



October 2015

CLIMATE CHANGE

HHS Could Take Further Steps to Enhance Understanding of Public Health Risks

Accessible Version

GAO Highlights

Highlights of [GAO-16-122](#), a report to congressional requesters

Why GAO Did This Study

The World Health Organization projects climate change will adversely affect health significantly over the next several decades. Some health effects of climate change are already being felt in the United States, according to assessments by the National Research Council, USGCRP, and others. Since the federal government is the nation's largest purchaser of health care services, federal health care expenditures could increase in future years due to climate-related impacts.

GAO was asked to review federal efforts to increase public health system preparedness for climate change. This report addresses (1) federal activities to enhance understanding about the risks climate change poses to public health, (2) federal resources used by selected states and localities to address these risks, and (3) challenges states and localities face and actions federal agencies could take to mitigate them. GAO examined federal, state, and local documents, and interviewed officials from federal agencies such as CDC, NIH, USGCRP, as well as state and local health departments, including all 18 recipients of CDC's Climate Ready States and Cities Initiative award.

What GAO Recommends

GAO recommends that HHS direct CDC to develop a plan describing when it will be able to issue climate change communications guidance to state and local health departments. CDC generally agreed with the recommendation, stating that it will issue guidance once HHS's climate change communication and outreach strategy is final.

View [GAO-16-122](#). For more information, contact J. Alfredo Gómez at (202) 512-3841 or gomezj@gao.gov, or Marcia Crosse at (202) 512-7114 or crossem@gao.gov.

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HHS Could Take Further Steps to Enhance Understanding of Public Health Risks

What GAO Found

Federal agencies are enhancing understanding of climate-related risks to public health by (1) supporting and conducting research, (2) providing data and informational resources, and (3) communicating about risks. The Department of Health and Human Services' (HHS) National Institutes of Health (NIH) supports a portfolio of research directly related to these risks. NIH reports awarding about \$6 million for such research in fiscal year 2014, including for one study examining health risks posed by heat and air pollution. Federal agencies have also provided data on climate and health issues, such as the number of extreme heat days that state and local officials can use to assess health risks. They have also reported about these risks, such as through the third National Climate Assessment issued in May 2014 by the U.S. Global Change Research Program (USGCRP).

Selected state and local health departments have used resources from HHS's Centers for Disease Control and Prevention (CDC) and other federal agencies to address and plan for the risks of climate change to public health. CDC's Climate Ready States and Cities Initiative awards an average of about \$200,000 per year each to 16 state and two local health departments to implement a risk management framework designed to help incorporate climate projections into public health planning. CDC also requires awardees to increase public awareness of the risks climate change poses to public health. Other federal resources used by health departments to prepare for these risks include funding provided through CDC's National Environmental Public Health Tracking Program.

When asked to identify challenges they face in addressing and planning for the risks of climate change to public health, state and local health officials identified challenges that GAO grouped into the three most frequently mentioned themes. First, the officials said they face challenges communicating about the public health risks of climate change, due to limited public awareness and the complexity of the issue. These officials reported that enhanced federal leadership could help address this challenge. Although HHS plans to develop a climate change communication and outreach strategy, its development has been delayed by over a year. Also, CDC currently does not have plans to issue climate change communications guidance, which state and local officials said would be helpful. CDC's limited resources are currently focused on resolving methodological and data issues related to its Climate Ready States and Cities Initiative. Given that health departments that have received awards under CDC's initiative are required to take steps to enhance public awareness, such guidance may help awardees better meet this requirement. Issuing such guidance would also be in line with CDC's core functions, which include translating climate change science to inform communities. Second, officials said they face challenges identifying health risks of climate change due to gaps in research and difficulties using climate data. Federal officials told GAO about actions they have taken or plan to take that could help address these challenges, such as issuing an assessment of climate change impacts on health, and creating a national heat health information system. Finally, the officials told GAO about other challenges they face that federal action may not be able to address, such as having insufficient local data on health outcomes, because states may not collect or have access to such data, and having insufficient staff resources for these activities.

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Abbreviations

ASTHO	Association of State and Territorial Health Officials
BRACE	Building Resilience Against Climate Effects
CDC	Centers for Disease Control and Prevention
CCHHG	Interagency Crosscutting Group on Climate Change and Human Health
EPA	Environmental Protection Agency
HHS	Department of Health and Human Services
NACCHO	National Association of County and City Health Officials
NASA	National Aeronautics and Space Administration
NCA	National Climate Assessment
NIH	National Institutes of Health
NOAA	National Oceanic and Atmospheric Administration
USGCRP	U.S. Global Change Research Program

