, Little River Band of Ottawa Indians, Little Traverse Bay Bands of Odawa Indians, Match-E-Be-Nash-She-Wish Band of Potawatomi (Gun Lake Tribe), Pokagon Band of Potawatomi, Saginaw Chippewa Indian Tribe, and Sault Ste. Marie Tribe of Chippewa Indians. Health-related mitigation and adaptation strategies recommended in the plan include reducing carbon pollution and implementing alternative energy sources; increasing green infrastructure; routine monitoring of infrastructure integrity; increasing community awareness through outreach and education; implementing an early warning system for extreme weather events and low air quality days; and creating environmentally-friendly pesticides to target specific species that may be vectors for disease.²¹
- The Gun Lake Tribe also created a standalone adaptation plan to address climate change impacts on human health, natural resources, food resources, and infrastructure.²² The main climate concerns outlined in the plan include heat waves, extreme weather events, and changes in precipitation regimes (e.g., more intense rain events). The plan also takes into consideration the impacts of contamination pathways, transmission dynamics, changes in agro-ecosystems, hydrology, and socioeconomic and demographic disruption on human health. Strategies recommended in the plan include increasing educational efforts to share climate change information with Tribal members; increasing energy efficiency of buildings, industries, and residences; and managing forested parcels for wildlife and air quality. Since the plan's release in 2015, the Gun Lake Tribe has installed rain gardens to filter stormwater pollution and developed a Conservation Incentive Program to incentivize energy retrofits in homes.
- The Saint Regis Mohawk Reservation in upstate New York's St. Lawrence River Valley is projected to experience rising temperatures, degraded air and water quality, flooding, threats to food production, extreme weather events, and drought. The Tribe's Environment Division developed a climate change adaptation plan in 2013 to guide future activities.²³ The plan identifies current non-climate related health threats within the Tribe including high rates of respiratory and coronary problems, cancer, diabetes, thyroid disease, and obesity. Climate change will exacerbate these existing issues and may also result in restricted access to healthcare facilities, and reduced capacity to provide medical services during extreme weather events. Notable health adaptation activities underway include maintaining the Tribal Seniors' Center as a heating and cooling shelter, reducing mosquito breeding sites, increasing outreach on community health services, and emergency planning for disease outbreaks and epidemics.
- The Puyallup Tribe of Indians prioritized heat waves, changes in air quality, and food-borne illnesses in its climate adaptation plan.²⁴ A core priority emerging from this planning effort was ensuring that services provided by critical medical and emergency facilities are consistently available to at-risk populations.

²¹ Michigan Tribal Climate Change Vulnerability Assessment and Adaptation Planning: http://www.itcni.org/wp-content/uploads/2017/02/BIA_CC_Adaptation_2016_Report.pdf

²² Match-E-Be-Nash-She-Wish Band of Pottawatomi Indians Climate Change Adaptation Plan: http://www.nicrn.org/uploads/7/2/8/1/72815671/glt_climate_adp_plan.pdf

²³ Climate Change Adaptation Plan for Akwesasne: https://www.srmt-nsn.gov/uploads/site_files/ClimateChange.pdf

²⁴ Puyallup Tribe of Indians Climate Change Impact Assessment and Adaptation Options: http://www.puyallup-tribe.com/tempFiles/PuyallupClimateChangeImpactAssessment_2016_FINAL_pages.pdf

Infrastructure retrofits

Incorporating climate change into the development or retrofitting of infrastructure may help limit the effects of climate change. Examples include:

- Brooklyn's Seagate Rehabilitation and Nursing Center (formerly known as the Shorefront Rehabilitation Center) is elevated almost 30 feet above ground to accommodate flooding. In addition, the facility's emergency power supply is capable of maintaining power to all systems and equipment during power outages. During Superstorm Sandy, the center was able to withstand the floodwaters, the emergency power supply supported services for four days during the local power outage, and staff and patients were able to safely shelter in place during the storm due to the center's sufficient supply of food and medical supplies.²⁵
- The City of Anacortes water treatment plant was redesigned to incorporate climate change projections. The plant serves over 55,000 customers and is the largest single source of water for Skagit and Island counties. The Skagit Climate Science Consortium worked with the City Public Works Department to develop a plan focused on future issues such as flooding, sediment deposit, and saltwater intrusion, all of which can impact human health by threatening the quantity and quality of water available to customers. In the redesign and construction, staff sought to protect against higher risk of flooding by (1) minimizing floodwater penetration below current 100-year flood elevation; (2) raising critical electrical equipment out of the 100-year flood level; (3) utilizing water-proofing techniques below 40-foot elevation; and (4) designing ring dikes for flood protection. The plant was elevated and dikes and pumps were installed to reduce risk of flooding and saltwater intrusion.^{26,27}

Climate and Public Health Case Studies

EcoAdapt staff identified potential projects to be written as case study examples through interviews and surveys and reviews of online resources and publications. All of the case studies follow the same format and include similar information underneath each heading – *Summary/Overview*, *Background*, *Implementation* (e.g., process, resources and information used, stakeholder or outreach engagement), and *Outcomes and Conclusions* (resources produced, anticipated and unanticipated outcomes, metrics for success, challenges and if/how they were overcome, next steps, lessons learned). Case studies underwent internal and external peer review. This section presents 18 long-form case studies from our survey of climate adaptation activities in the 16 U.S. states.

²⁵ Enhancing health care resilience for a changing climate:

<https://toolkit.climate.gov/sites/default/files/SCRHCFI%20Best%20Practices%20Report%20final2%202014%20Web.pdf>

²⁶ Anacortes, Washington rebuilds water treatment plant for climate change: <https://www.epa.gov/arc-x/anacortes-washington-rebuilds-water-treatment-plant-climate-change>

²⁷ Skagit Watershed – City of Anacortes Water Treatment Plant: http://www.skagitclimatescience.org/wp-content/uploads/2015/09/DrinkingWater_BriefOverview.pdf

Addressing climate-related public health risks in Colorado

Contact Information

Rob Pressly, Rob.Pressly@state.co.us
Colorado Department of Local Affairs
Colorado Resiliency Office
1313 Sherman Street
Denver, CO 80203
<https://www.coresiliency.com>

Summary/Overview

Colorado is implementing climate change adaptation and action initiatives across agencies and scales throughout the state. However, the integration of climate change into public health is limited and planning, implementation, and evaluation efforts are variable across state-, county-, and city-level endeavors. The Colorado Department of Public Health and Environment collaborated with the Department of Natural Resources, Colorado Energy Office, and other agencies in the development of the state Climate Action Plan; however, plans to implement these strategies and direct actions taken to address climate impacts on health at the state-level are largely unknown. Notable successes in the state include the City of Denver's strategic climate and health planning initiative as well as the dedication of the Colorado Resiliency Office in providing support during natural disasters that could threaten the health and safety of communities and individuals.

Background

Primary climate-related impacts of concern for Colorado include extreme weather events, wildfires, drought, flooding, degraded air quality, and diminished water availability caused by reduced snowmelt and runoff, each of which has consequences for public health.^{28,29,30} For instance, population displacements and insecurities in healthcare services, heat-related illnesses, reduced water supply and quality, water-borne diseases, and exacerbation of asthma and chronic disease are common concerns. In general, Colorado acknowledges climate change effects on human health at state and local levels, however, evidence of actions taken to address impacts is inconsistent.

Implementation

City and County Level Climate and Health Adaptation Efforts

At the local level, Denver is taking the lead on actions to address climate change effects on human health. The *City and County of Denver 2014 Climate Adaptation Plan* identifies extreme temperatures, urban heat islands, changes in disease patterns, air pollution, and water quality as priority concerns.³¹ The plan aims to (1) safeguard the health of citizens in light of climate change; (2) preserve the ability of medical and healthcare providers to sustain services during extreme heat events; (3) conduct vector monitoring and control; and (4) provide sufficient emergency response measures during extreme heat events. Specific strategies and actions include:

²⁸ NOAA National Centers for Environmental Information State Summaries: Colorado. <https://statesummaries.ncics.org/downloads/CO-print-2016.pdf>

²⁹ What Climate Change Means for Colorado: <https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-co.pdf>

³⁰ Climate Change and Health in Colorado: <https://www.nrdc.org/sites/default/files/climate-change-health-impacts-colorado-ib.pdf>

³¹ City and County of Denver Climate Adaptation Plan: https://www.denvergov.org/content/dam/denvergov/Portals/771/documents/EQ/Climate1/Climate_Adaptation_Final_with_letter.pdf

- Reducing health-related impacts of extreme weather events (e.g., increase number of shelters for at-risk populations, designate public cooling shelters, adopt a severe weather ordinance);
- Reducing health-related vulnerabilities from vector-borne diseases (e.g., develop a vector-borne and zoonotic disease surveillance system to improve epidemic predictions);
- Developing energy and communications systems that are resilient to power outages (e.g., install off-grid alternative systems, obtain reliable backup generation capacity); and
- Advising medical providers on whether critical infrastructure is at risk and identifying risk mitigation solutions.

To date, the city has assessed extreme heat events, created a city-wide vector control plan, and drafted an extreme heat annex for the city's Emergency Operations Plan.³² In progress activities include creating and executing an extreme events public education campaign and identifying how Denver Environmental Health will cooperate with other agencies (e.g., Office of Emergency Management and Homeland Security) during extreme heat events. In 2018, Denver released the 80 x 50 Climate Action Plan, which identifies the need for increased access to transportation choices that help decrease air pollution, safer and more reliable energy sources that would reduce greenhouse gas emissions and improve air quality, and equitable health outcomes to preserve quality of life in light of climate change.³³

Other noteworthy local planning efforts in Colorado that incorporate health concerns include Pitkin and Boulder Counties. Boulder County's *Climate Change Preparedness Plan* directly identifies public health threats associated with climate change, outlining potential impacts, opportunities, policy recommendations, and suggestions for future study and action.³⁴ While the report details ideas, it does not provide information on any actions underway. Pitkin County's *Climate Action Plan* focuses on greenhouse gas emissions reductions, and information provided by the County Public Health Department regarding potential adaptation strategies.³⁵ These goals include building local resilience by identifying vulnerable populations; improving public health preparedness, response, and communication; and improving disease education, surveillance, and response to food-borne and zoonotic diseases.

State Level Climate and Health Adaptation Efforts

Colorado's 2015 Climate Action Plan describes projected climate impacts (e.g., air quality, vector-borne disease, and extreme weather events) and potential health response strategies (e.g., monitoring, assessment, education, and outreach), however implementation details and direct actions taken to address climate impacts on health are lacking.

The Department of Public Health and Environment's website includes information on air quality issues and greenhouse gas emissions reporting,³⁶ and a local environmental health reporting tool.³⁷ The Colorado Public Health Tracking Portal serves as a data source for improved public health decision-

³² City and County Denver 2014 Climate Adaptation Update:

[https://www.denvergov.org/content/dam/denvergov/Portals/771/documents/EQ/Climate1/Adaptation Update - final.pdf](https://www.denvergov.org/content/dam/denvergov/Portals/771/documents/EQ/Climate1/Adaptation%20Update%20-%20final.pdf)

³³ Denver 80 x 50 Climate Action Plan:

https://www.denvergov.org/content/dam/denvergov/Portals/771/documents/EQ/80x50/DDPHE_80x50_ClimateActionPlan.pdf

³⁴ Boulder County Climate Change Preparedness Plan: <https://assets.bouldercounty.org/wp-content/uploads/2017/03/climate-change-preparedness-plan.pdf>

³⁵ Pitkin County Climate Action Plan: <https://www.pitkincounty.com/DocumentCenter/View/14694/Climate-Action-Plan?bidId>

³⁶ Colorado greenhouse gas reports: <https://www.colorado.gov/pacific/cdphe/colorado-greenhouse-gas-reports>

³⁷ Local Environmental Health Reporting Tool: <https://www.colorado.gov/pacific/coepht/local-environmental-health-reporting-tool>

making on factors related to air quality, drinking water quality, toxins, and harmful algal blooms.³⁸ The portal is part of the National Environmental Public Health Tracking Program, funded by the CDC. Additional resources on the department's website that do not explicitly include climate change but may support climate-informed decision-making include:

- The Engage-Calm-Distract resource kit, which provides strategies to help health providers rapidly respond to the psychological and emotional needs of children and parents in times of crisis;³⁹
- Disaster recovery guides for local public health departments⁴⁰ and the public,⁴¹ both of which detail human health concerns that arise from emergencies and disasters such as issues related to sanitation, disease, pollution, and shelter;
- The multiagency Colorado Crisis Education and Response Network for behavioral health disaster response; and
- Training related to field emergency response and psychological first aid.⁴²

The department also funds Supplemental Environmental Projects that benefit the environment or public health funded by monetary settlements of violations of environmental regulations. As of 2019, there have been two funded projects: one that promotes public health through green retrofits and another that focuses on solar energy.

The Colorado Resiliency Office (CRO) aims to empower Colorado to build stronger, safer, and more resilient communities in the face of natural disasters. The main climate impacts of concern for CRO include wildfires, drought, flooding, and subsequent impacts on air and water quality. While there is not a mandate for climate action work, CRO has recognized the need to address climate adaptation. In local-level initiatives, CRO encourages community resilience planning to incorporate climate change considerations (e.g., integration into comprehensive, hazard mitigation, land use, and economic development plans). CRO is working with the Colorado Department of Natural Resources' Water Conservation Board and Colorado's Division of Homeland Security and Emergency Management to develop a scenario-based risk assessment for the state to better understand the impacts of climate change on drought, wildfire, and flooding. The project's goals are to identify at both local and regional levels the impacts of climate change, the costs of inaction versus immediate action, tools for local-level decision-makers to better understand climate impacts, and needs for guidance on types of actions, best practices, and case studies. CRO and its partners recently secured funding for this project and aim to conduct outreach and education initiatives via its website; workshop series, such as the resilient Colorado communities workshop series;⁴³ and technical assistance on planning. CRO's Working Group investigates how to build resilience into state investments and operations (e.g., building resilience into competitive and discretionary grants, not building a school in a flood zone); how to take broad criteria and apply them to a range of agencies (e.g., public health or transportation); and how to add weighting criteria to guidelines and metrics.

The Colorado Communities Symposium, which kicked off in January of 2018, brought together a consortium of city and county agencies, including CRO, throughout the state that agreed to meet the

³⁸ Colorado Environmental Public Health Tracking: <https://www.colorado.gov/coepht>

³⁹ Engage-Calm-Distract Resource Kit: <https://www.colorado.gov/pacific/cdphe/engage-calm-distract>

⁴⁰ Disaster Recovery Guide for Local Public Health Agencies: <https://www.colorado.gov/pacific/cdphe/cdphe-disaster-recovery-guide-local-public-health-agencies>

⁴¹ Disaster Recovery Guide for the Public: <https://www.colorado.gov/pacific/cdphe/cdphe-disaster-recovery-guide-public>

⁴² Disaster behavioral health training: <https://www.colorado.gov/pacific/cdphe/disaster-behavioral-health>

⁴³ Colorado Resiliency Resource Center Trainings and Events: <https://www.coresiliency.com/trainings>

guidelines of the Paris Agreement.⁴⁴ The Symposium focused on transportation, energy, resilience, and aimed to identify goals for the state and communities. The Association of Climate Change Officers is leading the follow up to this symposium, and is interested in developing peer-to-peer exchanges and a resilience forum.

Outcomes and Conclusions

CRO has used the guidance and resources of the Water Conservation Board and climate change specialists in its efforts to address climate adaptation needs. A challenge in CRO's work is proper framing during communication with communities, particularly making sure conversations are relevant at local levels and addressing impacts that communities are already experiencing firsthand (e.g., long-term drought). Factors that facilitate climate action within CRO include the support of the state climate plan (e.g., implementing and meeting goals in a top-down direction), community openness and willingness to work on adaptation issues, and research institutions (e.g., National Center for Atmospheric Research, National Renewable Energy Laboratory, and University of Colorado) that provide technical resources and guidance.

While CRO is pushing climate action forward in Colorado by participating in adaptation initiatives and projects, there is little focus on public health impacts in plans. CRO's new project is still in developmental stages and there is no detail on project implementation or evaluation to date. This is a similar finding with other state, city, and county adaptation plans: public health seemingly is not a true focal point of action planning, and many proposed strategies and goals regarding health, while well outlined, are not supported by results in implementation.

Citation

Kershner J & Braddock KN. 2019. *Addressing climate-related public health risks in Colorado* [Case study on a project of the Colorado Department of Public Health and Environment and Colorado Resiliency Office]. Product of EcoAdapt's State of Adaptation Program. Last updated June 2019.

Building resilience to climate change in Florida's public health system

Contact Information

Dr. Tisha Holmes, ttholmes@fsu.edu

Dr. Ava Holt, alholt@fsu.edu

Florida State University

Florida BRACE Program

113 Collegiate Loop

Tallahassee, FL 32306

<https://flbrace.org/index.html>

Florida Department of Health

4052 Bald Cypress Way

Tallahassee, FL 32399

<http://www.floridahealth.gov/>

Summary/Overview

The Florida BRACE Program is building awareness and capacity in county health departments to address climate-related health impacts. The program has conducted a state-level vulnerability assessment to identify priority climate hazards, and used GIS mapping to better understand

⁴⁴ Colorado Communities Symposium: <https://www.coloradocommunities.org/>

geographical differences in social and medical vulnerability to those hazards. Since 2016, the Florida BRACE Program has been providing support to four counties as they plan for climate change and implement and monitor health interventions. The BRACE Program serves in an advisory and capacity building role, helping connect county health practitioners to needed resources, tools, and expertise using webinars, trainings, social media, and other tools. In addition, the nonprofit Florida Institute for Health Innovation has engaged in several climate change efforts.

Background

Florida's BRACE Program launched in 2012 with funding from the CDC. The Florida Department of Health led the Florida BRACE Program from 2012-2016 and in 2016, Florida State University took over leadership. This transition occurred in part because the Florida Department of Health lacked internal staff capacity, and because there was interest in having an independent arbitrator lead climate adaptation activities.

The primary goal of the Florida BRACE Program is to build awareness in county health departments and at the community level on health-related risks of climate change. The program strives to support county health departments in designing, implementing, and evaluating health interventions to address climate risks. The Florida BRACE Program largely serves in an advisory and capacity building role by providing resources, technical support, and evaluative capacity to county health departments to support local-level implementation. They act as an information repository, helping connect people doing on-the-ground work with needed resources and tools, and also helping connect county staff with a broader network of practitioners. The Florida BRACE Program has funding from the CDC through 2021.

Implementation

From 2012-2016, under the leadership of the Florida Department of Health, the Florida BRACE Program was primarily focused on better understanding and communicating climate change impacts on public health. Program staff collaborated with the University of South Carolina Hazards and Vulnerability Research Institute to conduct a vulnerability assessment, which identified seven priority climate hazards for the state: hurricane winds, storm surge, flash flooding, sea level rise, extreme heat, drought, and wildfire.⁴⁵ The program also identified and mapped the most at-risk areas by comparing medical and social vulnerability indices with hazard projection maps. Using this information, the program generated several communication products to inform health practitioners and the public about climate change risks. Products include profiles for the seven priority hazards, which outline risks and potential health outcomes, and touchstone event summaries, which highlight historical extreme events (e.g., drought, wildfires, flooding) and associated health outcomes in Florida.⁴⁶

Since 2016, the Florida BRACE Program has been focused on providing support to counties for planning, policy development, and implementing and monitoring health interventions to respond to climate change. The new leads at Florida State University are currently working with four counties, which were the first to express interest in collaborating with the BRACE program by applying for support through a statewide RFP process. The BRACE Program relies on county partners to identify climate hazards and associated health interventions of interest at the local level. BRACE Program staff

⁴⁵ Florida Vulnerability Assessment: <http://flbrace.org/fl-vulnerability-assessment.html>

⁴⁶ Priority Hazard Profiles and Touchstone Event Summaries: <http://flbrace.org/hazards.html>

help counties think through project processes and evaluative efforts, and provide technical support and assistance with county outreach and education efforts. Example engagements include:

- In east-central Florida, the BRACE Program collaborated with a county in implementing and evaluating an extreme heat education campaign. The county wanted to evaluate (1) if the campaign was reaching the right people; (2) if it had the right scope and used effective messaging; (3) how many people it reached; and (4) if the messaging was changing behavior. The BRACE Program helped the county develop different campaign components, identify tracking indicators, and better identify what type of data would need to be collected to measure progress, ultimately resulting in a detailed implementation plan. This plan will be evaluated during subsequent summer heat events.
- In southern Florida, the BRACE Program is working with a county to evaluate outcomes from Hurricane Irma in order to better prepare for future events. For example, they are evaluating the effectiveness of different evacuation and shelter procedures with the hope of minimizing hurricane impacts in the future.
- In southwest Florida, the BRACE Program worked with a county to develop an implementation and monitoring plan for a localized health impact assessment. The county wanted to identify local climate vulnerabilities, such as storm surge, and evaluate how those vulnerabilities may affect transportation and healthcare infrastructure. The BRACE Program provided advisory support in plan development by providing guidance on what questions to ask and how to monitor implementation outcomes. This resulting document now serves as a foundation for future adaptation efforts and can be shared with emergency management personnel.