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October 5, 2015

Congressional Requesters

The effects of a changing climate are viewed as threats to human health in a variety of ways, and, according to assessments by the National Research Council, the U.S. Global Change Research Program (USGCRP), and the Intergovernmental Panel on Climate Change, some effects are already being felt across the world and within the United States.¹ The World Health Organization projects that climate change will have significant adverse effects to health over the next several decades, including an increased number of deaths in 2030 from impacts such as heat exposure, malaria, diarrhea, and childhood malnutrition.²

Observations of a changing climate in the United States include trends such as an increase in average temperatures, shifting patterns of rainfall, rising sea levels, and more frequent and intense extreme weather events

¹National Research Council, America's Climate Choices: Panel on Adapting to the Impacts of Climate Change, *Adapting to the Impacts of Climate Change* (Washington, D.C.: 2010); Jerry M. Melillo, Terese (T.C.) Richmond, and Gary W. Yohe, eds., *Climate Change Impacts in the United States: The Third National Climate Assessment*, U.S. Global Change Research Program (Washington, D.C.: May 2014); and K.R. Smith, K.R., et al., Human Health: Impacts, Adaptation, and Co-Benefits in *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge, United Kingdom: 2014). The National Research Council is the principal operating agency of the National Academy of Sciences and the National Academy of Engineering. USGCRP coordinates and integrates the activities of 13 federal agencies that conduct research on changes in the global environment and their implications for the United States. USGCRP began as a presidential initiative in 1989 and was codified in the Global Change Research Act of 1990 (Pub. L. No. 101-606, § 103 (1990)). The act requires USGCRP to periodically prepare a scientific assessment—known as the National Climate Assessment—which is an important resource for understanding and communicating climate change science and impacts in the United States. The Intergovernmental Panel on Climate Change is a scientific body under the auspices of the United Nations that was designed to assess the scientific, environmental, and socioeconomic aspects of climate change.

²World Health Organization, *Quantitative Risk Assessment of the Effects of Climate Change on Selected Causes of Death, 2030s and 2050s* (Geneva, Switzerland: 2014). The World Health Organization directs and coordinates international health within the United Nations system. In this study, WHO modeling and simulation results estimate 240,000 additional deaths worldwide in 2030 due to the health effects of a changing climate.

such as heat waves, heavy downpours, and drought, according to reports from the National Research Council and USGCRP. While it is challenging to link any individual weather event to climate change, the National Research Council and USGCRP, among others, expect these climate trends to continue. According to assessments by the National Research Council and USGCRP, climate change will amplify existing health threats, and populations such as the elderly, children, those who are sick, and those living in poverty will face disproportionate health risks from climate change in the United States.³ In addition to being the nation's largest purchaser of health care services, the federal government bears the expense of these services for some of the most vulnerable populations to climate change impacts—spending \$815 billion on three such programs in 2014.⁴ As such, federal health care expenditures could increase in future years as a result of climate impacts. A 2006 summer heat wave in California illustrates the types of health impacts that could be associated with climate change, including increased hospitalizations for heat-related illnesses.⁵ In February 2013, we added limiting the federal government's fiscal exposure by better managing climate change risks to our High Risk List, which calls attention to agencies and program areas that are at high risk due to their vulnerabilities to fraud, waste, abuse, or are most in need of transformation.⁶

State and local public health authorities have responsibility for carrying out most public health activities in the United States, but a number of

³While climate change poses health risks worldwide, this report focuses on the risks that climate change poses to human health within the United States.

⁴In 2014, the federal government spent \$815 billion on Medicare, Medicaid, and the Children's Health Insurance Program, which provide coverage for the elderly, low-income individuals, and children, respectively. Office of Management and Budget, *Analytical Perspectives, Budget of the United States Government, Fiscal Year 2016* (Washington, D.C.: Feb. 2, 2015).

⁵During this 16-day heat wave, more than 10 times the number of hospitalizations for heat-related illnesses occurred statewide, and more than 23 times the number of emergency department visits for heat-related illnesses occurred in the most affected region, as had been recorded in 6 days prior and 10 days following the event. One study estimated that this heat wave resulted in nearly \$180 million in additional health care costs. K. Knowlton, et al., "The 2006 California Heat Wave: Impacts of Hospitalizations and Emergency Department Visits," *Environmental Health Perspectives* 117 (2009) and K. Knowlton, et al., "Six Climate Change-Related Events in the United States Accounted for About \$14 Billion in Lost Lives and Health Costs," *Health Affairs* 30, no. 11 (2011).

⁶GAO, *High-Risk Series: An Update*, [GAO-13-283](#) (Washington, D.C.: Feb. 14, 2013).

federal agencies also have a role. State and local public health agencies have responsibilities such as disease surveillance and responding to public health emergencies within their jurisdictions, including activities that may be related to climate change.⁷ The federal government's role in addressing public health includes providing high-level leadership through setting and communicating health-related policies, goals, and standards; supporting state and local health department efforts; and financing research and higher education. In addition, federal agencies, such as the Environmental Protection Agency (EPA), Department of Health and Human Services' (HHS) National Institutes of Health (NIH) and Centers for Disease Control and Prevention (CDC), and the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA), support the development of data and other information resources on climate change that others, including state and local health departments, can use to manage public health risks. CDC has also provided support to some state and local health departments to manage these risks.

You asked us to review federal efforts to increase the preparedness of the nation's public health system for the impacts of climate change. In this report, we (1) discuss the types of activities that selected federal agencies have conducted to enhance understanding about the risks that climate change poses to public health; (2) describe federal resources used by selected state and local health departments to address or plan for the risks that climate change poses to public health; and (3) examine challenges, if any, identified by state and local officials to addressing or planning for the risks that climate change poses to public health, and any steps they identified that federal agencies could take to mitigate these challenges.

To describe the types of activities that federal agencies have conducted to enhance understanding about the risks that climate change poses to public health, we reviewed federal documents such as USGCRP's 2014 third National Climate Assessment (NCA) and a 2010 report on climate

⁷Disease surveillance is the process of reporting, collecting, analyzing, and exchanging information related to cases of infectious diseases. For more information on state and local public health agency activities related to climate change, see H. Frumkin, et al., "Climate Change: The Public Health Response," *American Journal of Public Health* 98, no. 3 (2008).

change and human health research needs.⁸ We interviewed officials from 26 federal agencies, including CDC, EPA, NIH, NOAA, and others participating in a USGCRP working group on climate change and human health.⁹ We also interviewed representatives of 13 stakeholder groups, including public health organizations, such as the American Public Health Association,¹⁰ and academic institutions, such as the Georgetown Climate Center.¹¹ (App. I provides a complete list of agencies and stakeholders interviewed.) In addition, we reviewed NIH data on awards it made for research related to the public health risks of climate change from fiscal year 2011 through fiscal year 2014.¹² To assess the reliability of these data, we discussed them with agency officials, reviewed them for

⁸The 2014 assessment summarizes the impacts of climate change on the United States, now and in the future. A team of several hundred experts guided by a 60-member Federal Advisory Committee produced the report, which was extensively reviewed by the public and experts, including federal agencies and a panel of the National Academy of Sciences. The 2010 report, developed by an ad hoc interagency working group on climate change and health, summarizes research needs on the human health effects of climate change. See, Interagency Working Group on Climate Change and Health, *A Human Health Perspective on Climate Change: A Report Outlining the Research Needs on the Human Health Effects of Climate Change*, National Institute of Environmental Health Sciences (Research Triangle Park, N.C.: April 2010).

⁹Specifically, we interviewed officials from 26 federal agencies: Department of Commerce's National Oceanic and Atmospheric Administration; Department of Defense's Defense Health Agency, Department of Health and Human Services' Assistant Secretary for Preparedness and Response, Centers for Disease Control and Prevention, Indian Health Service, National Institutes of Health, and Office of the Assistant Secretary for Health; the Department of Homeland Security's Federal Emergency Management Agency and Office of Health Affairs; Department of the Interior's Bureau of Indian Affairs, Office of Insular Affairs, and U.S. Geological Survey; Environmental Protection Agency; National Aeronautic and Space Administration; National Science Foundation, and the U.S. Department of Agriculture's Agricultural Marketing Service, Animal and Plant Health Inspection Service, Agricultural Research Service, National Institute of Food and Agriculture, Economic Research Service, Forest Service, Natural Resources Conservation Service, and the Office of the Chief Economist, USGCRP, and the Council on Environmental Quality. These agencies include those that participate in USGCRP's Interagency Crosscutting Group on Climate Change and Human Health and whose focus is on understanding risks to populations within the United States.

¹⁰The American Public Health Association is a national nonprofit organization representing public health officials, whose mission is to improve the health of the public and achieve equity in health status.

¹¹The Georgetown Climate Center, a nonpartisan organization of Georgetown University Law Center, seeks to advance policies that reduce greenhouse gas emissions and help communities adapt to climate change.

¹²We did not review governmentwide data on funding for such research because such data were not readily available.

reasonableness and consistency, and determined that they were sufficiently reliable for our purposes. The results of our work provide examples of federal activities to enhance understanding of the risks that climate change poses to public health, and do not represent an exhaustive list of federal actions in this area.¹³ We did not evaluate the effectiveness of federal efforts to enhance understanding, as this was outside the scope of our review.