In their work with different counties, the Florida BRACE Program acts as a clearinghouse of different resources, tools, and expertise. They find and share tools, publications, and resources depending on the needs of each county. For example, they have collected and shared CDC best practices, publications and tools developed by other CDC grantees, and sea level rise viewers and models. They also connect county health departments with other individuals and organizations that can support their work.

The Florida BRACE Program is comprised of a diverse set of partners that span a broad range of expertise and interest. They have a Technical Advisory Group (TAG), which provides technical support as well as proposal, project, and data review. The TAG is comprised of numerous different area experts (e.g., health, urban and regional planning, climate science, communications), health practitioners, and policy makers. There is also a Community Advisory Group, which strategically partners with community groups all over Florida to build a community of practice and advance resilience work. Partners include county health departments, Physicians for Social Responsibility, Organize Florida, and Catalyst Miami.

The Florida BRACE Program is using a variety of methods to communicate ongoing activities and best practices, and build capacity across the state. The program's outreach efforts are mainly focused on county health departments. For example, they recently hosted an evaluation webinar, which introduced county health departments to the importance of evaluating adaptation activities and how to best conduct evaluation efforts at the local level. The program also participated in a climate change symposium hosted by Florida State Libraries, sharing current projects and lessons learned. Staff are also using social media (primarily Twitter and Facebook) to connect practitioners with relevant resources and other organizations working on climate change.

Outcomes and Conclusions

County engagements to date have been limited due to several factors, including available funding, county department staff capacity, and the learning curve for applying public health initiatives in a climate change context. Additionally, one overarching challenge is that state leadership does not acknowledge climate change. This has limited conversations and knowledge exchange by restricting the use of certain terminology (e.g., “climate change”), and limited adaptation progress because counties are not required to take action by the state. The Florida BRACE Program is focusing on incremental progress, providing whatever information, resources, support, and feedback they can to counties tackling adaptation in a politically unsupportive environment.

Despite these challenges, the Florida BRACE Program has found success through several mechanisms. They are focusing on geographic areas where conditions are ripe for work. For example, they are working with counties that have expressed interest, and have capitalized on existing synergies created by the Southeast Florida Regional Climate Change Compact and a newly established regional resilience initiative in southwest Florida. They have also found success by framing their work through a resilience lens, focusing on community resilience to all disturbances, including climate change. Disaster events, although challenging, also provide opportunities for education and outreach by heightening awareness about connections between climate change and community health. Other factors that have supported Florida BRACE activities include an interdisciplinary and diverse project team, and continued funding and support from the CDC and its network of practitioners.

The Florida BRACE Program hopes to expand in the future by engaging with more county health departments across Florida’s 63 counties. In addition, they hope to develop more outreach and engagement opportunities. They are particularly interested in opportunities such as workshops, meetings, symposia, and webinars, which help connect local practitioners and create space for creative thinking and generating new ideas.

The nonprofit Florida Institute for Health Innovation has engaged in several complementary climate change efforts. In 2013, the Institute created a Health Impact Assessment to examine the health-related effects of the climate change strategies recommended by the Southeast Florida Regional Climate Change Compact.⁴⁷ The Florida Institute for Health Innovation also partnered with Florida Atlantic University and the South Florida Regional Planning Council to identify the effects of sea level rise on health and map the most at-risk communities in Palm Beach, Broward, Miami-Dade, and Monroe counties. The team evaluated vulnerabilities by examining geographic (e.g., coastal areas likely to flood), social (e.g., lower socioeconomic status), and medical (e.g., rates of hospitalizations) factors. This information was combined to create maps of community “hot spots” that could be considered for Adaptation Action Areas, areas defined by Florida Statute 163.3177(6)(g)10 as “coastal zones that are experiencing coastal flooding due to extreme high tides and storm surge, and are vulnerable to the impacts of rising sea level.”⁴⁸ Recommended next steps from the sea level rise study include improved public messaging around health-related risks of sea level rise, more frequent data collection (e.g.,

⁴⁷ Health Impact Assessment: Minimizing the health effects of climate change in the South Florida region: http://flhealthinnovation.org/wp-content/uploads/2015/02/HIA-Final_Report_101514-compressed.pdf

⁴⁸ Florida Statute 163.3177(6)(g)10: <http://bit.ly/2IRp1hb>

water level changes, temperature, salinity), and increased surveillance and reporting of emerging diseases related to sea level rise.⁴⁹

Citation

Reynier W & Gregg RM. 2019. *Building resilience to climate change in Florida's public health system* [Case study on a project of the Florida BRACE Program]. Product of EcoAdapt's State of Adaptation Program. Last updated June 2019.

Preparing for the public health impacts of climate change in Illinois

Contact Information

Elena Grossman, Egross5@uic.edu
University of Illinois at Chicago
School of Public Health
2121 W Taylor Street, #559
Chicago, IL 60612
<https://braceillinois.uic.edu/>

Summary/Overview

Climate change impacts, including increases in extreme events such as flooding, heat waves, and drought, have already affected Illinois and are projected to continue. These kinds of extreme events can lead to health problems such as heat-related illnesses, asthma, vector- and water-borne diseases, and mental health issues. With funding from the CDC, the University of Illinois at Chicago School of Public Health (UIC) and the Illinois Department of Public Health (IDPH) are increasing knowledge and awareness of how climate change impacts public health, and improving the capacity of local health departments and emergency preparedness facilities to address the health effects of climate change.

Background

In September 2012, UIC and IDPH received a three-year grant from the CDC's Climate-Ready States and Cities Initiative to improve the capacity of the Illinois public health system to adequately address the health effects of climate change. Subsequent funding was awarded by the CDC in 2016 to continue implementing activities to help prepare for and respond to the health impacts of climate change in the state.

The project has prioritized heat-related illness, respiratory health, vector-borne diseases, extreme weather events (e.g., floods, water-borne diseases), and mental health. The long-term goal of this project is to reduce climate-related health illnesses in the state, and activities have primarily focused on working with local public health departments and communities to achieve this goal. Specific project objectives include:

- Increasing knowledge and awareness of climate change and public health within public health departments, physicians, and the general public;

⁴⁹ Health and sea level rise: Impacts on South Florida: <http://flhealthinnovation.org/wp-content/uploads/2016/07/Health-and-Sea-Level-Rise-Full-Report-2016.pdf>

- Improving the capacity of local health departments and emergency preparedness facilities to be able to address the health effects of climate change; and
- Contributing to the evidence-based field of climate change and public health (e.g., publishing in the peer-reviewed literature).

Implementation

Project activities include:

- Providing financial and technical support to five local public health departments, which includes facilitating strategic planning sessions to increase knowledge and awareness, prioritize health effects, identify adaptation strategies, generate an action plan, and provide guidance for implementation;
- Creating an online heat toolkit for local health departments, which includes guidance around messaging for warning levels, social vulnerability and heat health data for each county, and templates (e.g., press releases, social media) for community outreach during extreme heat events;
- Creating an online flood mapping toolkit for emergency preparedness professionals to use in hazard vulnerability planning activities;
- Creating educational videos for emergency preparedness professionals as well as the general public to increase awareness of climate change and health issues;
- Presenting to a variety of different audiences and professions (e.g., synagogues, churches, urban planners, engineering students, medical students) about the connections between climate change and health; and
- Convening two forums on climate and health. One forum concentrated on the 1995 Chicago heat wave – what happened, why it was so bad, outcomes, and what it could be like in the future. The purpose of this event was to reflect on the past but also to prepare for the future with a specific focus on prioritizing and targeting vulnerable populations.

The following information and resources have been used in the project: (1) National Climate Assessment, particularly sections on climate and health and climate projections; (2) American Public Health Association guidance for local health departments addressing climate change, health, and equity (i.e. Climate Change, Health, and Equity: A Guide For Local Health Departments); (3) the CDC's BRACE framework; (4) data from the U.S. Environmental Protection Agency; and (5) Intergovernmental Panel on Climate Change reports and climate science, among others. Additionally, the project has used communication guidance and tools from the CDC's Climate and Health Program and the Yale Program on Climate Change and Communication.

Outcomes and Conclusions

As a result of this work, UIC has several products to help Illinois prepare for the public health impacts of climate change. Example products include:

- Illinois Climate and Health Profile Report;
- Videos on climate change health in Illinois⁵⁰ and preparing for extreme weather;⁵¹
- Summer heat toolkit;⁵² and

⁵⁰ Climate Change and Health in Illinois: <https://braceillinois.uic.edu/video-climate-change-and-health-in-illinois/>

⁵¹ Preparing for Extreme Weather: <https://braceillinois.uic.edu/preparing-for-extreme-weather/>

⁵² Illinois Heat Toolkit: <https://braceillinois.uic.edu/summer-heat-toolkit/>

- Flood vulnerability maps.⁵³

The current CDC grant activities are focused on implementation and monitoring the effectiveness of implemented actions. Specifically, this project is assessing the effectiveness of different activities at the local health departments that were awarded funding. Examples of specific metrics include tracking the number of brochures handed out, the number of trainings, and website visits. UIC is also tracking the effectiveness of their trainings with physicians and other public health professionals by conducting pre- and post-training surveys. The surveys are intended to assess whether knowledge and awareness around climate change and public health has increased. Additionally, UIC evaluated the accessibility and usability of their heat toolkit and flood preparedness map.

Numerous factors have helped facilitate adaptation action throughout this project, including:

- Funding from the CDC;
- Experiencing recent extreme events (e.g., floods) that have brought attention to the need for planning and response; and
- Gaining the support of leaders from within the public health department (e.g., local, city, or state).

Some barriers that have arisen include politicization of the climate change issue; challenges connecting communicating the connections between current extreme events (e.g., floods, fires, hurricanes) and climate change; and finding simple ways to communicate the health effects of climate change as it is a complicated topic.

The Chicago Department of Public Health has engaged in complementary efforts. For example, the Healthy Chicago 2.0 plan includes 200 strategies to improve health, focusing on traditional health impacts as well as social determinants of health.⁵⁴ Some of the major objectives of the plan include: (1) coordinating with partner organizations for data collection, education, and planning; (2) launching public education campaigns on climate-informed health efforts; and (3) incorporating health, climate, and vulnerable populations into emergency planning. Successes include predicting emergent health issues among the most vulnerable populations; partnering with the Chicago Office of Emergency Management and Communications to develop an All-Hazards Emergency Operations Plan; collaborating with city hospitals to conduct syndromic surveillance to inform planning and response measures; collaborating to develop an urban sensing data network on airborne pollutants and climate factors; and being the first major city to be awarded a 2017 ENERGY STAR Partner of the Year for advancing energy efficiency strategies through local programs and policies.

Citation

Kershner J. 2019. *Preparing for the public health impacts of climate change in Illinois* [Case study on a project of the Illinois BRACE Program]. Product of EcoAdapt's State of Adaptation Program. Last updated June 2019.

⁵³ Health, Climate, and Location: <https://braceillinois.uic.edu/climate-change-health/people-places-at-risk/health-climate-location/>

⁵⁴ Healthy Chicago 2.0: Partnering to improve health equity 2016-2020: <https://www.chicago.gov/content/dam/city/depts/cdph/CDPH/Healthy%20Chicago/HC2.0Upd4152016.pdf>

Addressing climate change and environmental health risks in Iowa

Contact Information

Iowa Department of Health
321 East 12th Street
Des Moines, IA 50319-0075
<http://idph.iowa.gov>

Iowa Department of Natural Resources
502 E 9th Street, 4th Floor
Des Moines, IA 50319-0034
<https://www.iowadnr.gov>

Iowa Public Health Association
P.O. Box 13181
Des Moines, IA 50310
<https://www.iowapha.org>

Summary/Overview

The state of Iowa does not have a formal state climate action plan, however there are efforts within the state to address the impacts of climate change on public health, the environment, and communities. These efforts primarily focus on identifying climate change impacts, acquiring data and monitoring changes, and public outreach and education. The Iowa Department of Public Health tracks public health data on climate and environmental factors. In addition, the Iowa Department of Natural Resources has identified major public health risks due to climate change impacts for the state. Iowa City and nongovernmental agencies, such as the Iowa Public Health Association, are also working to address public health challenges related to climate.

Background

Climate change impacts of concern for Iowa include increased precipitation,⁵⁵ extreme heat, climate extremes that facilitate pest distribution and reproduction, air pollution, flooding, and prolonged pollen seasons. Direct public health concerns related to these impacts involve respiratory complications due to decreased air quality,⁵⁶ increases in infectious disease, mental stress, and a heightened prevalence of asthma and allergies.

Two now-defunct statewide entities, the Iowa Climate Change Advisory Council and the Iowa Climate Change Impacts Committee, published reports detailing climate change impacts in Iowa. The Council's 2008 report described certain components of public health in relation to costs and co-benefits of climate inaction and action. The Committee's report highlighted climate-related health issues including: (1) disease associated with extreme precipitation and rising humidity; (2) illness and death associated with extreme heat and heat waves; (3) respiratory problems related to warming temperatures and air quality; (4) allergies and pollen production; and (5) diseases transferred by food, water, and insects. These reports highlight major concerns for the state, however aside from strategies to reduce greenhouse gas emissions, neither plan includes specific actions to address these impacts.

⁵⁵ What Climate Change Means for Iowa: <https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-ia.pdf>

⁵⁶ Climate and Health in Iowa: <https://www.nrdc.org/sites/default/files/clean-power-plan-states-IA.pdf>

Implementation

The Iowa Department of Public Health does not have a formal climate action plan. However, the department does have a Public Health Tracking Portal, which contains public health data on climate and environmental factors.⁵⁷ The portal is part of the National Environmental Public Health Tracking Program, funded by the CDC. It highlights health and environmental issues related to air quality, climate (e.g., temperature, precipitation, extreme weather), heat-related illnesses, and water quality. These indicators can be used to aid state and local partners plan and evaluate measures concerning climate change and health. The climate-related data collected in this tracking portal were obtained through the Iowa State University Climate Science Program and the Iowa Environmental Mesonet.⁵⁸

The Iowa Department of Natural Resources identified critical climate-related public health effects in the state in its 2010 assessment, including increased stress on institutional services, increases in infectious disease transmission due to wetter and warmer climates, and increases in the prevalence and severity of asthma and allergies.⁵⁹

In 2014, the Iowa Public Health Association (IPHA) released a statement on climate impacts on the health of Iowans.⁶⁰ The statement, which was signed by 180 science faculty and researchers from 38 academic institutions in Iowa, indicated that the health-related effects of extreme events (e.g., extreme heat and precipitation) were the most obvious and immediate threats to the state. The statement concluded with a call for the adoption of strong climate policies to ensure human health and well-being. In addition, IPHA has a section on its website dedicated to climate change and health, which includes a link to the National Institute of Environmental Health Services' Climate Change and Human Health Literature Portal⁶¹ and resources from the American Public Health Association and CDC.

Iowa City released a climate adaptation plan in 2018 that details steps taken by the city to achieve a low-carbon, resilient footprint since 2005.⁶² As of 2015, the city has reduced greenhouse gas emissions by 23% since 2005 with aims towards an 80% reduction by 2050. The plan includes 35 actions to achieve climate mitigation and adaptation goals, including new policies and programs, partnerships, and education and awareness efforts. Health-related actions include improving accessibility to transportation options; documenting climate-related health impacts within the city and integrating findings into city planning, asset mapping, and communications and outreach; and expanding access to local food sources through community-supported agriculture and farmers markets, primarily in low-income and food-insecure neighborhoods.

Outcomes and Conclusions

While efforts exist throughout different state, city, and nongovernmental entities to present information and research on climate-related health impacts, there is limited mainstreaming of climate change into public health policies and planning. In addition, much of the available information on statewide efforts to address climate change has not been updated since the early 2010s.

⁵⁷ Iowa Public Health Tracking Portal: <https://tracking.idph.iowa.gov>

⁵⁸ Iowa Environmental Mesonet: <https://mesonet.agron.iastate.edu>

⁵⁹ Climate Change Impacts on Iowa 2010: <https://www.fws.gov/news/blog/images/states/iowa/iowaclimaterept.pdf>

⁶⁰ Iowa Climate Statement 2014: Impacts on the Health of Iowans: [https://www.iowapha.org/Resources/Documents/Iowa Climate Statement 2014-Impacts on the Health of Iowans FINAL with references.pdf](https://www.iowapha.org/Resources/Documents/Iowa%20Climate%20Statement%202014-Impacts%20on%20the%20Health%20of%20Iowans%20FINAL%20with%20references.pdf)

⁶¹ Climate Change and Human Health Literature Portal: <https://tools.niehs.nih.gov/cchhl/>

⁶² Iowa City Climate Adaptation Plan: <https://www8.iowa-city.org/weblink/0/edoc/1803121/Climate%20Action%20Plan.pdf>

Citation

Braddock KN. 2019. *Addressing climate change and environmental health risks in Iowa* [Case study on a project of the Iowa Department of Health, Iowa Department of Natural Resources, and Iowa Public Health Association]. Product of EcoAdapt's State of Adaptation Program. Last updated June 2019.

Preparing for the public health impacts of climate change through the Michigan Climate and Health Adaptation Program

Contact Information

Lorraine Cameron, cameronL@michigan.gov
Aaron Ferguson, FergusonA1@michigan.gov
Michigan Department of Health and Human Services
320 S Walnut Street
Lansing, MI 48933
<http://www.michigan.gov/mdhhs/>

Summary/Overview

Projected climate impacts for Michigan, including extreme heat events, extreme precipitation events leading to flooding, and extreme weather events (e.g., freezing rain, heavy snow), pose a significant threat to public health.^{63,64} In particular, five priority climate-related health outcomes have been identified: heat-related illnesses, air quality and respiratory diseases, vector-borne diseases, water-borne diseases, and injuries related to extreme weather events (e.g., carbon monoxide poisoning, injury). With funding from the CDC, the Michigan Climate and Health Adaptation Program (MICHAP) is helping build a climate-resilient public health system for the state, local health departments, and communities. Project activities have included efforts to raise awareness about the impacts of climate change on health and equity, funding community health impact assessments, developing a climate and health adaptation plan, outreach and training events, implementing pilot interventions (or adaptation actions), and evaluating the effectiveness of their programs and pilot interventions.

Background

In 2009, the Michigan Department of Community Health (MDCH, now MDHHS) was awarded a one-year planning grant funded by the CDC to develop a climate change and public health strategic plan. In 2010, as part of the Climate-Ready States and Cities Initiative, MDCH received a three-year grant from the CDC to fund the Michigan Climate and Health Adaptation Program (MICHAP) to implement the strategic plan; subsequent funding was awarded by the CDC in 2013 and 2016 to continue implementing activities to help prepare for and respond to the health impacts of climate change in the state.

To date, the MICHAP has focused on heat-related illness, air quality, vector- and water-borne diseases, and extreme weather events. Project activities, which have primarily focused on working with local

⁶³ What Climate Change Means for Michigan: <https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-mi.pdf>

⁶⁴ Climate Change and Health in Michigan: <https://www.nrdc.org/sites/default/files/climate-change-health-impacts-michigan-ib.pdf>

public health departments and communities, have been implemented over three phases: (1) 2010-2013, (2) 2013-2016, and (3) 2016-2021.