To describe federal resources used by selected state and local health departments to address or plan for the risks that climate change poses to public health, we used a variety of approaches to obtain information from state and local health departments. This included information about the activities they have conducted related to climate change and public health, and how they used federal resources to support these efforts. Specifically, we conducted interviews with state and local officials during site visits to two states—California and Maryland—and two cities—New York City and San Francisco—that received awards from CDC’s Climate Ready States and Cities Initiative, which is HHS’s primary investment in climate change adaptation.¹⁴ We selected these four locations from among the 18 awardees of CDC’s Climate Ready States and Cities Initiative to obtain geographic diversity, because climate change impacts are location-specific, and to have a mixture of state and local governments, because states and municipalities may have different approaches in preparing for the public health risks of climate change. We also facilitated four small group discussion sessions with officials from 22 state and local health departments to gather additional information about federal resources used by state and local health officials. We worked with representatives of the Association of State and Territorial Health Officials

¹³In identifying these examples, we did not limit the scope of our work to a specific time period.

¹⁴Adaptation refers to adjustments to natural or human systems that are made in response to actual or expected climate changes. While our report focuses on activities taken to adapt to the potential health impacts of climate change, federal agencies and others are also involved in climate change mitigation—that is, taking actions to limit the magnitude or rate of climate change. EPA recently reported on the physical and monetary benefits in the United States of global mitigation, including that it is projected to reduce the impact of climate change on air quality and the corresponding adverse health effects related to air pollution, avoiding 57,000 premature deaths in 2100. EPA, *Climate Change in the United States: Benefits of Global Action* (Washington, D.C.: June 2015).

(ASTHO)¹⁵ and the National Association of County and City Health Officials (NACCHO)¹⁶ to identify state and local public health officials who have expressed interest in climate change issues to participate in these sessions.¹⁷ In a third approach to gather perspectives, we interviewed officials from a nongeneralizable sample of 11 state and local health departments that reflected geographic diversity and that had either recently faced climate-related public health issues, had conducted work to plan for potential future health impacts from climate change, or had concerns about potential future health impacts. In total, through these approaches, we interviewed officials from all 18 state and local health departments that received awards from CDC's Climate Ready States and Cities Initiative, officials from 7 local health departments in some of those jurisdictions, and health department officials from 13 other states and

¹⁵ASTHO is a national nonprofit organization representing public health agencies in the United States, the U.S. Territories, and the District of Columbia, and over 100,000 public health professionals these agencies employ. ASTHO's primary function is to track, evaluate, and advise members on the impact and formation of public or private health policy that may affect them and to provide them with guidance and technical assistance on improving the nation's health.

¹⁶NACCHO's mission is to be a leader, partner, catalyst, and voice for the 2,800 local health departments across the United States in order to ensure the conditions that promote health and equity, combat disease, and improve the quality and length of all lives.

¹⁷We conducted one small group discussion session in person with state health department officials during the American Public Health Association's annual meeting, and we conducted three additional sessions by teleconference with state and local health department officials, to capture the perspectives of those who were unable to attend our in-person session. In total, we conducted three sessions with state health department officials and one session with local health department officials. In addition to working with ASTHO and NACCHO to identify potential participants, we also conducted some targeted recruitment of officials from state and local health departments receiving awards through CDC's Climate Ready States and Cities Initiative to include these jurisdictions in our small group discussion sessions.

localities.¹⁸ These interviews and small group discussions included open-ended questions that were not conducive to quantitative analysis. Therefore, using a qualitative approach, we identified examples of the types of federal resources that these officials have used to address and plan for the risks that climate change poses to human health. We also reviewed Climate Ready States and Cities Initiative awardees' annual progress reports to CDC. To obtain more information about these resources, we reviewed documentation about the types of support they offered, such as from funding opportunity announcements. We also reviewed information on fiscal year 2014 funding for CDC programs cited by state and local officials, as presented in the agency's congressional budget justification for fiscal year 2016. Furthermore, we interviewed officials from federal agencies, such as CDC and NOAA, and gathered the perspectives of stakeholders through interviews with representatives from groups such as ASTHO and NACCHO. The results of our review do not provide an exhaustive list of federal resources that state and local health departments could use to address and plan for the public health impacts of climate change, but are provided as illustrative examples of such resources.

To examine challenges identified by state and local officials to addressing or planning for the risks that climate change poses to public health, and any steps federal agencies could take to mitigate these challenges, we gathered the views of state and local health department officials during site visits, small group discussion sessions, and individual interviews. Through an inductive analysis of officials' views, we qualitatively grouped them into three themes that were most frequently mentioned about the types of challenges these public health departments face, and, in some cases, the opportunities officials see for federal action to address these

¹⁸We interviewed officials from all 16 states and two cities that were awarded funding through CDC's Climate Ready States and Cities Initiative—Arizona, California, Florida, Illinois, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New York, North Carolina, Oregon, Rhode Island, Vermont, Wisconsin, as well as New York City and San Francisco. In addition, we interviewed officials from seven local health departments located in states that received the CDC award, including Baltimore (MD), Benton County (OR), Multnomah County (OR), San Diego County (CA), San Luis Obispo County (CA), Washington County (MD), and Wicomico County (MD). We also interviewed officials from five other state and eight other local health departments: Alaska, Hawaii, Louisiana, Utah, and Washington, as well as Columbus (OH), Dallas County (TX), Houston (TX), Portsmouth (VA), Salt Lake County (UT), Shelby County (TN), Summit County (OH), and Toledo (OH). We interviewed officials from a few state and local health departments twice, through different approaches.

challenges.¹⁹ We also gathered the perspectives of stakeholder groups through interviews with representatives from ASTHO, NACCHO, and the Council of State and Territorial Epidemiologists. To gather information about steps federal agencies could take to mitigate these challenges, we interviewed officials from federal agencies such as CDC, NIH, and NOAA, as well as representatives from stakeholder groups. We examined federal documents, including those describing ongoing and planned federal actions aimed at reducing the impact of climate change on public health. We reviewed prior GAO work on the federal role in addressing challenges related to climate change, including challenges faced by state and local officials.

We conducted this performance audit from June 2014 to September 2015 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

Climate changes, including rising temperatures and shifting patterns of rainfall, are expected to impact public health across the nation in a variety of ways. Though state and local governments have primary responsibility for protecting the public health in their jurisdictions, the federal government also plays an important role in supporting state and local efforts by, for example, providing health departments with technical support and other resources. The federal government has also taken other targeted actions to help prepare the nation for climate change impacts, such as by issuing a number of orders, actions, and plans to provide state and local decision makers with information they need to manage such impacts, including impacts to public health.

¹⁹The results from our analysis identify the three themes that were commonly reported by a diverse group of state and local health departments. These results are not generalizable to other state and local health departments and do not necessarily include all challenges that public health departments may face.

Climate Change Impacts in the United States

Impacts from climate change in the United States have been observed, are projected to continue, and are likely to accelerate over the next several decades, with impacts varying considerably by region, according to assessments by the National Research Council and USGCRP.²⁰ According to USGCRP's third NCA, observed impacts in the United States include increases in average temperatures and precipitation, as well as changes to precipitation extremes, with variation across regions (see table 1). These and other climate changes are projected to continue over this century and beyond, according to USGCRP's third NCA. The magnitude of climate change beyond the next few decades depends primarily on the amount of heat-trapping gasses emitted globally, and how sensitive the Earth's climate is to those emissions, according to USGCRP's third NCA.²¹

²⁰National Research Council, America's Climate Choices: Panel on Adapting to the Impacts of Climate Change, *Adapting to the Impacts of Climate Change* (Washington, D.C.: 2010); and Melillo, Richmond, and Yohe, eds., *Climate Change Impacts in the United States: The Third National Climate Assessment*.

²¹Because of greenhouse gases already in the atmosphere, another 0.5 degree Fahrenheit increase would occur even if all emissions from human activities were suddenly stopped, according to USGCRP's third NCA.

Table 1: Observed and Projected Impacts of Climate Change in the United States

Category	Observed and projected impacts
Temperature	<ul style="list-style-type: none">• Observed impact: The last decade was the warmest on record for the contiguous United States, with 2012 as the warmest year on record [Note A]. The average temperature has risen by 1.3 to 1.9 degrees Fahrenheit since record keeping began in 1895, with most of this increase occurring since 1970.• Projected impact: Temperature increases are projected for all regions of the country during this century, with projected increases of 2 to 4 degrees Fahrenheit in the next few decades in most areas.
Precipitation	<ul style="list-style-type: none">• Observed impact: Precipitation has increased by an average of about 5 percent since 1900, with variation across regions. Heavy downpours have been increasing nationally in recent decades, with the largest increases in the Midwest and Northeast.• Projected impact: More winter and spring precipitation is projected for the northern United States, and less for the Southwest, during this century. Increases in the frequency and intensity of extreme precipitation events are projected for all regions.
Sea levels	<ul style="list-style-type: none">• Observed impact: Global sea level has risen by about 8 inches over the last century.• Projected impact: Global sea level is projected to rise another 1 to 4 feet by 2100, with additional increases well beyond this century.
Extreme weather events and impacts from storms	<ul style="list-style-type: none">• Observed impact: Some types of extreme weather events—such as heat waves and regional droughts—have become more frequent and intense in recent decades.• Projected impact: Droughts in the Southwest and heat waves everywhere are projected to become more intense. Rainfall from storms such as hurricanes is expected to increase, and sea level rise is expected to magnify the adverse impact of storm surges on some coastal communities.