Implementation

Phase 1 (2010-2013) focused on raising awareness within the state and local public health departments about the impacts of climate change on health and equity. Additionally, three community health impact assessments were funded: (1) expanding urban tree canopy in the City of Ann Arbor; (2) evaluating the Michigan Street Corridor Plan for the City of Grand Rapids; and (3) evaluating the benefits of non-motorized improvements in East Lansing.⁶⁵ A key, non-local partner in this work was Human Impact Partners, an Oakland, California-based organization dedicated to increasing considerations of health and equity in decision-making.

The Health Impact Assessment (HIA) for Ann Arbor examined the health and psychological benefits associated with targeted tree planting in residential areas through the City of Ann Arbor Urban Community Forest Management Plan. Extreme heat, changes in precipitation, and extreme weather events are identified as the key drivers of health-related challenges, including asthma/allergies, air pollution, heat stress/heat-related illness, chronic disease, low birth weight, substance abuse, mental distress, obesity, and crime.⁶⁶ The HIA uses the methodology developed by the North American HIA Practice Standards Working Group to identify several intermediate impacts of implementing a comprehensive urban forestry program (e.g., decreased urban and surface temperatures, infrastructure stress, and energy use) and projected health outcomes (e.g., decreased heat stress and heat-related illness, increased management of chronic illness, and decreased mental stress). The project mapped neighborhoods in the city that were most vulnerable to heat stress and associated with low tree canopy cover. The results of the assessment revealed six neighborhoods vulnerable to three or more adverse health outcomes associated with hot weather. Expanding tree canopy on public sites is recommended as a core priority along with strategies to incentivize planting on under-canopied private properties.

Phase 2 (2013-2016) focused on application of the CDC's BRACE framework, including developing a state climate and health profile report and vulnerability assessment, assessing the burden of disease, identifying priority health impacts and possible interventions, developing a climate and health adaptation plan, and starting to evaluate impacts and activities. MICHAP partnered with the Great Lakes Integrated Sciences and Assessment Center (GLISA) to synthesize climate impacts information for the climate and health report, and also worked with researchers from the University of Michigan School of Public Health to develop the disease burden projections for heat-related illness and death in Michigan. Priority health impacts identified in this phase included heat-related illness, exacerbation of respiratory diseases associated with air pollution, vector-borne diseases (e.g., Lyme disease, West Nile virus), water-borne diseases (e.g., related to flooding), and extreme weather events resulting in carbon monoxide poisoning and/or other impacts (e.g., hypothermia and frostbite). Mental health was also identified as an emerging issue. MICHAP partnered with other BRACE grantees in a review of available literature to identify and assess available interventions (or adaptation actions) in response to health

⁶⁵ Resilience Efforts at the National and Local Levels: https://www.michigan.gov/mdhhs/0,5885,7-339-71548_54783_54784_55975-365488--,00.html

⁶⁶ Expanding urban tree canopy as a community health climate adaptation strategy: A Health Impact Assessment for the Ann Arbor Urban and Community Forest Management Plan: https://www.michigan.gov/documents/mdhhs/A_Health_Impact_Assessment_of_the_Ann_Arbor_Urban_Forest_Community_Management_Plan_514426_7.pdf

impacts; however, limited information on intervention efficacy was found. This review resulted in a CDC White Paper, *Climate and Health Intervention Assessment: Evidence on Public Health Interventions to Prevent the Negative Health Effects of Climate Change*.⁶⁷

During Phase 2, MICHAP also engaged in extensive outreach and training activities with communities, including providing input on the Michigan Green Communities Challenge, assisting with the public health portion of the Detroit Climate Action Plan, and working with the nonprofit Land Information Access Association (LIAA) on resilient master planning. Specifically, with MICHAP's support, LIAA developed and led a climate and health training for community planners to help them incorporate climate and health concerns into Master Plan/Comprehensive Plan updates.

Phase 3 (2016-2021) has thus far focused primarily on implementing pilot interventions – one focused in an urban area (Detroit) and another focused on a rural area (Marquette County) – and assessing their effectiveness. In Detroit, MICHAP is working with the city's public health department to build their internal capacity to address health effects from climate and environmental exposures, particularly to impacts such as extreme heat and cold events. For example, the health department has begun working with Detroit's emergency response agencies to develop plans for extreme heat and cold events to include interventions (e.g., opening cooling centers, issuing heat alerts). MICHAP, in partnership with Michigan State University (MSU) Extension, the School of Planning, Design, and Construction (SPDC), and the Sustainable Built Environment Initiative (SBEI), has been working with the local government, community partners, and the health department in Marquette County to integrate climate and health into existing plans.⁶⁸ Activities have included one-on-one conversations with vulnerable populations (e.g., homeless, veterans, aging) and utilizing the MSU SBEI process to convene charrette-style events with the community to increase awareness about climate, health, and equity issues. As part of the charrettes, MSU Extension and SPDC used "before" and "after" images of sites from around the community to communicate climate impacts and interventions. For example, one photo showed a washed-out culvert, which they used to show downstream health issues, possible interventions, and how green infrastructure interventions could address the health issues. Charrettes focused on four health themes: (1) vector awareness; (2) air quality issues (e.g., particulates from fire, drought, increased pollen production from shifting seasons); (3) emergency response and extreme events (e.g., damage to transportation infrastructure and the energy grid and loss of access to services); and (4) water-related issues (e.g., drought and flooding).

MICHAP has also been working to develop resources for communities to help them address climate-related water issues. For example, some Michigan communities are more vulnerable to flooding impacts while in other areas, communities are more vulnerable to water shortages. They have partnered with a community planning group to develop resources on climate, water, and health including a compilation of existing local ordinances related to source water protection and an interactive story map. These resources are designed to help local communities better understand where their water comes from, the climate-related issues that could impact those resources, and examples of how they can be more protective, especially given potential climatic changes.

⁶⁷ Climate and Health Intervention Assessment: Evidence on Public Health Interventions to Prevent the Negative Health Effects of Climate Change: https://www.cdc.gov/climateandhealth/docs/ClimateAndHealthInterventionAssessment_508.pdf

⁶⁸ Marquette Area Climate and Health Adaptation: <https://superiorwatersheds.org/projects/marquette-area-climate-and-health-adaptation>

Throughout these activities, MICHAP has utilized the following information and resources: (1) National Climate Assessment, particularly sections on climate and health and climate projections; (2) resources from GLISA; (3) spatial data and monitoring data from the National Oceanic and Atmospheric Administration, U.S. Environmental Protection Agency (air quality), Michigan Department of Environmental Quality (water quality), and National Weather Service (air temperature); (4) CDC Climate and Health Program; (5) CDC National Environmental Public Health Tracking Program; and (6) materials from the American Public Health Association and American Planning Association, among others.

Outcomes and Conclusions

As a result of this work, MICHAP has produced numerous products to help Michigan prepare for the public health impacts of climate change. Example products include:

- Michigan Climate and Health Profile Report;⁶⁹
- Michigan Climate and Health Adaptation Program Strategic Plan Update: 2016-2021;
- City and County Health Impact Assessments;⁷⁰
- Compilation of Michigan Emergency Preparedness Information;⁷¹
- Marquette Area Climate and Health Adaptation Guidebooks, which discuss how health is impacted and lists over 140 policy options for implementing interventions;
- Climate Health Adaptation Planning in Michigan: Training for Local Planners and Decision Makers;⁷² and
- Many others that can be found on the MICHAP website.⁷³

As part of Phase 1, MICHAP underwent a process evaluation to assess program implementation and effectiveness of achievement of early outcomes of their work.⁷⁴ As part of Phase 3, MICHAP is now in the process of evaluating the effectiveness of their pilot interventions. Specifically, MICHAP identified three intervention tiers and corresponding evaluation metrics as part of the Marquette County project:

1. Build a network of partners and establish a common language (example metric: number of times met);
2. Conduct community education and outreach, including identifying vulnerable populations and gathering their input (example metric: change in stakeholder knowledge of local climate and health issues from before to after engagement process); and
3. Create a health adaptation guidebook (example metric: guidebook created).

MICHAP is continuing to work with Marquette County to prioritize policy recommendations, implement a demonstration of one of the recommendations, and then evaluate the demonstration. Because it is challenging to measure a change in health outcomes, the evaluation will likely focus on

⁶⁹ Michigan Climate and Health Profile Report 2015:

https://www.michigan.gov/documents/mdhhs/MI_Climate_and_Health_Profile_517517_7.pdf

⁷⁰ Resilience Efforts at the National and Local Levels: https://www.michigan.gov/mdhhs/0,5885,7-339-71548_54783_54784_55975-365488--,00.html

⁷¹ Resources and Tools for Adaptation Planning: https://www.michigan.gov/mdhhs/0,5885,7-339-71548_54783_54784_55975-365488--,00.html

⁷² Climate Health Adaptation Planning in Michigan: Training for Local Planners and Decision Makers: <http://www.liaa.org/health.asp>

⁷³ Michigan Climate and Health Adaptation Program: https://www.michigan.gov/mdhhs/0,5885,7-339-71548_54783_54784_74886-232323--,00.html

⁷⁴ Process Evaluation: Michigan Climate and Health Adaptation Program 2010-2013:

https://www.michigan.gov/documents/mdch/evaluation_report_3.19.14_with_table_457932_7.pdf

indicators that show a reduced risk of exposure to climate events (e.g., reduced number of flood events).

Numerous factors have helped facilitate adaptation action throughout this project, including:

- Bringing local information to local communities (e.g., historic storm data for the community);
- A focus on things the community has already been experiencing (e.g., extreme events) and how they are likely to get worse in the future;
- Working through the community planning process rather than as a standalone process;
- Identifying co-benefits of adaptation recommendations;
- Finding and working with core community members, leaders, and/or committees (e.g., trusted local voices and sources), who then serve as the messenger to the rest of the community; and
- Linking mitigation and adaptation where possible.

Some barriers that have arisen include a general lack of understanding about how decision-makers can affect health outcomes as well as how their work contributes to climate adaptation (e.g., stormwater management); disconnect between public health and other decision makers (e.g., community planners, elected officials); politicization of the climate change issue; and a perceived conflict between climate action and economic prosperity. Funding was also identified as a barrier to continued work in health and adaptation; however, climate health and equity is gaining momentum and new funding opportunities are emerging (e.g., Kresge Foundation and Robert Wood Johnson Foundation).

Citation

Kershner J. 2019. *Preparing for the public health impacts of climate change through the Michigan Climate and Health Adaptation Program* [Case study on a project of the Michigan Department of Health and Human Services]. Product of EcoAdapt's State of Adaptation Program. Last updated June 2019.

Raising the profile of climate-related health risks in Missouri

Contact Information

Scott Patterson, scott.patterson@health.mo.gov
Missouri Department of Health & Senior Services
912 Wildwood, PO Box 570
Jefferson City, MO 65102-0570
<http://health.mo.gov>

Summary/Overview

Neither the State of Missouri nor the Missouri Department of Health & Senior Services has a climate action or adaptation plan. Activities underway at the health department are focused primarily on monitoring, surveillance, and public outreach. In addition, the State Emergency Management Agency, City of St. Louis, and Jackson County have taken steps to address climate change impacts on public health and safety. The Missouri State Medical Association also recently passed a resolution to support and actively lobby the State Legislature for a comprehensive climate change policy.

Background

Missouri's temperatures have warmed by 0.5-2°F over the last century.⁷⁵ Projected climate change impacts include heavy precipitation events, more frequent flooding, increased extreme heat events, increased ground-level ozone smog, increased length and severity of the pollen season, and higher risk of vector-borne illnesses such as the West Nile virus and Lyme disease.

The Missouri Department of Health & Senior Services (DHHS) has not engaged in climate adaptation planning. However, the department does provide tracking and educational resources that may support action on climate change. In addition, the State Emergency Management Agency, City of St. Louis, and Jackson County have taken steps to address climate change impacts on public health and safety. The City of St. Louis and Jackson County are ranked as having high and moderate-high vulnerability respectively on the CDC's Social Vulnerability Index.

Implementation

DHHS established the Environmental Public Health Tracking Program (EPHT) in 2002 as part of the National Environmental Public Health Tracking Program, funded by the CDC. The department hosts the EPHT Data Portal, which collects and provides data to support decision-making to improve prevention and response measures.⁷⁶ The site is used to analyze trends over time through hazard and disease surveillance, identify effective interventions, and to support public health research. EPHT operates in collaboration with the Missouri Public Health Information Management System (MOPHIMS) to support community health assessments of factors such as hospital and emergency room visits, injuries, and fatalities.⁷⁷ EPHT provides historical weather and climate data (1990-2015) on factors such as temperatures, winds, and humidity. The department also provides links to resources on extreme heat and cold events,⁷⁸ heavy precipitation and flooding,⁷⁹ vector-borne diseases,⁸⁰ and harmful algal blooms.⁸¹

DHHS's Disaster and Emergency Planning program created the online *Ready in 3* toolkit to help residents prepare by (1) creating a plan for different situations (e.g., evacuation vs. staying home), (2) preparing an emergency kit, and (3) listening for information from city, county, and state officials.⁸² Other resources included in the toolkit are guidelines for schools, adult care facilities, healthcare facilities, and emotional preparedness.

Missouri State Emergency Management Agency

The State Emergency Management Agency (SEMA) released the Missouri State Hazard Mitigation Plan in 2018, which includes climate change considerations as they may exacerbate future hazard events, such as intense storms and precipitation, heat waves, drought, and flooding. The plan links climate change with human health impacts such as decreased air quality, reduced water availability, increased

⁷⁵ What Climate Change Means for Missouri: <https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-mo.pdf>

⁷⁶ Missouri Environmental Public Health Tracking: https://ephtn.dhss.mo.gov/EPHTN_Data_Portal/index.php

⁷⁷ Missouri Public Health Information Management System: <https://webapp01.dhss.mo.gov/MOPHIMS/MOPHIMSHome>

⁷⁸ Hyperthermia: <https://health.mo.gov/living/healthcondiseases/hyperthermia/index.php>

⁷⁹ Checklists for Evacuation Preparations: <https://health.mo.gov/emergencies/ert/pdf/floodevacprep.pdf>

⁸⁰ Mosquitos and Ticks Can Spread Disease: <https://health.mo.gov/living/healthcondiseases/communicable/tickscarrydisease/pdf/MosquitoandTickPoster.pdf>

⁸¹ Harmful Algal Blooms and Blue-Green Algae: <https://dnr.mo.gov/env/cyanobacteria.htm>

⁸² Ready in 3 Toolkit: <https://health.mo.gov/emergencies/readyin3/>

respiratory illnesses, elevated emotional stress levels, and food-, and vector- and water-borne diseases.

City of St. Louis

In 2017, the City of St. Louis released a Climate Action and Adaptation Plan to improve human health and well-being, protect built and natural assets, and advance equity.⁸³ The plan includes several mitigation and adaptation goals related to human health, including reducing greenhouse gas emissions by 80% of 2005 levels by 2050. Other strategies include investing in walkable neighborhoods, creating and maintaining green spaces, reducing risks associated with temperature extremes (e.g., increase presence of and mobility to cooling and heating centers, education of vulnerable populations), and reducing flood impacts and health-associated risks (e.g., protect vulnerable water treatment facilities, promote green infrastructure).

Jackson County

In July 2018, the Jackson County Health Department released *Climate Change in Jackson County: An Examination of the Health Impacts of Climate Change*, which identifies key climate-related risks and essential responses to protect public health and safety.⁸⁴ Recommended strategies include increased public education and outreach, improving operational emergency response capacity, maintaining surveillance of conditions and public health data, and improving healthcare infrastructure.

Outcomes and Conclusions

There is limited overall action on climate change in Missouri. However, some entities are taking initial steps to raise the profile of climate-related health risks. In addition, the Missouri State Medical Association recently passed a resolution to support and actively lobby the State Legislature for a comprehensive climate change policy to reduce greenhouse gas emissions and environmental pollution and improve the public health of all state residents.⁸⁵

Citation

Gregg RM. 2019. *Raising the profile of climate-related health risks in Missouri* [Case study on a project of the Missouri Department of Health & Senior Services]. Product of EcoAdapt's State of Adaptation Program. Last updated June 2019.

⁸³ St. Louis Climate Action and Adaptation Plan:

https://www.stlouis-mo.gov/government/departments/mayor/initiatives/sustainability/documents/upload/v1-1-CAP_FINAL.pdf

⁸⁴ Climate Change in Jackson County: an Examination of the Health Impacts of Climate Change: <https://jacohd.org/files/health-reports/climate-change-and-health-report.pdf>

⁸⁵ Missouri State Medical Association. 161st (2019) House of Delegates Resolution Actions and Decisions.

<https://www.msma.org/resolution-actions.html>

Statewide efforts to address climate-related health risks in Nevada

Contact Information

Amos Hollar, ahollar@health.nv.gov

Nevada Department of Health and Human Services

4126 Technology Way #100

Carson City, NV 89706

Nevada Division of Emergency Management

2478 Fairview Dr. #B

Carson City, NV 89701

<http://dem.nv.gov>

Nevada Division of Environmental Protection

901 S Stewart Street, Suite 4001

Carson City, NV 89701

<https://ndep.nv.gov>

Summary/Overview

Efforts in Nevada to address climate-related public health risks include tracking of clinic and hospital visits, reduction of greenhouse gas emissions and investment in renewable energy sources, and water conservation measures. In addition, Nevada joined the U.S. Climate Alliance in March 2019, committing to several climate adaptation and mitigation goals.

Background

Nevada's temperatures have increased about 2°F over the last century.⁸⁶ Temperatures are projected to continue to increase, causing more extreme heat waves, droughts, wildfires, and poor air quality.⁸⁷ In addition, warming temperature will cause more frequent days at or above 105°F, and the cooling effects of nighttime temperatures may be minimized with increasing overnight low temperatures.

Former Governor Jim Gibbons created a Climate Change Advisory Committee in 2007 charged with developing recommendations for addressing climate change. The 2008 Nevada Climate Change Advisory Committee Final Report explicitly addresses how climate change will affect public health via extreme heat, increased ozone pollution and dust and particulate matter concentrations, and increased infectious diseases. These impacts include asthma, allergies, food and water scarcity, decreased pulmonary function in adults, and susceptibility to water-, food-, and vector-borne diseases. The report advises the creation of a statewide climate action plan to control greenhouse gas emissions and facilitate environmentally-friendly transportation and living, but does not provide direct strategies to alleviate the effects of climate change on public health. In addition, there is no clear evidence that any of the strategies listed in the report are being implemented.

While the Nevada Department of Health and Human Services does not have a formal climate action or adaptation plan, there are steps the department and other state and local agencies are taking to address climate change impacts on public health and safety.

⁸⁶ What Climate Change Means for Nevada: <https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-nv.pdf>

⁸⁷ NOAA National Centers for Environmental Information State Summaries: Nevada. <https://statesummaries.ncics.org/downloads/NV-screen-hi.pdf>

Implementation

Nevada Department of Health and Human Services

The Nevada Health Alert Network (NVHAN) is administered by the Department of Health and Human Services' Division of Public and Behavioral Health. NVHAN is a statewide alert system that supports rapid connection between hospitals, healthcare facilities, first responders, healthcare providers, law enforcement, and critical services (e.g., communications, water, energy) during public health emergencies. HAVBED (Hospital Available Beds for Emergencies and Disasters) tracks bed availability and hospital capacity and its system features multiple backup servers containing critical health and emergency preparedness documents that are useful during crises (e.g., Nevada's Public Information and Communications Plan).⁸⁸ While not directly tied to climate change, the information collected may improve syndromic surveillance and is now shared with neighboring western states to inform regional efforts.

Nevada Division of Environmental Protection

The mission of the Division of Environmental Protection is to protect the environment in order to sustain ecosystems, the economy, and public health through programs focused on land, water, and air. The department monitors air and water quality and prepares greenhouse gas emissions inventories for the state every four years. The most recent inventory report, released in 2016, detailed 2013 levels and projected future emissions through 2030.⁸⁹ Emissions in Nevada peaked in 2005 but have since declined due in part to the closure of the large coal-fired Mohave Power Station. In 2016, more than 85% of the energy consumed by Nevada came from outside of the state.⁹⁰ Nevada voters approved an initiative in 2018 to acquire 50% of its energy from renewable sources by 2030,⁹¹ which will expand Nevada's energy independence and reduce greenhouse gas emissions.