Source: U.S. Global Change Research Program's third National Climate Assessment. | GAO-16-122

Note A: The National Oceanic and Atmospheric Administration and the National Aeronautics and Space Administration have since declared 2014 as the warmest year on record since 1880.

Climate Change and Human Health

What Is a Vector-Borne Disease?



Vector-borne diseases are transmitted by mosquitoes, ticks, and fleas. West Nile virus is one type of vector-borne disease and is most commonly transmitted to people by the bite of infected mosquitoes. First detected in North America in 1999, it has since spread to all states except Alaska and Hawaii, with outbreaks occurring every summer. Most people who are infected with West Nile virus experience no symptoms, but one in five infected people will develop a fever with other symptoms such as headaches and body aches, and a very small number of infected people—less than 1 percent—will develop a severe neurological illness that can result in paralysis or death. People who work or play outside are especially vulnerable because of greater exposures to mosquitoes.

Source: Centers for Disease Control and Prevention/James Gathany. | GAO-16-122

According to USGCRP's third NCA, climate change is expected to impact human health in the United States by exacerbating some existing health threats and by posing new risks. For example, projected changes in temperature are expected to increase the length of pollen seasons, which could increase allergies and asthma episodes. According to USGCRP's third NCA, extreme weather events, which are expected to become more common with climate change, are linked with increases in injuries, deaths, and mental health problems, such as anxiety and posttraumatic stress disorder. Furthermore, according to this assessment, changes in the climate may contribute to the spread of vector-borne diseases that are transmitted to humans by animals, including invertebrate animals such as mosquitoes and ticks. Examples of vector-borne diseases that currently pose health risks in some regions of North America include chikungunya virus, dengue, Lyme disease, Rocky Mountain spotted fever, and West Nile virus.²² Table 2 summarizes these and additional risks that climate change poses to human health.

²²Chikungunya is a viral disease spread to people by the bite of infected mosquitoes. According to CDC, the first locally acquired cases of chikungunya were reported in Florida in 2014. Dengue is caused by any one of four related viruses transmitted by mosquitoes. According to CDC, dengue is endemic to Puerto Rico and the Pacific Islands, and occurs only infrequently in the United States. Lyme disease is a bacterial disease that is transmitted to humans through the bite of infected blacklegged ticks. Most Lyme disease cases reported to CDC through national surveillance are concentrated heavily in the Northeast and upper Midwest. West Nile virus is most commonly transmitted to humans by mosquitoes. According to CDC, the virus has been detected in all of the 48 contiguous United States, but not in Hawaii or Alaska.

Table 2: Examples of Health Risks Posed by Climate Change in the United States

Health risk	Exposure or event posing health risk	Reason for increased risk from climate change
Allergies, asthma, and other adverse respiratory impacts	Pollen, smoke from wildfires, and ground-level ozone (a key component of smog)	Pollen seasons are becoming longer because of climatic changes, such as increases in the number of frost-free days. Wildfires are projected to increase in some regions in part because of drought and other stressors exacerbated by climate change. Rising temperatures can also lead to higher levels of ozone pollution.
Food-borne and water-borne illnesses	Pathogens such as disease-causing bacteria, viruses, and parasites from untreated water or other sources	Factors that contribute to flooding, such as more extreme downpours, sea level rise, storm surges, and more rapid spring snowmelt may increase releases of sewage to surface waters. In addition, diarrheal diseases caused by pathogens such as Salmonella are more common when temperatures are high.
Heat-related illnesses and deaths [Note A]	Unusually high temperatures, including prolonged heat waves	Extreme heat events are expected to become more frequent and intense in coming decades because of climate change.
Injuries and deaths	Extreme weather events—such as winter storms and heavy precipitation—and their aftermaths, and changes to natural or built environments that introduce hazards	Some types of extreme weather events are expected to become more frequent and severe because of climate change. Extreme weather events may result in direct injury and impact natural or built environments in ways that increase risk of injury. Heavy precipitation events may result in flash floods, which can lead to drownings.
Mental health and stress-related disorders	Any adverse change to an individual's environment, way of life, or health, such as displacement following a disaster	Climate-related disasters such as floods, heat waves, and wildfires may result in increases in mental health problems, such as anxiety and post-traumatic stress disorder.
Vector-borne diseases	Pathogens spread by vectors—including fleas, ticks, and mosquitoes—cause diseases such as dengue, Lyme disease, Rocky Mountain spotted fever, and West Nile virus	Habitats of some pathogen-carrying vectors may expand into previously unaffected regions, in part because of climate change.

Source: U.S. Global Change Research Program's third National Climate Assessment. | GAO-16-122

Note A: Heat-related illnesses and deaths may result from heat stroke or heat-sensitive conditions such as cardiovascular disease, kidney disease, cerebrovascular disease, and other conditions exacerbated by exposure to extreme heat.

The type and severity of health impacts that communities and individuals face from climate change will depend on a variety of factors, and not everyone is equally at risk, according to assessments by the National Research Council, USGCRP, and others. Populations of special concern include children, the elderly, those who are sick, those who are living in poverty, those who work outdoors, some communities of color, and

Native American communities.²³ According to the National Research Council and USGCRP's third NCA, key factors in determining health risks include the following:

- **Location.** Because climate change impacts are expected to vary across the country, people will face different risks depending on where they live, work, and travel. People located in cities may be at increased risk for heat-related illnesses (e.g., heat stroke or heat-sensitive conditions such as cardiovascular disease), for example, because land cover changes associated with urbanization, including increases in the amount of paved areas, can result in higher air temperatures compared to the surrounding rural areas, according to USGCRP's third NCA. Those who work outdoors, such as farmers, fishermen, firefighters, and utility workers, may be adversely affected by climate impacts because they have more frequent, intense, and longer exposures to the climate than the general public, according to CDC's website. For example, as extreme weather events such as floods become more frequent and severe, outdoor workers could be at increased risk of traumatic injury. Figure 1 provides examples of potential impacts by region.

²³For example, Native American communities' vulnerabilities to climate change impacts are exacerbated by poor socioeconomic conditions, according to USGCRP's third NCA.

Why Are Children Especially Vulnerable to Some Health Risks from Climate Change?

Children are more vulnerable than adults to some health risks from environmental hazards—including hazards exacerbated by climate change—because of differences in their biology and behavior. Children breathe more air relative to their body mass than adults do and their natural defenses are less developed, which makes them especially vulnerable to health impacts from decreased air quality. Asthma is one of the most common serious chronic diseases among children, and can be aggravated by poor air quality. Children also behave differently from adults, such as by spending more time outdoors and playing closer to the ground, which makes them especially vulnerable to mosquito and tick bites that can cause disease.