Nevada Division of Emergency Management

Governor Brian Sandoval enacted Executive Order 2018-4 *Implementation of Nevada's Statewide Resilience Strategy*, which required the Nevada Commission on Homeland Security to develop a five-year plan for consideration. Health-related recommendations from the Commission included building capacity for health professionals to operate with greater freedom during public health emergencies or disasters (e.g., temporary waivers for out-of-state practitioners; mobilizing trained volunteers); providing training for disaster response; creating a database of trained professionals; and establishing a statewide Disaster Behavioral Health Plan and Psychological First Aid standards and training requirements.⁹²

The 2018 Nevada Enhanced Hazard Mitigation Plan defines the state's goals, priorities, and strategies with respect to efforts to limit or eliminate risks associated with natural and human-caused disasters. Critical hazards in the state include drought, extreme heat, floods, storms, wildfire, epidemics,

⁸⁸ U.S. Department of Health and Human Services (DHHS). 2011. From Hospitals to Healthcare Coalitions: Transforming Health Preparedness and Response in Our Communities. U.S. DHHS Assistant Secretary for Preparedness and Response Report on the Hospital Preparedness Program. End-of-year 2007-2009 Reporting Periods. <http://www.phe.gov/Preparedness/planning/hpp/Documents/hpp-healthcare-coalitions.pdf>

⁸⁹ Greenhouse Gas Emissions: <https://ndep.nv.gov/air/air-pollutants/greenhouse-gas-emissions>

⁹⁰ Nevada State Profile and Energy Estimates: <https://www.eia.gov/state/?sid=NV#tabs-3>

⁹¹ Why Nevada upped its renewable energy standards (and Arizona didn't): <https://grist.org/article/why-nevada-upped-its-renewable-energy-standards-and-arizona-didnt/>

⁹² Statewide Resilience Strategy and Legislative Recommendations to the Nevada Commission on Homeland Security: <http://dem.nv.gov/uploadedFiles/demnv.gov/content/About/State%20Resilience%20Strategy%20and%20Recommendations%20FINAL%200.pdf>

avalanches, and earthquakes. High-risk hazards include fires, floods, and earthquakes, medium-risk include extreme heat, drought, and storm events, and low-risk hazards include avalanches and epidemics. The plan indicates that climate change is likely to exacerbate the duration and severity of floods, droughts, and extreme heat events. Increased winter precipitation occurring as rain instead of snow will increase the risk of winter floods. Declining snowpack will lead to reduced summer water supply and drought conditions in ecosystems, farmlands, and rangelands. Warming air temperatures will likely cause more frequent days at or above 105°F, and the cooling effects of nighttime temperatures will be negated with increasing overnight low temperatures. Wildfires are also projected to become larger and more frequent and destructive in a changing climate. The plan includes strategic goals and actions to reduce negative effects on communities, ecosystems, and infrastructure. For example, to reduce injuries and the loss of life, the plan identifies increasing public awareness of hazards and preparedness, response, and recovery measures as a critical strategy. In the case of wildfire, this includes educating homeowners about increasing defensible space within the Wildland-Urban Interface to decrease vulnerability to fire.

Southern Nevada Water Authority

The Southern Nevada Water Authority (SNWA) manages water needs in the Clark County region through a collaboration of water and wastewater agencies. SNWA conducted a vulnerability assessment of its service area using the U.S. Environmental Protection Agency's Creating Resilient Water Utilities program framework. The assessment evaluated risks associated with extreme heat, drought, and harmful algal blooms. One of the biggest resilience measures undertaken by SNWA is water conservation. Between 2002-2017, this program reduced consumptive use of the Colorado River water supply by 28 billion gallons, increased water banking and recharge efforts, and began construction on pumping stations to provide a reliable water supply under low-flow conditions.⁹³ SNWA is also a founding member of the U.S. Water Utility Climate Alliance, a partnership between 12 water agencies to address climate change.

Outcomes and Conclusions

While the statewide advisory committee recommended the formal development of climate mitigation and adaptation plans, limited progress has been made since 2008. However, in March 2019, Nevada became the 23rd state to join the U.S. Climate Alliance, signaling a renewed effort towards taking specific actions towards addressing climate change. The U.S. Climate Alliance is a collaboration between states seeking to take on-the-ground action towards climate adaptation and mitigation, particularly by meeting the goals of the Paris Agreement to reduce greenhouse gas emissions by 26-28% below 2005 levels by 2025.

Citation

Gregg RM. 2019. *Statewide efforts to address climate-related health risks in Nevada* [Case study on a project of the Nevada Department of Health and Human Services, Nevada Division of Emergency Management, and Nevada Division of Environmental Protection]. Product of EcoAdapt's State of Adaptation Program. Last updated June 2019.

⁹³ Southern Nevada Water Authority Water Resource Plan and Water Budget: <https://www.snwa.com/assets/pdf/water-resource-plan.pdf>

Assessing links between climate change and public health and safety in New Jersey

Contact Information

New Jersey Department of Health
P.O. Box 360
Trenton, NJ 08625-0360
<https://www.nj.gov/health/>

New Jersey Department of Environmental Protection
401 E State Street
Trenton, NJ 08608
<https://www.nj.gov/dep/>

New Jersey Climate Change Alliance
57 US Highway 1
New Brunswick, NJ 08901-8554
<http://njadapt.rutgers.edu>

Summary/Overview

Efforts to address climate-related public health risks by the New Jersey Department of Health include environmental public health data monitoring, tracking of medical assets and extreme events, education and technical assistance, and targeted research to evaluate programmatic vulnerabilities. Complementary activities include efforts to advance climate mitigation and adaptation goals through the New Jersey Climate Change Alliance, U.S. Climate Alliance, and state and regional initiatives to reduce greenhouse gas emissions.

Background

New Jersey's temperatures have increased by about 3°F over the last century.⁹⁴ Additional climatic changes and impacts of concern in the state include sea level rise, saltwater intrusion, extreme storms and flooding, extreme heat events, vector-borne diseases, and a more severe allergy season.

In 2009, *Meeting New Jersey's 2020 Greenhouse Gas Limit: New Jersey's Global Warming Response Act Recommendations Report* identified the challenges associated with greenhouse gas emissions. The primary focus of the report is on emissions reductions but does include limited discussion of how climate change can affect public health via degraded air quality and reduced quality of life. While a full statewide adaptation plan was recommended as part of the 2009 report, no formal plan has been released. The New Jersey Department of Health (DOH) also does not have a formal climate or adaptation plan, but does have several programs and activities relevant to climate change and public health and safety.

Implementation

DOH conducts monitoring and surveillance of climate-related health factors, provides education and technical assistance to local health departments and communities during emergencies, and funds research to evaluate how its operations fare during extreme events.

Monitoring and surveillance

While the department's Environmental Public Health Tracking Program is not directly linked to climate change, it does include monitoring of air and water quality, heat stress, Lyme disease, and disaster

⁹⁴ What Climate Change Means for New Jersey: <https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-nj.pdf>

response through the State Health Assessment Data (SHAD) system.⁹⁵ SHAD provides access to public health data indicators (e.g., air and water quality, cardiovascular disease, infectious disease), details on tracking mechanisms and sources, and links to other relevant datasets and publications to support decision-making. DOH also uses the Hippocrates online system to capture and share critical health information and support day-to-day operations and rapid response and recovery for emergency situations.⁹⁶ The system integrates data from DOH's Medical Coordination Centers, local health departments, clinics, and other healthcare facilities. Hippocrates combines real-time feeds of weather events (e.g., fires, floods), incidents, and medical assets (e.g., hospitals, command centers, blood banks) with basic GIS map layers on a closed system only accessible by public health practitioners.

Education and technical assistance

DOH and the Department of Environmental Protection (DEP) partnered to launch the Clean Air NJ campaign in 2015 to raise public awareness about the negative effects of ground-level ozone and measures that can reduce the likelihood of smog.⁹⁷ The Clean Air NJ website provides details about the health and environmental effects of smog, access to daily air quality data via the Air Quality Index, and tips on how the public can reduce ozone formation and avoid exposure.

DOH's Division of Public Health Infrastructure, Laboratories, and Emergency Preparedness (PHILEP) oversees the Office of Disaster Resilience, Office of Emergency Medical Services, and the Public Health and Environmental Laboratories.⁹⁸ Superstorm Sandy tested PHILEP's preparedness, response, and recovery initiatives. For example, the Office of Emergency Medical Services collaborated with public health agencies and practitioners to provide transportation for residents from vulnerable areas to shelters, and provided technical assistance to local departments overwhelmed by the storm's impacts.

Targeted research

DOH also funded the Sandy Child and Family Health Study (S-CAFH), an initiative to examine the health needs of families affected by Superstorm Sandy and inform the modification of departmental programs to better serve the state in the face of future extreme events. S-CAFH was modeled after the post-Hurricane Katrina Gulf Coast Child and Family Health Study, and is a partnership between the Rutgers University School of Social Work, New York University's Global Institute of Public Health, Columbia University's National Center for Disaster Preparedness, and Colorado State University's Center for Disaster Risk and Analysis. The project team conducted interviews with over 1,000 adults from the most affected counties in the state to identify household decision-making processes (e.g., evacuation vs. shelter-in-place), post-storm health and well-being, and health services sought after and received. For example, 24% of the residents (~240,000 people) were under a mandatory evacuation order but only one-third of them complied, and over 90% of residents that suffered major infrastructure damage reported being directly in contact with floodwaters, debris, and/or mold. Mold exposure was directly linked to asthma and mental distress diagnoses as a result of the storm, and children in these counties were found to be at very high risk for psychological and emotional health problems. Two reports have been released to date on the study's findings: *Hurricane Sandy PLACE Report: Evacuation Decisions, Housing Issues, and Sense of Community*,⁹⁹ and *Hurricane Sandy PERSON Report: Disaster Exposure*,

⁹⁵ New Jersey State Health Assessment Data: <https://www.doh.state.nj.us/doh-shad/home/Welcome.html>

⁹⁶ Hippocrates: <https://hippocrates.nj.gov/>

⁹⁷ Clean Air NJ: <https://www.nj.gov/dep/cleanairnj/>

⁹⁸ PHILEP Website: <https://www.nj.gov/health/philep/>

⁹⁹ The Sandy Child and Family Health Study Place Report: Evacuation Decisions, Housing Issues, and Sense of Community: http://academiccommons.columbia.edu/download/fedora_content/download/ac:187431/CONTENT/SCAFH_Place_Report.pdf

Health Impacts, Economic Burden, and Social Well-Being.¹⁰⁰ Both reports include key findings as well as implications for improved preparedness, response, and recovery programs. For example, some suggested improvements include:

- Advanced physical and mental health screening and psychological first aid programs for residents with greatest exposure to the disaster(s);
- More targeted risk communication to garner attention and compliance for evacuation orders, although many residents that remained at home did not have a place to go; and
- Financial counseling to assist residents, particularly those in the poorest communities. One key finding from the study was that the poorest residents tended to have the greatest housing needs but were much less likely to apply for assistance from resources such as the Sandy Homeowner and Renter Assistance Program and therefore suffered an additional “poverty penalty.”

Outcomes and Conclusions

Although New Jersey is not a formal participant in CDC’s Climate-Ready States and Cities Initiative, the New Jersey Climate Change Alliance (formerly the Climate Adaptation Alliance) used the initial steps of the BRACE framework to create a Climate and Health Profile Report.¹⁰¹ The report covers observed and projected climate change impacts in the state with a detailed emphasis on the most vulnerable populations. The report recommends several action steps for the New Jersey Climate Adaptation Alliance’s Climate Change and Public Health Working Group to advocate for advancement, including:

- Creation of a coordinated statewide pharmacy plan to support prescription distribution during emergency events;
- Creation of a web-based registration system to track individuals in emergency shelters;
- Provision of crisis counseling to emergency shelter staff and residents;
- Development of a statewide emergency stockpile plan for food, water, medication, fuel, and other supplies; and
- Assessment of the state’s capacity to adequately address the climate-related health needs of vulnerable populations and communities.

In January 2018, the DEP’s Air Quality, Energy, and Sustainability program was directed to re-commit to participation in the Regional Greenhouse Gas Initiative (RGGI), an effort to reduce regional emissions between other New England and Mid-Atlantic states. Governor Phil Murphy’s Executive Order links participation in RGGI to efforts to improve air quality and public health, increase energy efficiency, and grow the state’s green economy.¹⁰² In February 2018, New Jersey also joined the U.S. Climate Alliance, a collaboration between states seeking to take on-the-ground action towards climate adaptation and mitigation, particularly by meeting the goals of the Paris Agreement to reduce greenhouse gas emissions by 26-28% below 2005 levels by 2025. This commitment is in addition to the state’s objective to reduce emissions by 80% of 2006 levels by 2050.¹⁰³

¹⁰⁰ The Sandy Child and Family Health Study Person Report: Disaster Exposure, Health Impacts, Economic Burden, and Social Well-being: http://academiccommons.columbia.edu/download/fedora_content/download/ac:187434/CONTENT/SCAFH_Person_Report_Final.pdf

¹⁰¹ New Jersey Climate and Health Profile Report: <https://njadapt.rutgers.edu/docman-lister/njcaa-meetings/199-chpr-final-12-6-2017/file>

¹⁰² Governor Phil Murphy’s Executive Order No.7. 2018: <https://www.nj.gov/infobank/eo/056murphy/pdf/EO-7.pdf>

¹⁰³ State of New Jersey Greenhouse Gas Inventory: <https://www.state.nj.us/dep/ages/sggi.html>

Citation

Gregg RM. 2019. *Assessing links between climate change and public health and safety in New Jersey* [Case study on a project of the New Jersey Department of Health, New Jersey Department of Environmental Protection, and New Jersey Climate Change Alliance]. Product of EcoAdapt's State of Adaptation Program. Last updated June 2019.

Building capacity to reduce human health impacts of climate change in New York State

Contact Information

Neil Muscatiello, neil.muscatiello@health.ny.gov

New York State Department of Health

Corning Tower, Empire State Plaza,

Albany, NY 12237

<https://www.health.ny.gov>

Summary/Overview

In New York State, the climate is becoming warmer, wetter, and more variable. Impacts such as heat waves, flooding, and extreme weather events (e.g., heavy rain or snow) are already affecting human health and well-being and are projected to continue.¹⁰⁴ In 2010, the New York State Department of Health (NYSDOH) was awarded a grant from the CDC to build capacity and develop a plan for reducing human health impacts of climate change. The NYSDOH is prioritizing planning for extreme weather events, extreme heat, and vector-, food-, and water-borne diseases.

Background

In 2010, the NYSDOH was awarded a Climate-Ready States and Cities Initiative (CRSCI) grant from the CDC to assess the impacts of climate change on public health and develop ways to improve resiliency. Subsequent funding was awarded by the CDC in 2013 and 2016 to continue implementing activities to help prepare for and respond to the health impacts of climate change in the state.

The NYSDOH is prioritizing planning for extreme weather events, extreme heat, and vector-, food-, and water-borne diseases, although current project activities have concentrated on preparing for extreme heat events. Specific project goals include working with partners to implement climate adaptation options to reduce potential climate impacts on health, and developing tools for local health departments and other agencies to address the public health impacts of climate change.

Implementation

The NYSDOH has collected data and conducted research to better understand and characterize the health impacts from extreme heat events, and has created supporting tools for local health departments and communities. Some examples of project activities include:

- Revising the threshold at which the state issues heat-health warnings based on research linking temperature data with heat-related illness data;
- Creating a heat vulnerability index and supporting maps, including locations of cooling centers;

¹⁰⁴ What Climate Change Means for New York: <https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-ny.pdf>

- Creating county-specific heat-health profiles, which explore how temperatures have increased over time, summarize heat-related illnesses (e.g., dehydration, heat stroke), and provide links to resources that may benefit their population (e.g., cooling assistance program);
- Projecting the economic impacts of different heat forecasts and the associated increases in respiratory diseases;
- Developing fact sheets, social media messages, brochures, and other outreach materials for heat events;
- Working with the NYS Office for the Aging to develop materials for senior citizens, including adding a link to the Cooling Center Mapping Application¹⁰⁵ on their Aging Services app, which connects older adults with information on health, housing, and transportation options; and
- Working with the Department of Environmental Conservation's Climate-Smart Communities Program to integrate health-related action items (e.g., conducting a vulnerability assessment for a public health issue, designating cooling centers, etc.) into their climate-smart certification program.

Other key project partners have included the NYS Energy and Research Authority and the NYS Office of Temporary and Disability Assistance. The National Climate Assessment and New York State ClimAid report were instrumental resources for these efforts.

Outcomes and Conclusions

As a result of this work, NYSDOH has created several products to help the state prepare for the public health impacts of climate change, including the Climate and Health Profile Report,¹⁰⁶ County Heat and Health Profiles,¹⁰⁷ Heat Vulnerability Index,¹⁰⁸ and Cooling Center mapping tool.

The NYSDOH has evaluated or plans to evaluate several aspects of their project, including surveying local health departments to assess the effectiveness of products and tools (e.g., heat-health index) and collecting information on how and when cooling centers are used. Next steps for the project include working with local health departments to identify their heat-health priorities, establishing mini-grants for local health departments to implement adaptation options for heat-health priorities, pursuing opportunities for working with tribes and tribal organizations in the state, and participating in the process to create a state adaptation plan.

Factors that have helped facilitate adaptation action throughout this project include state-level political support for addressing climate change and recent extreme events (e.g., several 500-year flood events) that have impacted communities and brought attention to the need for planning and response. Some barriers that have arisen include limited funding and challenges attributing changes in health trends with climate change.

¹⁰⁵ New York Cooling Centers Mapping Application:

https://apps.health.ny.gov/statistics/environmental/public_health_tracking/tracker/#/CCMap

¹⁰⁶ New York Climate and Health Profile Report: <https://www.health.ny.gov/environmental/weather/docs/climatehealthprofile6-2015.pdf>

¹⁰⁷ New York State County Heat and Health Profile Reports: <https://www.health.ny.gov/environmental/weather/profiles/>

¹⁰⁸ New York Heat Vulnerability Index: https://www.health.ny.gov/environmental/weather/vulnerability_index/

Citation

Kershner J. 2019. *Building capacity to reduce human health impacts of climate change in New York State* [Case study on a project of the New York State Department of Health]. Product of EcoAdapt's State of Adaptation Program. Last updated June 2019.

Implementing interventions for heat-related illness and wildfire smoke exposure in North Carolina

Contact Information

Lauren Thie, lauren.thie@dhhs.nc.gov

North Carolina Department of Health and Human Services

Occupational & Environmental Epidemiology Branch: Climate and Health Program

5505 Six Forks Road

Raleigh, NC 27699-1912

<https://www.ncdhhs.gov>

Summary/Overview

The North Carolina Department of Health and Human Services (NCDHHS) is utilizing the BRACE framework to address heat-related illness and wildfire smoke exposure in their most vulnerable counties. NCDHHS has collaborated with community stakeholders to develop tailored health intervention activities, and is implementing two adaptation pilot projects at the local level. One project is piloting a heat alert system and associated heat education efforts to ameliorate incidents of heat-related illness. A second project is integrating wildfire smoke exposure and safety messaging into existing Smokey Bear education programs for elementary students. Lessons learned from these two pilot projects will be used to refine health and climate messaging and develop additional adaptation projects in the future.

Background

NCDHHS initially began working on climate change issues due to concerns about potential public health impacts from increasing temperatures. With funding from the CDC, the department implemented the BRACE framework, completing an impacts assessment that evaluated all potential climate threats to public health. Published in 2015, this Climate and Health Profile identified heat-related illnesses associated with extreme heat events and wildfire smoke exposure as the greatest climate impacts of concern in North Carolina. Other identified impacts included air pollution, extreme weather events, and water-borne pathogens.

With additional CDC funding, NCDHHS then conducted more in-depth vulnerability assessments for heat-related illnesses and wildfire smoke exposure to identify priority adaptation locations. Using the state syndromic surveillance system, the department tracked heat-related emergency room (ER) visits, which revealed high ER visit rates in the southeast Sandhills region of the state. Subsequent analyses identified a five county sub-region as being highly vulnerable to heat-related illness. For wildfire smoke, NCDHHS investigated the number of pre-existing conditions that could be aggravated by smoke exposure, and used GIS mapping to identify the most vulnerable counties in the state (e.g., those with high exposure to wildfire smoke and high numbers of residents with underlying conditions). One

county was ultimately prioritized for action because in addition to high vulnerability, residents also had low access to tools that could inform healthy decision-making, such as the EPA's air quality information system.

Implementation

NCDHHS is now working on implementing two local health adaptation pilot projects to address heat and wildfire. The department is piloting a heat health alert system in southeast North Carolina. This system will alert target populations when heat levels become dangerous, and provide residents with actions they can take to reduce their risk. The heat health alert system is tailored to residents most at risk for heat-related illness, including farm workers, older adults, low-income families, and youth. For wildfire smoke exposure, NCDHHS is collaborating with the U.S. Forest Service in North Carolina to integrate smoke safety information with existing Smokey Bear programs for elementary school students. Educational pieces include identifying smoke-sensitive health conditions and messaging around healthy behaviors during smoky conditions. For both projects, NCDHHS has developed full implementation and monitoring plans.¹⁰⁹

These intervention actions were selected after a thorough review process with stakeholder input. NCDHHS first identified a range of possible intervention actions vetted in the scientific literature. These options were presented to and evaluated by stakeholders according to a variety of criteria, such as ease of implementation, cost, and timeliness. Stakeholders also added additional criteria, such as language accessibility. Stakeholders ultimately selected health intervention actions based on a combination of evaluation scores and the needs of local communities. For example, for the heat health alert system, stakeholders emphasized the need to include a health education component to teach residents how to use the system. For wildfire smoke, the chosen intervention activity was entirely stakeholder-designed rather than sourced from the literature, as stakeholders strongly believed leveraging existing Smokey Bear programming would be the best approach.

In addition to identifying appropriate and feasible health interventions at the local level, community stakeholders have also been critically important in refining messaging to best reach residents. These stakeholders include local health departments and emergency management departments, nonprofit organizations, agricultural extensions, and land management agencies (e.g., local fire departments, the U.S. Forest Service, The Nature Conservancy).

Outcomes and Conclusions

NCDHHS has CDC funding through 2021. They plan to continue implementing these two pilot projects, and then revise and expand their adaptation activities based on lessons learned. For example, they are currently collecting feedback on the utility of different heat health education materials and trainings. They are also tracking over the longer-term whether the implemented health interventions alter health behaviors and outcomes. All feedback will be used to update existing implementation and monitoring plans, and to refine and develop additional educational materials.

¹⁰⁹ Climate and Health Implementation and Monitoring Strategy for Heat-Related Illness: <https://epi.publichealth.nc.gov/oeec/climate/HeatIMSNorthCarolinaExecutiveSummary.pdf> and Climate Health Implementation and Monitoring Strategy for Landfire Smoke: <https://epi.publichealth.nc.gov/oeec/climate/SmokeIMSNorthCarolinaExecutiveSummary.pdf>

Primary barriers encountered by NCDHHS during the course of their work include working in rural communities and communities with diverse health problems. Most existing adaptation materials are geared toward larger population centers. Rural communities face different challenges (e.g., low population numbers and population density, high poverty rates, low rates of higher education), and adaptation options developed for urban areas are not always applicable. For example, rural residents may not be able to easily travel to cooling shelters during extreme heat events. Additionally, many of North Carolina's most vulnerable communities face diverse health impacts and have very limited resources. For example, many of the communities the NCDHHS is working with also experience high levels of poverty, score poorly in many health categories, and were those hardest hit by Hurricanes Matthew and Florence.

NCDHHS has found that relying on the expertise and connectedness of community leaders is key in addressing these challenges. Although vulnerable, these communities have survived and been resilient to past extreme events and associated health impacts. Community leaders have detailed knowledge about their community and how best to respond to climate challenges moving forward. NCDHHS has found that as a state agency, they experience the most success by empowering local community leaders to use and adapt the BRACE framework, and by building on existing community efforts (e.g., Smokey Bear education programs).

Citation

Reynier W. 2019. *Implementing interventions for heat-related illness and wildfire smoke exposure in North Carolina* [Case study on a project of the North Carolina Department of Health and Human Services]. Product of EcoAdapt's State of Adaptation Program. Last updated June 2019.

Building awareness of climate-related health risks in Ohio

Contact Information

Aparna Bole, Aparna.Bole@uhhospitals.org

Ohio Environmental Council

Ohio Clinicians for Climate Action

1145 Chesapeake Avenue, Suite I

Columbus, OH 43212

<https://theoec.org/clean-energy/ohio-clinicians-climate-action/>

Ohio Department of Health

246 N High Street

Columbus, OH 43215

<https://odh.ohio.gov/>

Summary/Overview

The State of Ohio does not have a state climate adaptation plan or an official Department of Health climate action plan. However, there are efforts underway to address the public health impacts of climate change in some city and county plans as well as efforts across nongovernmental organizations in the region.

Background

The major climate impacts of concern for Ohio include extreme heat and precipitation, drought, inland flooding, threats to air quality, and harmful algal blooms.^{110,111} These impacts can threaten health by influencing changing patterns of infectious disease, exacerbating the occurrence and severity of asthma, and causing detrimental burdens on mental health.

In general, state-initiated actions to integrate climate change into public health planning is limited. However, some state-level programs may indirectly address climate impacts and the associated health threats through emergency preparedness and hazard mitigation planning. Some notable actions within the state include Cleveland's and Cuyahoga County's climate action plans and nongovernmental efforts to increase awareness of the public health risks of climate change.

Implementation

State-Level Implementation

The Ohio Department of Health has an office dedicated to emergency preparedness and multiple programs that may address potential public health impacts of climate change, even though climate change is not mentioned outright. For example, the department provides information on and monitors harmful algal blooms (HABs) in addition to facilitating programs for asthma awareness and infectious and zoonotic disease surveillance.

The Ohio Department of Public Safety's State of Ohio 2011 Hazard Mitigation Plan covers issues such as drought and inland flooding in planning strategies. Human health impacts as a result of climate change or environmental factors are mentioned in a section on hazard identification and risk assessment as they relate to hazardous dam or levee classifications. Mental health, water supply and quality, and general public safety are also mentioned in the report's mitigation strategies.

The Ohio Department of Transportation in partnership with Resource Systems Group, Inc. has developed an Infrastructure Resiliency Plan to conduct vulnerability and risk assessments of infrastructure (e.g., bridges) impacted by climate change.¹¹² The plan mentions public health in regards to threats to air quality in the region.

City and County Implementation

In 2018, the City of Cleveland released a Climate Action Plan that examines climate impacts, actions needed to address these impacts, and cross-cutting priorities for the city.¹¹³ While public health is not one of these priorities (e.g., energy efficient and green building, clean energy, sustainable transportation, clean water and vibrant green space, and more local food and less waste), it is mentioned as a key benefit of taking climate action. Direct impacts, such as heat-related stress, greater risk of vector-borne illness, and reduced air quality in urban areas are mentioned in the plan and public health is addressed as a general cross-cutting theme across categories. Many of the plans outlined goals and actions will impact public health (e.g., sustainable transportation and access to healthcare

¹¹⁰ What Climate Change Means for Ohio: <https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-oh.pdf>

¹¹¹ Climate and Health in Ohio: <https://www.nrdc.org/sites/default/files/clean-power-plan-states-OH.pdf>

¹¹² Final Report Ohio Department of Transportation Infrastructure Resiliency Plan:

<http://www.dot.state.oh.us/Divisions/Planning/Environment/Documents/Ohio%20DOT%20Infrastructure%20Resiliency%20Plan.pdf>

¹¹³ Cleveland Climate Action Plan Update: <https://drive.google.com/file/d/1Z3234sMp7S7MjaXvMgcZtcAaYs4x2oHE/view>

services, updating land policy to foster health and equity, and increasing tree plantings to mitigate urban heat islands). The plan calls for the formation of a Water Quality Task Force and the development of a resident entrepreneurial network to provide healthy, local foods to citizens.

Cuyahoga County is addressing the physical and mental health of its citizens by increasing urban tree planting efforts to address heat island impacts, increasing access and availability of planning tools (emergency, vulnerability, and stormwater), and taking action through the Healthy Cleveland Initiative,¹¹⁴ a partnership of individuals, nonprofits, and businesses to make a healthier Cleveland. The county is focused on efforts to address extreme weather, air quality, and food-, vector-, and water-borne diseases. The county also has an online vulnerability assessment mapping tool¹¹⁵ and a Climate Action Plan,¹¹⁶ which aims to reduce greenhouse gas emissions and develop an adaptation strategy for the county. The Cuyahoga County Board of Health is also currently working on finalizing a Climate and Health Action Plan.

Nongovernmental Efforts

The Ohio Clinicians for Climate Action (OCCA) network is working with the Ohio Environmental Council in coordinating efforts to (1) raise awareness of the intersections of climate and public health policies and (2) provide Ohioans with credible and health-based perspectives on climate issues. The OCCA has partnered with Ohio Physicians Action Network¹¹⁷ and the nationwide Center for Climate Change and Health¹¹⁸ in efforts to address environmental policy and health within the state. The group has advocated for specific issues such as clean energy, drinking water quality, and protection of and access to public lands. The group provides a space for health professionals to work together, exchange knowledge, and share resources with the common goal of addressing Ohio's climate issues. Similarly, Healthcare without Harm, an organization focused on sustainability in the health sector, is working with a network of physicians in Ohio to enhance climate and health policy advocacy efforts. The organization has a climate program aimed at positioning the health sector to be a leader in advocating for climate change action as a public health issue.

The Ohio Public Health Resiliency Coalition formed by the Ohio Public Health Association (OPHA) issued the *Climate Resilience in Ohio: A Public Health Approach to Preparedness and Planning* in 2017.¹¹⁹ The report details public health threats due to climate change and needs for collaboration, and emphasizes the importance of purposeful consideration of the needs of vulnerable communities. The report references the CDC's BRACE framework as a guiding tool for incorporating social determinants of health, health equity, and vulnerability assessments into action planning.

Outcomes and Conclusions

While there is limited overall state-level action on climate change and health in Ohio, some agencies and organizations are elevating the conversation around climate-related health risks through planning, advocacy, and knowledge sharing between and among networks.

¹¹⁴ Healthy Cleveland: <https://www.healthycle.org>

¹¹⁵ Cuyahoga County Climate Change Vulnerability Assessment: <http://www.countyplanning.us/projects/climate-action-plan/vulnerability-assessment/>

¹¹⁶ Cuyahoga County Climate Change Action Plan: <http://www.countyplanning.us/projects/climate-action-plan/>

¹¹⁷ Central Ohio Physicians in Support of Progressive Causes: <https://physiciansactionnetwork.com>

¹¹⁸ Center for Climate Change and Health: <http://climatehealthconnect.org>

¹¹⁹ Climate Resilience in Ohio: A Public Health Approach to Preparedness and Planning: <https://ohioph.org/download/climate-resiliency-in-ohio/?wpdmdl=3101&refresh=5b7d8074669bc1534951540>

Citation

Braddock KN. 2019. *Building awareness of climate-related health risks in Ohio* [Case study on a project of the Ohio Department of Health and Ohio Clinicians for Climate Action]. Product of EcoAdapt's State of Adaptation Program. Last updated June 2019.

Mainstreaming climate change in public health policy and practice in Oregon

Contact Information

Emily York, Emily.A.York@dhsosha.state.or.us

Oregon Health Authority

800 NE Oregon Street, Suite 640

Portland, OR 97232

<https://www.oregon.gov>

Summary/Overview

The Oregon Health Authority's Climate and Health Program is striving to integrate climate change into public health practice, systems, and policies to ensure that all Oregon residents have equitable access to clean air, clean water, and healthy food. The department has worked with five local health jurisdictions to create and implement adaptation plans, and created a Resilience Toolkit based on lessons learned to support other local entities in similar efforts.¹²⁰ The Climate and Health Program has also developed a state-level Climate and Health Resilience Plan, which identifies overarching resilience strategies and associated implementation activities for state and local agencies. They are also working to increase climate literacy and information sharing among public health practitioners by convening the Northwest Climate and Health network in collaboration with the Washington Department of Health. The program is also actively working to increase integration of climate change, health, and equity principles across different agencies and in state policy by convening an interagency climate working group, writing policy papers on climate risks to public health, and collecting and sharing community perspectives and priorities with decision-makers.

Background

The Oregon Health Authority (OHA), Oregon's state health department, was one of the first states to receive competitive grant funding from the CDC's Climate-Ready States and Cities Initiative. OHA received initial funding in 2010, and largely passed funds down to five local health jurisdictions to develop local climate and health adaptation plans. Collectively referred to as the Oregon Climate and Health Collaborative (OCHC), these local jurisdictions include Benton, Crook, Jackson, and Multnomah Counties, and the North Central Public Health District, which serves Wasco, Sherman, and Gilliam Counties.

OHA received subsequent CDC funding in 2013 to formally establish and staff the state Climate and Health Program and to lead state-level assessment and planning efforts. The Climate and Health Program is completely funded by the federal CDC grant, and is currently funded through mid-2021 under a cooperative agreement. The Climate and Health Program has strong support from OHA and

¹²⁰ Resilience Toolkit: <https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/CLIMATECHANGE/TOOLKIT/Pages/index.aspx>

the state governor, so even with an uncertain funding future, there is high interest in continuing its activities and addressing climate impacts on health.

The primary goal of OHA's Climate and Health Program is to integrate climate change into public health systems, practice, and policies. Oregon's diverse geography means its communities face numerous climate challenges, such as extreme heat, flooding, drought, sea level rise, and wildfire. The Climate and Health Program is working to ensure that all Oregon residents, including the most vulnerable populations, have access to clean air, clean water, and healthy food.

Implementation

With initial CDC funding, the Climate and Health Program worked with the five OCHC members from 2010-2013 to pilot the CDC's BRACE framework. Each jurisdiction developed county-level climate and health adaptation plans, which were published in 2013. OHA collected lessons learned from these pilots and created a Resilience Planning Toolkit, which is a modified version of the BRACE framework and aims to provide guidance for local jurisdictions on how to integrate climate change into local public health practice. In 2016-2017, the Climate and Health Program received and then distributed further CDC funding to the five OCHC members (\$28,000 each) to begin implementing interventions identified in their adaptation plans.

At the state level, OHA's Climate and Health Program has been working to integrate climate change considerations across all health department sections and state agencies. For example, they convene an interagency climate working group comprised of 20 different state agencies. As the convener, they work to ensure that health, community perspectives, and equity are central to decision-making. OHA is committed to ensuring that its most vulnerable residents have a voice and that their perspectives are present in policy decisions. To this end, they have collaborated with community partners, such as the Confederated Tribe of Warm Springs, to better identify and share community concerns and priorities.

The OHA Climate and Health Program is also committed to increasing the climate literacy of public health practitioners. For example, they co-convene a regional climate and health network with the Washington State Department of Health. This network brings together public health practitioners, researchers, students, and other interested individuals through an email listserv and quarterly conference calls. This network fosters the exchange of collective wisdom and lessons learned, and helps health practitioners identify emerging opportunities.

Outcomes and Conclusions

Major milestones for the OHA's Climate and Health Program include:

- Working with the five OCHC members to develop local climate and health adaptation plans and then using lessons learned to generate a Resilience Toolkit for other jurisdictions (2010-2013);
- Publishing the Oregon Climate and Health Profile Report, which assesses climate and health risks and vulnerable populations in Oregon (2014);¹²¹
- Publishing a Social Vulnerability Assessment, which spatially identifies populations with high social vulnerability (2015);¹²² and

¹²¹ Oregon Climate and Health Report:

<https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/CLIMATECHANGE/Documents/oregon-climate-and-health-profile-report.pdf>

¹²² 2015 Social Vulnerability Assessment:

<https://www.oregon.gov/oha/PH/HEALTHYENVIRONMENTS/CLIMATECHANGE/Documents/Social-Vulnerability-Assessment.pdf>

- Publishing the Oregon Climate and Health Resilience Plan, which features overarching strategies to address climate-related risks to public health and identifies associated implementation actions for state and local agencies (2017).¹²³ Actions identified in this plan are evidence-based interventions sourced from the scientific literature and then evaluated based on criteria developed by a 20-member advisory group.

The Climate and Health Program tracks annual progress on climate and health initiatives. The development of the 2017 Climate and Health Resilience Plan has been very helpful because the program can now measure progress on plan-identified activities. The program produces annual progress reports, which have also been integrated into other health division program reports and OHA Public Health Division's Strategic Plan, marking significant progress as it is the first time climate change has been featured in such capacity.

The Climate and Health Program is also in the process of collecting and analyzing data on the health outcomes of climate change. Specifically, they are using the state syndromic surveillance system to track emergency room visits during climate-related events (e.g., heat waves), and have collected over two years of data so far. Having near real-time data facilitates communication with decision-makers and the media during climate-related events, and also helps to inform future health intervention activities.

One major facilitating factor in the Climate and Health Program's work has been a transition from using a hazard mitigation framework to using an all-hazards, strengths-based approach to resilience planning. Rather than focusing on how to address discrete climate risks, the program instead asks, "What do we do well? What can we leverage to build resilience to multiple climate stressors?" This allows program staff to focus on longer-term, anticipatory changes to public health policies, systems, and practices that simultaneously address many different climate risks. The Climate and Health Program has also experienced success by changing the phrasing of their work from "adaptation" to "resilience," which has fostered productive dialogue among diverse stakeholders and has made it easier to identify opportunities for achieving co-benefits.

Moving into the future, the Climate and Health Program is focused on bringing health and climate change to the attention of decision-makers in the hopes of driving equitable climate-informed state policy. Influencing policy will hopefully increase funding for health resilience work. For example, the state is considering a cap and trade policy to reduce greenhouse gas emissions, and reduce co-pollutants that impact health. Additionally, revenues from this policy could be re-invested in communities most impacted by climate change, and fund local interventions that both improve community health and address broader climate impacts.

In addition to policy work, OHA's Climate and Health Program will continue to support local health departments in addressing climate change. The agency currently does not have funding to provide grants to additional jurisdictions as they did for OCHC members, but they try to provide local jurisdictions with technical assistance, data analysis, and planning support to facilitate local adaptation action.

¹²³ 2017 Climate and Health Resilience Plan: <https://apps.state.or.us/Forms/Served/le8267a.pdf>

Citation

Reynier W & Gregg RM. 2019. *Mainstreaming climate change in public health policy and practice in Oregon* [Case study on a project of the Oregon Health Authority]. Product of EcoAdapt's State of Adaptation Program. Last updated June 2019.

Addressing heat-related illness, wildfire smoke exposure, and environmental justice in Multnomah County, Oregon

Contact Information

Brendon Haggerty, brendon.haggerty@multco.us
Multnomah County Health Department
619 NW 6th Ave
Portland, OR, 97209
<https://multco.us/health>

Summary/Overview

The Climate and Health Program of Oregon's Multnomah County Health Department aims to protect residents from illness and premature death associated with climate-related hazards. Building on their 2013 Climate Change and Public Health Preparation Plan, the health department is currently implementing several public health interventions to address extreme heat events and wildfire smoke exposure. Specific activities include implementing an early warning system during extreme heat events, operating cooling centers, planting trees to reduce urban heat islands, educating large sporting event operators on ways to mitigate and recognize heat-related illness, and collaborating with state agencies and the City of Portland on public messaging around ways to reduce wildfire smoke exposure. They are also collaborating extensively with local nongovernmental and community-based organizations to advance environmental justice in their adaptation work. The health department is also monitoring emergency room visits for heat-related illness and respiratory illness, tracking heat-related deaths, and recently completed an urban heat island mapping project in Portland; information from these efforts will inform future refinement of adaptation activities.

Background

The Multnomah County Health Department has been formally working to address climate change risks to public health since 2010. With a CDC grant through the Oregon Health Authority (the state health department), Multnomah County was one of five Oregon counties selected to pilot the CDC's BRACE framework. This formal focus on climate risk to public health was a natural progression of existing county adaptation efforts. For example, health department staff were already participating in the Climate Change Working Group of the National Association of County and City Health Officials (NACCHO). Additionally, the county and the City of Portland had jointly adopted a Climate Action Plan in 2009.

Multnomah County is located in northern Oregon. It encompasses several large metropolitan areas, including Portland and Gresham, and has a population of roughly 800,000 people. The health department operates county-wide, but much of its adaptation activity centers around the City of

Portland, given that a majority of county residents reside there and because it is the geographical focus of the county and city's joint Climate Action Plan.

The primary goal of the health department's Climate and Health Program is to protect Multnomah County residents from illness and premature death associated with climate risks and climate-related hazards. Currently, the county is focused on two primary impacts: heat-related illness associated with rising temperatures and extreme heat events, and respiratory issues associated with wildfire smoke exposure. The county is also working on harmful algal bloom monitoring and public messaging for the Willamette River, and vector control and monitoring of mosquitos and ticks. While the department has received past grant funding to support climate and health initiatives, current activities are all state funded, either through the state general fund or fee supported measures.

Implementation

With CDC BRACE funding, the health department developed their 2013 Climate Change and Public Health Preparation Plan. This plan identifies climate change risks to public health at the local level, identifies which populations and geographic areas may be impacted, discusses why equity and justice are important aspects to address, and outlines potential response activities. Findings and proposed activities from the Public Health Preparation Plan informed the 2015 Climate Action Plan update; the updated plan now features many health-related adaptation activities.

The health department is now working on implementing activities identified in the Public Health Preparation Plan and the 2015 Climate Action Plan with special focus on extreme heat and wildfire smoke exposure. For extreme heat, they are implementing an early warning system to alert and educate residents about extreme heat events. This system includes public communication and outreach efforts, such as press releases and hosting online information (e.g., briefings on symptoms of heat-related illness and safe behaviors during high heat periods). The department also hosts an interactive and seasonally updated online map that identifies cool places for people to take refuge from the heat (e.g., libraries, public buildings with air conditioning, water stations). During the most extreme events, the county also opens cooling shelters.

In addition to these short-term interventions, the health department is also working on some longer-term interventions to address extreme heat. They are increasing the number of air conditioned spaces in the county, installing air conditioning in structures utilized by the most vulnerable populations, and collaborating with the City of Portland on tree planting efforts in areas that consistently host heat islands and support vulnerable populations. The health department also provides guidance on recognizing and alleviating symptoms of heat-related illness for organizers of large sporting events that take place in the summer. During heat waves, the health department also conducts direct outreach to event planners to confirm readiness plans. This low-cost intervention was designed in direct response to early analyses of emergency room visits that showed that many heat-related incidents involved participants from such sporting events (e.g., healthy, fit adults competing in triathlons and marathons).

The health department is also working on several health interventions for wildfire smoke exposure, although response options for smoke are more limited than for heat. They are collaborating with state and city agencies on strong public messaging, such as online videos discussing actions people can take to limit smoke exposure (e.g., limiting outdoor activity, replacing indoor air filters, and creating lower-cost/do-it-yourself air filters). New challenges continue to arise; for example, wildfire season has begun

to overlap with the start of the school year. In response, the health department has inventoried county schools, categorizing them by the degree of filtration and air conditioning they provide to identify potential needs for future upgrades. For smoke exposure, longer-term interventions identified by the department include ensuring that all public buildings (including schools) have high-quality air filtration and air conditioning, and helping public buildings establish clean air spaces (e.g., through the use of HEPA filters, which clean the air sufficiently even for highly sensitive groups).

The health department is also working on harmful algal blooms and vector control and monitoring. For example, they collaborate with the state and City of Portland on weekly monitoring for harmful algal blooms in the Willamette River during the summer. If blooms are detected, they implement an advisory protocol that includes public outreach and education efforts (e.g., where/when not to swim). For disease vectors, the health department monitors for mosquitoes and ticks, and conducts spraying to reduce mosquitoes.

Multnomah County has also been working with community-based nonprofit organizations and local cultural organizations to better incorporate environmental and social justice principles in its response to climate change. The Kresge Foundation provided initial funding for the county to engage with local organizations with expertise in these realms, and the county has worked extensively with the Coalition of Communities of Color. The county is now working to inform state-level policy by ensuring that legislative decisions advance environmental justice initiatives. For example, Oregon is currently developing greenhouse gas pricing legislation, and revenues from this bill could be invested in protecting vulnerable populations from climate-related health hazards.

These health adaptation activities are part of larger adaptation planning and implementation efforts occurring under the updated 2015 Climate Action Plan. This plan is led by the Multnomah County Office of Sustainability and the Portland Bureau of Planning and Sustainability, and has been supported by the Institute for Sustainable Solutions at Portland State University. Given that many other local and county government departments are actively working on climate change, the health department focuses on bringing the public health perspective to bear in adaptation work that is already happening.

The health department and other partners have used a variety of tools and resources to inform their adaptation efforts. Climate science from the Oregon Climate Assessment Reports and the National Climate Assessment, as well from the Northwest Climate Toolbox and modeled and gridded climate data, have been used to inform the county's efforts. For monitoring health outcomes of climate-related events, the health department has used their syndromic surveillance system, which monitors emergency room visits, as well as the National Environmental Health Public Health Tracking Portal. The department has also used different tools to communicate with the public and decision-makers, including different Yale Program on Climate Change Communication products. More generally, the health department conducts public outreach and stakeholder involvement via web communication, press releases, and targeted outreach to other agency departments, counties, and health practitioners.

Outcomes and Conclusions

The health department has several assessment activities underway. These activities are designed to create a better situational awareness of climate-created health problems, which can then be used to inform and refine response activities such as the heat early warning system. Specifically, the health department is trying to better understand public exposure to climate risks (e.g., number of days/nights

with extreme heat, air particulate matter). They recently completed a study that measured temperature differentials and mapped urban heat islands in Portland, which has allowed more nuanced analyses and visualization of heat risk. For example, the study identified neighborhoods that are more likely to experience higher temperatures based on their physical form. The health department recognizes the need to continue to improve tools for monitoring climate events that impact health. For example, they have a monitoring network that measures smoke exposure, but no existing monitoring for allergenic pollen.

The health department is also tracking health outcomes of climate-related events. For example, they are tracking emergency room and urgent care visits for heat-related illnesses and deaths and respiratory illnesses from smoke exposure and allergenic pollens. The health department is also leveraging existing monitoring systems to gain additional insights. For example, physicians are required to report certain diseases, and some of these are vector-borne (e.g., West Nile Virus, Lyme disease), creating climate-informed tracking opportunities.

One primary challenge the health department has faced is the current lack of evidence-supported interventions or off-the-shelf toolkits for climate change like there are for other public health issues (e.g., tobacco use, flu vaccines). As a discipline, public health relies heavily on data-driven and evidence-supported approaches. However, for climate issues, identifying what kind of data to collect and how to collect it has been difficult, and the evidence base for different interventions has been slow to build. In the interim, the health department has relied on creativity to generate low-cost, easily implementable, and no-regret interventions (e.g., providing guidance on heat-related illness prevention and management to operators of large sporting events). Health adaptation activities have also been facilitated by supportive leadership at the agency, county, and state level, which has fostered bold action as well as frank and honest discussion and reflection. Additionally, the health department has benefitted greatly from collaborating with many Northwest academic scientists, resulting in abundant, relevant, and high-quality research.

The health department and the county as a whole continue to be challenged by funding availability, particularly restrictions that limit the ways or places in which money can be spent. These limitations result in a piece-meal approach to funding adaptation activities (e.g., tree planting and building retrofits to address extreme heat impacts are funded separately). However, existing and previous funding (e.g., through the CDC) has connected the health department to a network of health and climate change practitioners, fostering knowledge exchange. For example, the health department has benefitted from interacting with large metropolitan areas in other states.

Looking to the future, the health department is concerned about human migration to the Pacific Northwest as a result of climate change. This phenomenon is hard to credibly forecast or track, and poses many risks to the health sector and human communities. Human migration may increase communicable disease risk and disease vectors, heighten demand for existing health care and social services, and further impact disadvantaged communities by increasing competition for scarce resources (e.g., housing). However, migration may also present opportunities; population growth will likely reinforce the demand for healthy, supportive neighborhoods, and create opportunities to make or remake built environments to better house resources that support public health.

Moving forward, the health department has several overarching goals for its Climate and Health

Program. First, the department is pursuing funding to partner with neighboring counties subject to similar climate risks to establish key climate-related health indicators and outcomes. In doing so, they aim to create a broader, integrated network of health practitioners responding to climate change threats. Secondly, in partnership with the City of Portland, the department hopes to continue their work with a strong focus on environmental justice, so that in the course of responding to climate change they can correct historic injustices and improve upon unacceptable disparities. The department is in the final stages of evaluating how equity goals outlined in the 2015 Climate Action Plan are being met, and updated health and environmental justice goals and activities will be integrated into the next update of the Climate Action Plan, scheduled for 2020. Ultimately, they hope their environmental justice efforts will become a standard for other counties and cities to follow as they begin to address climate change.

Citation

Reynier W. 2019. *Addressing heat-related illness, wildfire smoke exposure, and environmental justice in Multnomah County, Oregon* [Case study on a project of the Multnomah County Health Department]. Product of EcoAdapt's State of Adaptation Program. Last updated June 2019.

Efforts to address climate-related risks to public health and safety in Pennsylvania

Contact Information

Pennsylvania Department of Health
8th Floor West, 625 Forster Street
Harrisburg, PA 17120
<https://www.health.pa.gov>

Department of Conservation and Natural Resources
400 Market Street
Harrisburg, PA 17101
<https://www.dcnr.pa.gov>

Department of Environmental Protection
400 Market Street
Harrisburg, PA 17101
<https://www.dep.pa.gov>

Summary/Overview

Pennsylvania does not have an official health department climate action plan. The Pennsylvania Department of Health (PADOH) recognizes that there are climate discussions taking place in Pennsylvania in a number of organizations. However, PADOH is not actively involved in these discussions.

Background

The major climate impacts of concern in the state of Pennsylvania have been identified as extreme heat, drought, air quality, and inland and coastal flooding.^{124,125} These impacts pose threats to public health by causing heat-related death and illness, increasing the spread of vector-borne disease,

¹²⁴ What Climate Changes Means for Pennsylvania: <https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-pa.pdf>

¹²⁵ Climate and Health In Pennsylvania: <https://www.nrdc.org/sites/default/files/clean-power-plan-states-PA.pdf>

influencing the amount and severity of asthma counts, and damaging capacity and access to healthcare services and infrastructure.

PADOH has not engaged in climate adaptation action or planning. However, the department does keep records on water-borne disease outbreaks, a public health concern that may be exacerbated by the increased stress of climatic events such as coastal and inland flooding. While PADOH is not actively involved in climate discussions, at the state level, Pennsylvania has taken measures to address climatic events.¹²⁶ For example, Pennsylvania's Department of Conservation and Natural Resources are leading the state in climate mitigation and adaptation efforts, but the integration of public health impacts into these efforts is limited.

Implementation

Pennsylvania Department of Health

Until its discontinuation in 2017, PADOH had a program to track environmental public health within the state, monitoring factors such as air quality, drinking water quality, and lead poisoning in children. In 2015, the PADOH released EDDIE (Enterprise Data Dissemination Informatics Exchange) an online database for collecting health statistics that monitors similar public health concerns.¹²⁷ While the connection to how climate change may affect these concerns is not explicit on EDDIE, these datasets could be useful for the state in monitoring health trends in light of climate change. For example, the state tracks water-borne disease outbreaks from community water systems through the PADOH Bureau of Epidemiology.¹²⁸ Finally, the PADOH State Health Improvement Plan 2015-2020 mentions climate change as a "force of change" identified to impact the future ways in which community and public health systems operate within the state.¹²⁹ However, exactly how climate change may impact public health in the state is not mentioned.

Pennsylvania Department of Conservation and Natural Resources

In 2018, the Pennsylvania Department of Conservation and Natural Resources (DCNR) released a Climate Change Adaptation and Mitigation Plan,¹³⁰ calling for a review and update of preparedness plans in order to account for changing risk profiles within the state. The plan recommends actions including training staff about climate-related threats, increasing awareness of shifts in weather, and adjusting the scheduling of field seasons to minimize exposure to hazards. The plan also mentions increased monitoring and control of ticks and mosquitos that could address threats of vector-borne diseases in the state. The DCNR's 2015 report, DCNR and Climate Change: Planning for the Future,¹³¹ contains a section on Employee Health and Safety, where it mentions factors such as heat-related stress, airborne allergens, and vector-borne disease as climate-related health risks.

¹²⁶ Pennsylvania Climate Action Plan 2018:

<http://www.depgreenport.state.pa.us/elibrary/GetDocument?docId=1454161&DocName=2018%20PA%20CLIMATE%20ACTION%20PLAN.PDF%20%20%20%3cspan%20style%3D%22color:blue%3b%22%3e%28NEW%29%3c%20span%3e>

¹²⁷ Enterprise Data Dissemination Informatics Exchange: <https://www.phaim1.health.pa.gov/EDD/>

¹²⁸ Water-borne Disease Outbreak Counts:

<https://www.health.pa.gov/topics/HealthStatistics/HealthyPeople/Documents/current/state/eh-5-waterborne-disease-outbreaks-count.aspx>

¹²⁹ State Health Improvement Plan 2015-2020: https://www.health.pa.gov/topics/Documents/SHIP/2015-2020_PA_SHIP.pdf

¹³⁰ Pennsylvania Department of Conservation and Natural Resources Climate Change Adaptation and Mitigation Plan.

http://www.docs.dcnr.pa.gov/cs/groups/public/documents/document/dcnr_20033598.pdf

¹³¹ Pennsylvania Department of Conservation and Natural Resources Climate Change: Planning for the Future.

http://www.docs.dcnr.pa.gov/cs/groups/public/documents/document/dcnr_20031815.pdf

Pennsylvania Department of Environmental Protection

In 2011, the Pennsylvania Department of Environmental Protection released a report detailing that that public health and emergency management should be included in the climate action plan as key components of climate adaptation efforts in Pennsylvania's climate change strategy.¹³² The plan states the need for proactive planning for extreme heat events, taking advantage of federal resources, and support efforts to increase data quality. The plan calls for a revision of the Pennsylvania state strategic climate change plan to include a section on public health response. The plan also suggests that the Philadelphia Department of Public Health's early warning system for heat waves¹³³ should be implemented in other parts of the state to warn against extreme heat events. In order to address threats caused by flooding, the plan recommends increased actions for assessment, surveillance, response and recovery planning, and health education. The plan also calls for increased measures to prevent and control adverse health effects caused by drought conditions, increased data acquisition and quality, as well as interdisciplinary collaboration.

The Pennsylvania Department of Environmental Protection's 2015 Climate Change Action Plan Update stresses the impacts of extreme heat-related events on human populations in metropolitan areas as well as threats to air and water quality and vector-borne diseases.¹³⁴ The report identifies stressors to human health caused by climatic events, but does not provide specific recommendations or action plans to address these concerns at the state level involving the PADOH.

Outcomes and Conclusions

There is still much to be done in Pennsylvania with regards to integrating climate change into public health planning. Some state agencies have taken steps to initiate these conversations.

Citation

Braddock KN. 2019. *Efforts to address climate-related risks to public health and safety in Pennsylvania* [Case study on a project of the Pennsylvania Departments of Health, Environmental Protection, and Conservation and Natural Resources]. Product of EcoAdapt's State of Adaptation Program. Last updated June 2019.

Local efforts to address climate change and public health in Philadelphia

Contact Information

Jessica Caum, Jessica.Caum@phila.gov

Alexandra Skula, Alexandra.Skula@phila.gov

Philadelphia Department of Public Health

1101 Market Street, 13th Floor

Philadelphia, PA 19107

<https://www.phila.gov/departments/departments-of-public-health/>

¹³² Pennsylvania Climate Adaptation Planning Report: Risks and Practical Recommendations: <https://pahmp.com/wp-content/uploads/2017/04/2700-RE-DEP4303-Combined.pdf>

¹³³ Safety and Emergency Preparedness: Hot Weather: <https://www.phila.gov/services/safety-emergency-preparedness/natural-hazards/excessive-heat/>

¹³⁴ Pennsylvania Department of Environmental Protection 2015 Climate Action Plan Update: <http://www.depgreenport.state.pa.us/elibrary/GetDocument?docId=5342&DocName=2015%20CLIMATE%20CHANGE%20ACTION%20PLAN%20UPDATE.PDF%20>

City of Philadelphia Office of Sustainability
1515 Arch Street
Philadelphia, PA 19102
<https://www.phila.gov/departments/office-of-sustainability/>

City of Philadelphia Office of Emergency Management
240 Spring Garden Street
Philadelphia, PA 19123
<https://www.phila.gov/departments/oem/>

Summary/Overview

The City of Philadelphia’s Department of Public Health (PDPH) is working to integrate climate change action into public health planning and outreach. While a formal climate and adaptation plan is still in progress, PDPH is actively working to engage the public on issues regarding climate-related risks to health and safety. PDPH aims to clarify public health concerns based on climate projections, identify vulnerable populations, secure funding and resources to quantify and estimate possible disease burdens caused by climate change, and develop and implement adaptation strategies.

Background

As an urban center in the northeastern United States, Philadelphia is threatened by extreme precipitation, extreme heat events, and flooding, which have direct links to human health and safety (e.g., displaced populations, infrastructure vulnerability, vector- and water-borne diseases, and heat-related illness). The city has one of the highest social vulnerability rankings within the state (Social Vulnerability Index¹³⁵ = 0.9191). In 2015, the Philadelphia Mayor’s Office of Sustainability and ICF International released a climate action plan for the city.¹³⁶ PDPH was part of the working group for this plan and provided a series of recommendations for climate adaptation. These recommendations included identifying threats from vector-borne disease, flooding, extreme heat, and air quality, and creating and maintaining cooling centers. The plan also recommends including climate change and health tracking metrics in a community health assessment, implementing regular mapping of vulnerable populations, and detailing information on projected changes in climate and increases in high heat days in health bulletins and outreach materials. PDPH hosts online resources on climate change and environmental hazards (such as air quality, extreme weather, and vector-borne diseases) that may be exacerbated by climate change.¹³⁷

PDPH participated in the working group for the city’s climate adaptation plan, *Growing Stronger: Toward a Climate-Ready Philadelphia*, which details the need to address changing climate extremes through adopting “new normals” and support for public health improvement in light of climate challenges.¹³⁸ In 2015, PDPH obtained funding through the Public Health Institute’s Center for Climate

¹³⁵ CDC’s Social Vulnerability Index (SVI): <https://svi.cdc.gov/map.html>

¹³⁶ Growing Stronger: Toward a Climate-Ready Philadelphia: <https://www.phila.gov/media/20160504162056/Growing-Stronger-Toward-a-Climate-Ready-Philadelphia.pdf>

¹³⁷ Mental and Physical Health: Environmental Health Hazards: <https://www.phila.gov/services/mental-physical-health/environmental-health-hazards/>

¹³⁸ Growing Stronger: Toward a Climate-Ready Philadelphia: <https://www.phila.gov/media/20160504162056/Growing-Stronger-Toward-a-Climate-Ready-Philadelphia.pdf>

Change and Health to participate in the Climate Change and Public Health Learning Collaborative.¹³⁹ The project aimed to advance PDPH research on climate-related health impacts, particularly those linked to severe asthma (a major concern for Philadelphia¹⁴⁰). The project then expanded to encompass interests across a broader array of climate and health concerns. One of the major outcomes of this work was the Climate Change and Health Advisory Group, an assembly of 40 individuals representing healthcare and government agencies, academic institutions, and community-based organizations.

With input from the Advisory Group, PDPH is in the process of compiling and synthesizing information to develop a climate and health adaptation plan. PDPH is building Philadelphia's capacity to deal with climate impacts on health by conducting research, developing resources and tools, facilitating and participating in community engagement and outreach, and collaborating with other city agencies to support climate-related emergency preparedness.

Implementation

The main climate impacts of concern identified by PDPH include extreme heat, increased precipitation, flooding, and decreased air quality. PDPH's developing climate and health adaptation plan will include sections on anticipated health impacts, at-risk populations, mitigation and adaptation strategies, and vulnerability indices and maps. The Climate Change and Health Advisory Group meets on a quarterly basis to discuss specific topics to be detailed in the plan (e.g., extreme heat, respiratory disease and air quality, and vector-borne diseases). A series of preliminary adaptation strategies have been developed that target the identification of at-risk populations, community engagement, research and data analysis, and severe weather response strategies and mass care capacity. Some short-term strategies include:

- Continuing to conduct heat-related morbidity and mortality surveillance;
- Educating community members about extreme heat impacts on health (e.g., distributing materials focused on preventing heat-related illness); and
- Educating healthcare providers about the impacts of extreme heat on health for patients with chronic health conditions.

The climate and health plan is underway and is projected to take between 18-24 months to complete. There is no specific timeline for the completion or release of the proposed plan.

PDPH also actively conducts research to identify what residents know about climate change and how prepared they are for climate-related public health emergencies. This information is used to inform future actions, adaptation strategies, public information, and outreach initiatives. In July 2018, PDPH conducted a survey at participating Free Library of Philadelphia branches to assess these outcomes. Findings indicated that residents likely underestimate their current risk to the health effects of coastal storms and flooding and that a sizable proportion of residents are not prepared to handle such events in their home or neighborhood. PDPH also learned how residents cope with extreme heat events, and found that even though most have air conditioning in their homes, they are often not able to use it during high-heat days due to financial restrictions.

¹³⁹ PHI's Center for Climate Change and Health Announces Learning Collaborative for Urban Health Departments:

<http://www.phi.org/news-events/838/phis-center-for-climate-change-and-health-announces-learning-collaborative-for-urban-health-departments>

¹⁴⁰ Asthma Capitals: The Most Challenging Places to Live with Asthma: <https://www.aafa.org/media/2119/aafa-2018-asthma-capitals-report.pdf>

PDPH has utilized a variety of resources to support its research and planning efforts, including peer-reviewed scientific literature, agency reports, expert knowledge, in addition to published and collected data regarding historical weather trends. The department has used the CDC's BRACE Framework and *Assessing Vulnerability to Climate Change: A Guide for Health Departments* to identify methods and best practices for assessing local vulnerabilities (e.g., extreme heat vulnerability).¹⁴¹ PDPH has also looked to Arizona's research on heat-related issues,¹⁴² as well as the cities of San Francisco¹⁴³ and New York,¹⁴⁴ the State of Maryland,¹⁴⁵ and the counties of Los Angeles¹⁴⁶ and Multnomah County.¹⁴⁷

Tools and Resources Produced: Health Information Portal and Heat Vulnerability Index

PDPH has a public, online Health Information Portal that tracks health advisory alerts and surveillance data, and links to related online resources.¹⁴⁸ A Heat Vulnerability Index (HVI) interactive map is accessible through this portal, and additional climate and health resources will soon be available on the platform. The online and interactive HVI tool developed by PDPH takes into account factors that increase sensitivity, exposure, and adaptive capacity to extreme heat events.¹⁴⁹ The HVI maps areas within Philadelphia that are most at-risk to extreme heat, and this information has been utilized to identify optimal locations for cooling centers.¹⁵⁰

Partnerships, Engagement, and Outreach

PDPH has worked closely with a number of partners including Drexel University, National Nurse-led Care Consortium (NNCC), Energy Coordinating Agency, Clean Air Council, and St. Christopher's Hospital for Children, among others. The city is part of the Climate and Urban Systems Partnership (CUSP), which pools resources to educate residents about climate change and emphasize local impacts. CUSP, led by the Franklin Institute, is well established in Philadelphia and includes over 90 institutions.

The Philadelphia Office of Sustainability (OOS) and PDPH are collaborating with other CUSP partners to address health impacts of concern through citywide initiatives that provide resources for citizen engagement and facilitate grassroots community workshops. These workshops provide educational materials, activities, and a discussion platform for the community at large. For example, PDPH included thermometers in "kits" distributed to attendees of an extreme heat-related workshop to help those in non-energy efficient housing or those at higher risk (e.g., senior citizens) know how hot it is in their

¹⁴¹ Assessing Health Vulnerability to Climate Change: A Guide for Health Departments:

<https://www.cdc.gov/climateandhealth/pubs/assessinghealthvulnerabilitytoclimatechange.pdf>

¹⁴² Climate and Health Adaptation Plan: Public Health Guidance for the State of Arizona:

<https://www.azdhs.gov/documents/preparedness/epidemiology-disease-control/extreme-weather/pubs/arizona-climate-health-adaptation-plan.pdf>

¹⁴³ San Francisco Climate and Health Profile Report: https://sfclimatehealth.org/wp-content/uploads/2018/12/SFDPH_ClimateHealthProfile_FinalDraft.pdf

¹⁴⁴ New York City Panel on Climate Change 2015 Report Chapter 5: Public Health Impacts and Resiliency:

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4749144/pdf/nihms756429.pdf>

¹⁴⁵ Maryland Climate and Health Profile Report:

<https://mde.maryland.gov/programs/Marylander/Documents/MCCC/Publications/Reports/MarylandClimateandHealthProfileReport.pdf>

¹⁴⁶ Climate and Health Series Report 1: Your Health and Climate Change in Los Angeles County:

<http://publichealth.lacounty.gov/eh/docs/climatechange/YourHealthandClimateChange.pdf>

¹⁴⁷ Climate Change Preparation Plan: An Assessment of Public Health Impacts of Climate Change and Actions to Protect Our Health:

https://multco.us/sites/default/files/documents/multnomah_county_climate_change_and_public_health_preparation_plan_2013.pdf

¹⁴⁸ Philadelphia Health Information Portal: <https://hip.phila.gov>

¹⁴⁹ Philadelphia Heat Vulnerability Index: <https://hip.phila.gov/EmergencyResponse/HeatVulnerabilityIndex>

¹⁵⁰ City of Philadelphia Cooling Centers Map:

<https://phl.maps.arcgis.com/apps/webappviewer/index.html?id=0afe8e198cd84da6a51ca4af027a7056>

homes. Other workshops have focused on severe storms and flooding, and how such events affect mold frequency, asthma rates, and chronic disease. Using the HVI, OOS identified the Hunting Park neighborhood as being at-risk for extreme heat impacts. In 2018, OOS, with support from PDPH and other partners, led a community-based *Beat the Heat* project in Hunting Park to help identify heat island mitigation strategies and coping mechanisms.¹⁵¹

Collaborations: Excessive Heat Plan and Syndromic Surveillance

The Philadelphia Office of Emergency Management's (OEM) 2018 *Citywide Excessive Heat Plan*, details citywide response actions to extreme heat events including public notifications; activation of city services, such as cooling centers; and outreach to the homeless. The plan describes thresholds and levels for declaring a Heat Health Emergency, which is the trigger for activating city services. PDPH has worked with the OEM to finetune the excessive heat warning system thresholds based on both National Weather Service (NWS) and local health data. Additionally, PDPH used 10+ years of syndromic surveillance data to identify trends in heat-related visits to emergency departments and compared the data with weather conditions during those times. Through this analysis, PDPH identified the conditions (e.g., heat index and duration of event) that are most likely to result in adverse health outcomes and used this information to develop a health-focused, rather than strictly weather-focused, system for issuing excessive heat declarations. The thresholds developed are part of PDPH Heat Emergency System¹⁵² and Emergency Preparedness¹⁵³ initiatives and go beyond sending alerts alongside NWS watches and warnings. There are two levels to the heat emergency system: Heat Caution and Heat Health Emergency. A Heat Caution calls for action mainly at the city government level, notifying agencies and partners that a heat event is happening and that there should be an augmentation of public information particularly toward identified at-risk populations. During a Heat Health Emergency, a variety of city services are activated, including cooling centers and the Philadelphia Corporation for Aging Heatline, a call center available to all residents who may be experiencing difficulty during the heat event. In addition, during a Health Emergency, utility shut-offs due to residential non-payments are suspended and a city ordinance regarding pets being kept outdoors is activated. Preliminary assessment from the summers of 2017 and 2018 support this revised health-focused extreme heat warning system, although evaluation is ongoing.

Outcomes and Conclusions

PDPH seeks to frame climate change and health issues in ways that are relevant across sectors and scales in Philadelphia while keeping information local and solutions-focused, and emphasizing the importance of increasing citywide resilience and co-benefits of adaptation actions.

Barriers for PDPH's climate-related work include limited funding, a shortage of dedicated staff, and a scarcity of technological resources (e.g., support for performing advanced statistical analyses to project disease burdens related to climate change). Despite these barriers, PDPH is supported by local stakeholders and institutions, and continues to involve citizens in climate and health-related outreach while the adaptation plan is in progress. The network of climate-related efforts that PDPH is part of in Philadelphia is a great support to facilitating the quantity and quality of PDPH's work.

¹⁵¹ Beat the Heat: Hunting Park: <https://www.phila.gov/2018-08-07-beat-the-heat-hunting-park/>

¹⁵² Part of the Plan: Excessive Heat: <https://www.phila.gov/posts/oem/2017-05-31-part-of-the-plan-excessive-heat/>

¹⁵³ Safety & Emergency Preparedness Website: <https://www.phila.gov/services/safety-emergency-preparedness/prepare-for-an-emergency/stay-informed/>

Future goals for PDPH include finalizing the climate change and health adaptation plan and folding this plan into an overarching adaptation plan for the city. PDPH will continue to search for and apply to funding sources to support these next steps. The Advisory Group will continue to discuss further edits and contributions to the draft climate and health adaptation plan. PDPH plans to detail strategies that can be applied at governmental, community, and individual levels.

Citation

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Incorporating climate change into state public health policy in Virginia

Contact Information

Parham Jaber, Parham.Jaberi@vdh.virginia.gov
Brenden Rivenbark, Brenden.Rivenbark@vdh.virginia.gov
Virginia Department of Health
109 Governor Street
Richmond, VA 23219
<http://www.vdh.virginia.gov>

Summary/Overview

The Virginia Department of Health (VDH) is in the beginning stages of incorporating climate change impacts into its public health programs through its newly established Climate Change Committee (C-3). Other Virginia agencies and organizations are also incorporating public health considerations into climate actions.

Background

General Climate Change and Health Integration in Virginia

Major climate impacts of concern for Virginia include extreme heat, sea level rise, inland and coastal flooding, warmer temperatures leading to increased ground ozone, and extreme weather events. These impacts pose risks to human health as they may increase issues such as heat-related illness or death, the spread of vector- and water-borne diseases, severity and occurrence of asthma and other pulmonary conditions, and the potential displacement of communities and exacerbation of inequities in access to healthcare services.

The VDH does not have an official climate action or adaptation plan. However, the state's 2008 climate action plan identifies public health concerns. The plan highlights physical and behavioral health concerns, particularly among highly vulnerable communities. The plan calls for a network of institutions to monitor climate change impacts on human health, as well as increased disease surveillance and monitoring by VDH, strengthening of emergency response measures, increased public education and outreach, as well as implementation of vector control programs. Other efforts include Virginia's 2018 Hazard Mitigation Plan, which covers risks related to extreme heat and flooding events while highlighting some health impacts; Executive Order 24, signed in 2018 by Governor Northam of

Virginia, which calls for increasing Virginia’s resilience to sea level rise and natural hazards;¹⁵⁴ and the partnership between VDH Portsmouth District in the Hampton Roads Region and the National Association of County and City Health Officials to examine the effects of climate change on public health in the state.¹⁵⁵

Virginia Department of Public Health and Climate Discussions

In January 2019, VDH created C-3 with the specific purpose of addressing public health response to climate change issues. C-3 began as a result of a “listening tour” by Health Commissioner Dr. Norman Oliver.¹⁵⁶ One subject brought up by stakeholders and community representatives during the tour was that of climate change impacts on individuals. VDH is in the resource acquisition and intradepartmental evaluation phase of understanding where it stands as an agency on the topic of climate change and how it can address these public concerns. The goals of C-3 include developing a report with climate response recommendations for Virginia stakeholders and becoming a trusted source of information regarding climate change and public health for the communities of Virginia. There is no set funding source for C-3 or its work as of date, however current investigations are underway to facilitate funding opportunities in order to sustain these efforts in the long term.

The entire state of Virginia is the focal area for C-3 and its future reports and projects. However, Virginia has certain geographic features that may determine where particular climate change impacts could be the most severe. For example, a large portion of the state contains coastal lands vulnerable to sea level rise and flooding. C-3 has not issued a formal plan or agenda, however, climate change and health risks under discussion include air pollution and increased allergens, vector ecology and diseases, harmful algal blooms, sea level rise, extreme weather, water temperature increases, and inland flooding. Other areas of concern for VDH involve the exacerbation of chronic diseases, displaced and vulnerable populations, behavioral health challenges associated with extreme weather and population displacement, and general economic and social impacts on communities. VDH and the Virginia Department of Emergency Management plan to partner to address these and other concerns such as the exacerbation of chronic diseases (e.g., cardiovascular predispositions, congestive heart failures).

Implementation

The priority actions of C-3 include identifying resources within VDH and evaluating departmental capacity. Next steps involve identifying public and private sector community partners. C-3 has so far been guided by expert advice from within VDH, the nonprofit Virginia Clinicians for Climate Action, and the Commissioner’s Public Health Advisory Council, a coalition of Masters of Public Health program representatives from across the state. Other partners that VDH has collaborated or would like to collaborate with on public health and climate response integration include the Virginia Institute for Marine Science, Science Museum of Virginia, universities across the Commonwealth, and the Virginia Department of Environmental Quality. VDH is guiding its discussion and planning processes by applying the BRACE framework, a step-by-step program to guide health officials in climate change and public health preparedness.

¹⁵⁴ Executive Order 24: Increasing Virginia’s Resilience to Sea Level Rise and Natural Hazards:

<https://www.governor.virginia.gov/media/governorvirginiagov/executive-actions/ED-24-Increasing-Virginias-Resilience-To-Sea-Level-Rise-And-Natural-Hazards.pdf>

¹⁵⁵ Local Health Departments are preparing for the Health Effects of Climate Change: https://www.naccho.org/uploads/downloadable-resources/VirginiaPortsmouth_LHD_Flyer.pdf

¹⁵⁶ Virginia Health Commissioner 2018 Listening Tour: <http://www.vdh.virginia.gov/news/m-norman-oliver-md-ma/health-commissioner-2018-listening-tour/>

Outcomes and Conclusions

The current challenges that face the committee and the development of a climate change and health plan include obtaining reliable information, securing long-term funding, and staffing capacity. The VDH C-3 seeks to be a source of information for Virginians and to be recognized as such when it comes to health information, planning, and response. C-3 is continuing to engage and identify community partners and hopes to hold a summit with community partners regarding climate change and related impacts on public health. The results of the summit will be used in the development of the Virginia Health Impacts of Climate Change Response Plan.

Citation

Braddock KN. 2019. *Incorporating climate change into state public health policy in Virginia* [Case study on a project of the Virginia Department of Health]. Product of EcoAdapt's State of Adaptation Program. Last updated June 2019.

Addressing climate change impacts on public health in Washington State

Contact Information

Marnie Boardman, Marnie.Boardman@doh.wa.gov
Washington State Department of Health
111 Israel Road Southeast
Tumwater, WA 98501
<https://www.doh.wa.gov>

Summary/Overview

The Climate and Health Program of the Washington State Department of Health aims to reduce the negative effects of climate change on public health by working with local health departments, communities, and other state, tribal, and local agencies. The department seeks to address climate change by strengthening monitoring of and response to climate-sensitive health risks, characterizing the specific threats climate change poses to people's health in Washington, and working with partners to carry out evidence-based strategies that protect and improve community health in an era of climate change.

Background

Climatic changes such as warming temperatures, declining snowpack, drought, wildfire, sea level rise, flooding, and ocean acidification are projected to have various consequences on human health in Washington State. For example, drier and warmer conditions are expected to increase wildfires, in turn posing increased health risks for people exposed to unhealthy levels of smoke. Climate change is also expected to increase illness, injuries and deaths from extreme weather events like high heat days, storms and flooding, increase some vector-, water-, and food-borne diseases, disrupt critical infrastructure and services, and negatively impact mental health.

The Washington State Department of Health participated in the development of the state's Integrated Climate Response Strategy. The Strategy explicitly notes that climate change will negatively affect

public health, particularly the state's most vulnerable populations, as well as mental health and quality of life. The Strategy recommends five overall strategies:

1. Protect the most vulnerable communities by providing financial and technical support to local health departments and communities, improving community planning efforts to support healthy communities (e.g., expand open space, prevent development in vulnerable zones), and develop and improve access to emergency shelters and evacuation routes.
2. Enhance surveillance, reporting, and response systems by improving surveillance systems to better detect climate-related disease outbreaks, expanding public health datasets and tracking, and developing harmful algal bloom warning systems.
3. Incorporate climate adaptation into DOH's programmatic efforts by incorporating mitigation and adaptation strategies into health planning and regulations, and enabling local health and emergency departments to better prepare for and respond to events.
4. Engage and motivate the public to create resilient communities by improving climate change awareness and knowledge among the medical community, public water resources managers, and the public.
5. Build capacity to effectively protect human health by improving training on climate-related health risks, developing response strategies, and securing reliable funding sources to enable climate-informed action.

DOH is an active participant in the Washington Interagency Climate Adaptation Network (ICAN), a partnership of state agencies that aims to implement the Strategy, advance climate resilience, share knowledge, and leverage partnerships. While DOH does not have a formal departmental climate adaptation plan, programs across the agency are taking steps to address climate change impacts on public health, such as:

- Integrating climate change into the Department's Strategic Plan;
- Examining how climate change magnifies the hazards that DOH Office of Emergency Preparedness and Response addresses in its everyday work;
- Coordinating a strengthened public health response to wildfire smoke events;
- Publishing indicators for climate-sensitive health outcomes on the publicly accessible Washington Tracking Network;
- Strengthening syndromic surveillance for climate-sensitive conditions, using data from patient visits to emergency rooms, hospitals, and clinics to detect emerging health risks and inform public health response;
- Using early warning systems to detect the presence of dangerous marine biotoxins in water and shellfish to prevent human exposures;
- Partnering with researchers to understand how climate conditions in Washington influence risk of zoonotic and mycotic diseases, such as West Nile Virus, Lyme disease and other tick-borne diseases, hantavirus, leptospirosis, Valley Fever from *Coccidioides*, and infection with *Cryptococcus gattii*;
- Funding projects to advance understanding of climate and ocean acidification risks to shellfish safety and explore adaptation options;
- Providing low interest grants and loans for protecting drinking water resources and building more resilient drinking water infrastructure; and
- Raising awareness of the links between climate change and public health within the department, with other state agencies, and with the public.

Implementation

DOH Strategic Plan

The department incorporated climate change impacts and resilience into its two most recent strategic plans—2014-2016¹⁵⁷ and 2016-2019.¹⁵⁸ Climate change is recognized as a major external factor that influences the success of the DOH mission from negative effects on air and water quality to threats to public safety from sea level rise and storms. Strategic goals for the department include creating effective prevention, surveillance, and response systems; maintaining operational readiness within DOH; raising awareness of the effects of climate change on public health; and providing quality data to support local health department and community decision-making.

Office of Emergency Preparedness and Response

As part of routine work to plan and build capacity for rapid public health response to emergencies, DOH's Office of Emergency Preparedness and Response considers how changing climate conditions are magnifying hazards such as floods, wildfires, and heatwaves and increasing weather-driven disruptions to critical services such as power and drinking water. In addition to training for and responding to events, they provide Emergency Fact Sheets on a range of threats and preparedness topics.¹⁵⁹

Washington Tracking Network (WTN)¹⁶⁰

WTN, supported by the CDC as part of the National Environmental Public Health Tracking Network, helps users identify and analyze environmental health data. Established in 2002, WTN includes data on air and water quality, drought, flooding, snowpack, heat events, weather extremes, wildfire, and disease. WTN also includes an Environmental Health Disparities Map that provides a way to compare broader environmental health risks between communities depending on exposure and social determinants of health. For example, users can compare particulate matter concentrations, toxic releases from industrial facilities, percentage of disabled population, and cancer deaths between an urban area such as Seattle and Moclips on the remote outer coast. DOH continues to pull together climate-related data for WTN and uses the site to synthesize information for local health departments and communities to track health challenges over time.

Syndromic surveillance system

DOH also houses the Rapid Health Information NetWOrk (RHINO) Program, which collects, analyzes, and disseminates near real-time data on symptoms, diagnoses, and demographic data from patient visits to emergency rooms, hospitals, and outpatient clinics. Syndromic surveillance is an approach to timely population-based health surveillance used for rapid detection of outbreaks, changing trends, and emergent disease occurrence, providing early alerts to prompt public health response. The RHINO program collects and validates data from clinics and hospitals before sharing with the CDC's National Syndromic Surveillance Program and other health surveillance partners throughout Washington state. Public health practitioners and officials have access to these records to compare trends across communities, regions, and the country. DOH is investigating how weather and climate data could

¹⁵⁷ Washington of Health Strategic Plan 2014-2016: https://www.doh.wa.gov/Portals/1/Documents/1000/2014-16_UpdatedStrategicPlan.pdf

¹⁵⁸ Washington Department of Health Strategic Plan September 2016-August 2019: <https://www.doh.wa.gov/Portals/1/Documents/1000/2016-19%20Strategic%20Plan.pdf>

¹⁵⁹ DOH Office of Emergency Preparedness and Response Fact Sheets: <https://www.doh.wa.gov/Emergencies/BePreparedBeSafe/Publications/Factsheets>

¹⁶⁰ Washington Tracking Network (WTN): <https://www.doh.wa.gov/DataandStatisticalReports/EnvironmentalHealth/WashingtonTrackingNetworkWTN>

support informed surveillance that may improve overall preparedness, and currently uses weather and air quality data to enhance its surveillance of heat and cold-related illnesses and the health effects of wildfire smoke.

Monitoring impacts on shellfish

Changes in ocean temperatures and chemistry along with increased land-based pollutant runoff are increasing the risk of harmful algal blooms (HABs) and diseases. Shellfish are of natural, cultural, and economic importance to the state. Increased HAB occurrence, ocean acidification, and hypoxic conditions all contribute to declines in shellfish growth and production.¹⁶¹ HABs produce marine biotoxins such as domoic acid and okadaic acid that can bioaccumulate throughout the food web. These biotoxins are of particular concern to DOH as people consuming contaminated shellfish may contract amnesic, diarrhetic, and/or paralytic shellfish poisoning. DOH's Biotoxin and Illness Prevention Program closely monitors toxin levels, temporarily closing shellfish harvest areas when conditions are unsafe.

Outreach and communication efforts

DOH also works extensively to effectively communicate public health risks to local health departments and communities. For example, wildfires have become a more pervasive threat in the state over the last few summers and department epidemiologists have prioritized public messaging on wildfire smoke and preparedness. This includes work with partners to deliver critical health protection messages, and development of the "Smoke From Wildfires Toolkit," which provides information in multiple languages about air quality advisories, health effects and evidence-based protective measures (e.g., masks, air filters).¹⁶²

Outcomes and Conclusions

Future goals include increasing collaboration with other state agencies, tribal governments, and local partners to advance climate adaptation and mitigation initiatives, and improving internal departmental efforts to incorporate climate change into programmatic work. As part of ICAN, DOH has an opportunity to engage with other members of the network but identifying other potential venues for collaboration with state agencies is an important next step. Additional efforts DOH aims to take on include:

- Conducting a more honed health-specific assessment by compiling information on relevant climate and health risks in the state;
- Integrating climate change projections into public health programs and planning, particularly by identifying opportunities for early warning and response systems;
- Providing climate-informed health information relevant to policy makers about energy, land use and the built environment; and
- Showcasing how proven public health strategies like supporting physically active transportation choices can reduce greenhouse gas emissions while improving community health.

¹⁶¹ Gregg RM, Score A, Pietri D, Hansen L. 2016. The State of Climate Adaptation in the U.S. Marine Fisheries Management. EcoAdapt. https://www.cakex.org/sites/default/files/documents/EcoAdapt_MarineFisheriesAdaptation_August2016_1.pdf

¹⁶² Smoke from Wildfires Toolkit:

<https://www.doh.wa.gov/CommunityandEnvironment/AirQuality/SmokeFromFires/SmokefromFiresToolkits>

Citation

Gregg RM. 2019. *Addressing climate change impacts on public health in Washington State* [Case study on a project of the Washington Department of Health]. Product of EcoAdapt's State of Adaptation Program. Last updated June 2019.

Building capacity for adaptation action through the Wisconsin Climate and Health Program

Contact Information

Colleen Moran, colleen.moran@dhs.wisconsin.gov

Wisconsin Department of Health Services

Division of Public Health

1 W Wilson Street, #150

Madison, WI 53703

<https://www.dhs.wisconsin.gov/>

Summary/Overview

Projected climate impacts for Wisconsin, including increased flooding and precipitation, extreme temperatures (hot and cold), and drought, among others, can affect mental health and lead to increased disease and illness. With funding from the CDC, the Wisconsin Department of Health Services (WDHS) is helping local health departments and others prepare for and respond to climate-related public health impacts. Specifically, WDHS created the Wisconsin Climate and Health Program to study how climate impacts public health and to create strategies, tools, and trainings to help communities prepare for health outcomes related to climate change.

Background

In September 2012, WDHS received a three-year grant from the CDC's Climate-Ready States and Cities Initiative to study how climate change affects public health in the state and to create strategies, tools, and trainings to help communities prepare for and respond to these impacts. Subsequent funding was awarded by the CDC in 2016 to continue implementing activities and evaluate the effectiveness of their activities.

The long-term goal of the Wisconsin Climate and Health Program is to prepare the state to be resilient in the face of climate change through a better understanding of climate-related public health vulnerabilities with a focus on extreme heat, flooding, and vector-borne disease. Primary stakeholders include local public health departments, local governments, and emergency management and preparedness offices.

Implementation

The Wisconsin Climate and Health Program has engaged in a number of different activities, including:

- Assessing vulnerabilities to extreme heat (e.g., heat vulnerability index) and creating a climate and health profile report;
- Developing a series of toolkits and companion fact sheets to help local governments, local health departments, and citizens prepare for and respond to different impacts;

- Creating the Wisconsin flood mapping tool, which looks at risk and vulnerability of communities, priority populations, and infrastructure within the 100-year floodplain;
- Developing a flood resilience scorecard for communities to assess environmental, social and institutional, and sociodemographic vulnerabilities and identify recommended actions for enhancing resilience;
- Partnering with the vector-borne disease program to produce educational materials (e.g., surveillance brief, videos);
- Providing technical and financial assistance to seven different communities to engage in climate change and public health planning, including convening meetings to present impacts, identifying feasible adaptation options, and helping develop implementation plans; and
- Working with the Milwaukee Health Department, Sixteenth Street Community Health Centers, and UniteMKE to conduct a Community Assessment for Public Health Emergency Response (CASPER) for Milwaukee. A CASPER is typically done post-disaster to collect information about a community, but the WDHS used it prospectively to collect data and information about community needs during an extreme heat event.

In their efforts, WDHS has frequently used the U.S. Global Change Research Program's 2016 Climate and Health Assessment, National Climate Assessment, and the 2011 Wisconsin Initiative on Climate Change Impacts report.

Outcomes and Conclusions

As a result of this work, the Wisconsin Climate and Health Program has created several products to help Wisconsin prepare for the public health impacts of climate change. Example products include:

- Heat vulnerability indices for Wisconsin, Milwaukee, counties, and tribes;¹⁶³
- Toolkits and companion fact sheets for extreme heat, flooding, wildfire, drought, harmful algal blooms, and vector-borne diseases, among others;¹⁶⁴ and
- A Climate and Health Community Engagement Toolkit and companion Climate and Health Community Engagement Workbook.¹⁶⁵

Partnerships (e.g., with universities) have helped facilitate the department's adaptation efforts while some barriers that have arisen include politicization of climate change, staff capacity, and finding additional funding sources. The Wisconsin Climate and Health Program is now evaluating the CASPER tool and data collected to determine whether to apply it in other communities. Additionally, they are testing and evaluating the feasibility of the flood resilience scorecard in two rural communities. Longer-term next steps include updating their climate adaptation plan and better integrating climate change and health equity into WDHS programs.

Citation

Kershner J. 2019. *Building capacity for adaptation action through the Wisconsin Climate and Health Program* [Case study on a project of the Wisconsin Department of Health Services]. Product of EcoAdapt's State of Adaptation Program. Last updated June 2019.

¹⁶³ Vulnerability Indices: <https://www.dhs.wisconsin.gov/climate/wihvi.htm>

¹⁶⁴ Climate and Health Toolkits: <https://www.dhs.wisconsin.gov/climate/toolkits.htm>

¹⁶⁵ Wisconsin Climate and Health Program Community Engagement Toolkit: <https://www.dhs.wisconsin.gov/publications/p01637.pdf>

Appendix A. State Climate and Hazard Mitigation Plans and Reports

State	State Climate Action Plan
Colorado	Colorado Climate Plan (2015): https://www.cakex.org/documents/colorado-climate-plan-state-level-policies-and-strategies-mitigate-and-adapt Colorado Natural Hazard Mitigation Plan (2018): https://www.cakex.org/documents/colorado-natural-hazard-mitigation-plan
Florida	Florida's Energy and Climate Change Action Plan (2008): https://www.cakex.org/documents/florida%E2%80%99s-energy-climate-change-action-plan State Hazard Mitigation Plan 2018 Update (2018): https://www.cakex.org/documents/florida-hazard-mitigation-plan-2018-update
Illinois	Report of the Illinois Climate Change Advisory Group (2007): https://www.cakex.org/documents/report-illinois-climate-change-advisory-group Illinois Natural Hazard Mitigation Plan (2018): https://www.cakex.org/documents/illinois-natural-hazard-mitigation-plan
Iowa	Iowa Climate Change Advisory Council Report (2008): https://www.cakex.org/documents/iowa-climate-change-advisory-council-report Iowa Hazard Mitigation Plan (2013): https://www.cakex.org/documents/iowa-hazard-mitigation-plan
Michigan	Michigan Climate Action Council Plan (2009): https://www.cakex.org/documents/michigan-climate-action-council-plan Michigan Hazard Mitigation Plan (2019): https://www.cakex.org/documents/michigan-hazard-mitigation-plan-updated-april-2019-edition
Missouri	Missouri State Hazard Mitigation Plan (2018): https://www.cakex.org/documents/missouri-state-hazard-mitigation-plan
Nevada	Nevada Climate Change Advisory Committee Final Report (2008): https://www.cakex.org/documents/nevada-climate-change-advisory-committee-final-report Nevada Enhanced Hazard Mitigation Plan (2018): https://www.cakex.org/documents/nevada-enhanced-hazard-mitigation-plan-2018
New Jersey	New Jersey's Global Warming Response Act Recommendations Report (2009): https://www.cakex.org/documents/meeting-new-jersey%E2%80%99s-2020-greenhouse-gas-limit-new-jersey%E2%80%99s-global-warming-response-act-recommendations-report New Jersey State Hazard Mitigation Plan (2014): https://www.cakex.org/documents/2014-new-jersey-state-hazard-mitigation-plan
New York	New York State Climate Action Plan (2010): https://www.cakex.org/documents/new-york-state-climate-action-plan New York State Hazard Mitigation Plan (2019): https://www.cakex.org/documents/new-york-state-hazard-mitigation-plan
North Carolina	Recommended Mitigation Options for Controlling Greenhouse Gas Emissions (2008): https://www.cakex.org/documents/recommended-mitigation-options-controlling-greenhouse-gas-emissions

State	State Climate Action Plan
	North Carolina Hazard Mitigation Plan (2018): https://www.cakex.org/documents/north-carolina-hazard-mitigation-plan
Ohio	Ohio Standard Hazard Mitigation Plan (2014): https://www.cakex.org/documents/state-ohio-standard-hazard-mitigation-plan-shmp-2014
Oregon	Oregon Climate Change Adaptation Framework (2010): https://www.cakex.org/documents/oregon-climate-change-adaptation-framework Oregon Natural Hazards Mitigation Plan (2015): https://www.cakex.org/documents/oregon-natural-hazards-mitigation-plan
Pennsylvania	Pennsylvania Climate Change Action Plan (2019): https://www.cakex.org/documents/pennsylvania-climate-change-action-plan Pennsylvania State Hazard Mitigation Plan (2018): https://www.cakex.org/documents/commonwealth-pennsylvania-2018-state-hazard-mitigation-plan
Virginia	Virginia Governor’s Commission on Climate Change: A Climate Change Action Plan (2008): https://www.cakex.org/documents/virginia-governor%E2%80%99s-commission-climate-change-climate-change-action-plan Commonwealth of Virginia Hazard Mitigation Plan (2018): https://www.cakex.org/documents/commonwealth-virginia-hazard-mitigation-plan
Washington	Washington State’s Integrated Climate Response Strategy (2012): https://www.cakex.org/documents/washington-state%E2%80%99s-integrated-climate-response-strategy Washington State Enhanced Hazard Mitigation Plan (2016): https://www.cakex.org/documents/washington-state-enhanced-hazard-mitigation-plan
Wisconsin	Strategy for Reducing Global Warming (2008): https://www.cakex.org/documents/wisconsin%E2%80%99s-strategy-reducing-global-warming Wisconsin Hazard Mitigation Plan (2016): https://www.cakex.org/documents/state-wisconsin-hazard-mitigation-plan

Appendix B. Survey Questions

This survey aims to assess the needs of health professionals (e.g., managers, planners, etc.) working to prepare for and respond to multiple stresses, including climate change. The survey intends to assess understanding of climate change impacts among public health officials, and identify activities to prepare for, respond to, and recover from climate-related challenges. The survey will take approximately 10–15 minutes to complete. For more information, please contact project lead, Rachel M. Gregg, at Rachel@EcoAdapt.org.

1. Please identify your affiliation.

- Academic
- City Government
- County Government
- State Government
- Federal Government
- Tribal Nation
- Nongovernmental Organization
- Private Sector
- Other (please specify)

2. Please indicate the area in which you work. Check all that apply.

- Disaster Risk Management
- Education/Outreach
- Emergency Management/Preparedness
- Environmental Justice
- Infrastructure
- Planning
- Policy
- Public Health
- Rural/Indigenous Livelihoods
- Scientific Research
- Water Resources
- Other (please specify)

3. Please identify the type of position you hold.

- Physician/Nurse/Assistant
- Paramedic/Emergency Responder
- Emergency Planner/Manager
- Healthcare Specialist
- Public Health Official
- Manager
- Scientist

- Planner
- Communications
- Environmental Consultant
- Other (please specify)

4. Please indicate the state/region in which you work.

5. Which of the following best describes the focus of your/your organization's interest(s) in health? Select all that apply.

- Physical Health
- Behavioral Health
- Mental Health
- Healthcare Infrastructure
- Other (please specify)

Threats to Health and Health Services

6. Climate change poses significant threats to the health of individuals and communities, as well as the delivery of healthcare services. Please indicate your level of concern about the following.

	Very concerned	Moderately concerned	A little concerned	Not at all concerned	Don't have enough information
Increasing air temperature					
Extreme heat events					
Wildfire					
Precipitation changes (e.g., timing, amount)					
Storms and extreme weather events (e.g., frequency, intensity)					
Sea level rise					
Flooding					
Drought					
Other (please specify)					

Please provide specific examples if you have any to share.

7. For each of the likely climatic impacts on health and health services listed below, please indicate those that you are concerned about, along with your level of concern.

	High	Moderate	Low	N/A
Air quality (e.g., toxins, particulate matter, allergens, spores)				
Chemical exposure				

Displacement of individuals and communities due to extreme events or other risks				
Food security (e.g., production, quantity, quality) and nutrition				
Food-borne disease				
Heat-related illness and/or death				
Infrastructure damage (e.g., leading to interruptions in healthcare services)				
Injuries and fatalities				
Mental health and stress-related illnesses				
Presence of/Access to healthcare services (e.g., hospitals, clinic, cooling centers)				
Public safety (e.g., loss of lives)				
Species distribution (e.g., range shifts of pests)				
Threats to biodiversity (e.g., affecting nutrition, medicines, infectious disease, etc.)				
Vector-borne disease (e.g., mosquitoes, ticks, rodents)				
Water supply				
Water-borne disease (e.g., water quality, harmful algal blooms, recreational water)				
Other (please specify)				

Climate Change and Health

8. Do you think climate change is having or is likely to have a significant effect on health and health services?

- Yes
- No
- Maybe

9. How knowledgeable do you feel you are about climate change?

- Very knowledgeable
- Moderately knowledgeable
- Slightly knowledgeable
- Not at all knowledgeable

10. Have you ever adjusted your health-related activities to address the potential impacts of climate change?

- Yes
- No

11. If yes, approximately how long have you done so?

- Less than 6 months

- 6 months to 1 year
- 1-3 years
- More than 3 years

12. Are there any specific challenges that you have encountered?

- Current, more pressing issues
- Lack of funding
- Insufficient staff resources/capacity
- Lack of stakeholder demand
- Lack of technical assistance
- Lack of leadership
- Opposition from stakeholder groups
- Lack of access to information and data
- No legal mandate
- Scientific uncertainty
- Not enough time
- Lack of scientific information on relationship between health and climate change
- Lack of access to forecasting information and data
- Lack of specific climate change information/data for my area
- Lack of options for management
- Climate change is not relevant
- Other (please specify)

13. If no to Question 10, please indicate why. Check all that apply.

- Current, more pressing issues
- Lack of funding
- Insufficient staff resources/capacity
- Lack of stakeholder demand
- Lack of technical assistance
- Lack of leadership
- Opposition from stakeholder groups
- Lack of access to information and data
- No legal mandate
- Scientific uncertainty
- Not enough time
- Have not thought to
- Lack of scientific information on relationship between health and climate change
- Lack of access to forecasting information and data
- Lack of specific climate change information/data for my area
- Lack of options for management
- Climate change is not relevant
- Other (please specify)

14. Which of the following strategies have you used and/or do you think should be considered to support health and healthcare services in a changing climate? Please check all that apply.

15. Which of the following strategies do you think should be considered to support health and healthcare services in a changing climate? Please check all that apply.

- Design or reform institutions to address climate change (e.g., committees, task forces)
- Conduct research, studies, and assessments (e.g., vulnerability, impact, risk, other targeted research program)
- Enhance coordination and collaboration between individuals, communities, departments, and service providers
- Conduct training and planning exercises (e.g., workshops, scenario planning)
- Increase/improve public awareness, education, and outreach efforts
- Create/enhance resources and tools (e.g., guidance and decision support, modeling and analysis, mapping)
- Monitor environmental and climatic conditions and impacts
- Evaluate management effectiveness
- Develop/implement adaptation plans
- Create new or enhance existing policies or regulations
- Develop/implement adaptive management strategies
- Reduce non-climate stressors likely to interact with climate change (e.g., reduce pollution, reduce stormwater runoff)
- Make infrastructure resistant or resilient to climate change (e.g., create new or retrofit, assess infrastructure integrity)
- Community planning (e.g., developing climate-informed communities)
- Implement green infrastructure (e.g., rain gardens, low impact development methods, pervious pavement, green roofs, swales, etc.)
- Create or modify development measures (e.g., building codes, zoning, limit development within vulnerable areas)
- Develop emergency preparedness and response plans and policies
- Other (please specify)

Knowledge Products and Services

16. What kind of information do you currently use to make programmatic decisions at work? Please check all that apply.

- Models (e.g., atmospheric, ecosystem, economic)
- Spatial data
- Traditional knowledge
- Case studies
- Best practices/lessons learned
- Scientific literature
- Grey literature (e.g., agency plans, frameworks)
- Other (please specify)

17. What 3-5 resources or tools do you currently use to inform your decision-making? Please be as specific as possible.

18. Please rate your interest in the following products.

	High interest	Some interest	No interest	Not sure
Best practices/Case studies				
Trainings or workshops				
Expert networks/associations				
Guidance on how to integrate climate change into planning and management				
Information on how to communicate climate change to the public and engage stakeholders				
Specific information about the effects of climate change on health and health services				
Example policies, ordinances, and model codes				
Spatial data				
Decision support tools for the purpose of integrating change and other stressors				
Webinars				
Scientific reports and articles				
Other (please specify)				

19. Are you interested in integrating climate change into your work? Why or why not?

20. Do you have a climate-informed health initiative or project(s) that you would be willing to share?

- Yes
- No
- Not sure

21. Please enter your contact information.

Name:

Organization:

Email:

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For more information about this report, please contact Rachel M. Gregg at Rachel@EcoAdapt.org.



EcoAdapt, founded by a team of some of the earliest adaptation thinkers and practitioners in the field, has one goal - creating a robust future in the face of climate change. We bring together diverse players to reshape planning and management in response to rapid climate change.

P.O. Box 11195
Bainbridge Island, WA 98110
EcoAdapt.org