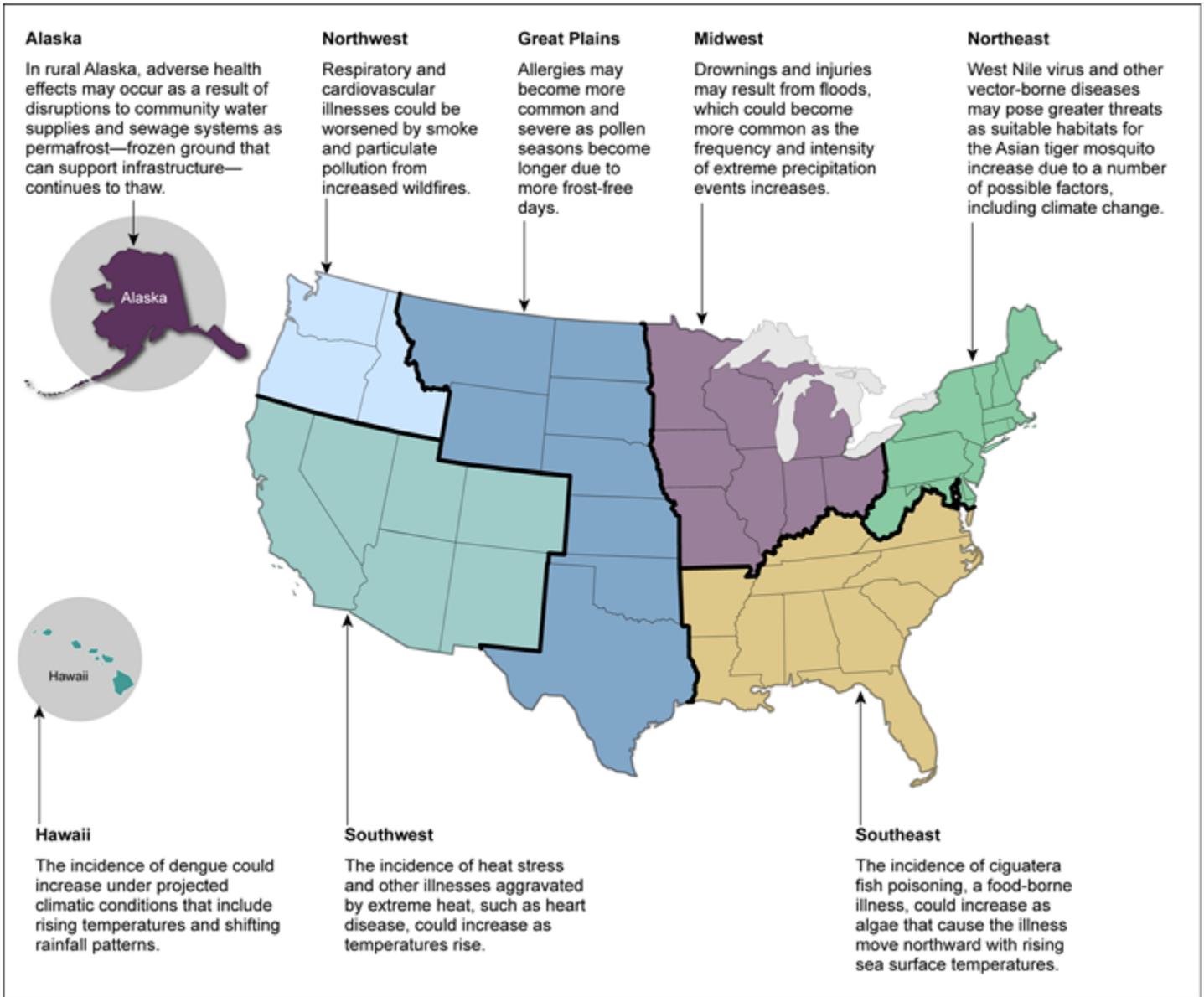


Source: Environmental Protection Agency. | GAO-16-122

- **Age.** A person's age also plays a role in determining his or her vulnerability to health impacts, including those related to climate change, according to USGCRP's third NCA. For example, children suffer disproportionately from the effects of heat waves and other environmental hazards associated with climate change, according to USGCRP's third NCA. One reason is that children playing outside during heat waves may not be aware that they need to drink more water as a preventative measure, according to EPA.²⁴ Older adults are also vulnerable to some climate-related impacts, according to USGCRP's third NCA. Specifically, this assessment states that limited mobility among older adults can increase their flood-related health risks, and that older people are at much higher risk of dying during extreme heat events.
- **Adaptive capacity.** The extent to which people and communities have the capacity to successfully adapt to adverse events also affects the health risks they face, and is influenced by characteristics such as disabilities and socioeconomic status. For example, according to USGCRP's third NCA, limited economic resources for adapting to or escaping from health-sensitive situations will place the poor at higher risk of health impacts from climate change than higher-income groups. In contrast, communities that have access to early warning systems, such as for forecasting and alerting people about impending heavy precipitation events and flooding, may be better positioned to reduce health risks from such adverse events.

²⁴EPA, *Climate Change and Children's Health* (Washington, D.C.: December 2009). In a prior report, we noted that as children's bodies are still developing, they can be more vulnerable than adults to certain environmental hazards, including air pollutants. See GAO, *Environmental Health: EPA Has Made Substantial Progress but Could Improve Processes for Considering Children's Health*, [GAO-13-254](#) (Washington, D.C.: Aug. 12, 2013).

Figure 1: Examples of Potential Health Impacts from Climate Change in the United States, by Region



Sources: GAO analysis of U.S. Global Change Research Program's third National Climate Assessment; Map Resources (map). | GAO-16-122

Note: Impacts described for certain regions do not imply that they do or can occur only in those regions.

Roles and Responsibilities for Managing Public Health Risks in the United States

State, local, territorial, and tribal governments have primary responsibility for managing public health risks within their jurisdiction. Public health departments vary greatly in their size, responsibilities, and resource levels, among other factors.²⁵ Activities that public health departments may undertake to help promote health and well-being include monitoring and investigating health problems, educating people about health issues, developing plans to support health efforts, and researching new solutions to health problems, among other activities.

The federal government's role in managing public health includes providing leadership through setting and communicating health-related policies, goals, and standards. Federal agencies also finance research and higher education, support state and local health department efforts, and support the development of data and decision support resources that decision makers can use to manage for risks to public health, including from climate change.²⁶ For example, through its various programs, CDC provides technical and financial support to state and local health departments to enhance their capacity to monitor and promote public health, including preparing for the risks posed by climate change. The agency's Climate and Health Program, established in 2009, supports state and local health department efforts to plan for and address the health risks posed by climate change. According to CDC, the program's three core functions are to translate climate change science into health policy for action by health departments and communities, create decision support resources to build capacity, and serve as a credible leader in planning for the public health impacts of climate change.

Federal Efforts to Enhance Resilience to Climate Change Impacts

The federal government has undertaken a number of efforts to enhance the nation's resilience to climate change impacts, such as strengthening federal agencies' adaptation planning and providing states and localities with information for managing risks posed by climate change. In July 2014, we reported that investing in resilience—actions to reduce potential

²⁵Each of the 50 states has a state health department and according to NACCHO, about 2,800 local health departments exist across the nation, including those that function at the city, county, or multicounty level.

²⁶Decision support resources—including tools and decision-making frameworks—can help decision makers to understand and apply scientific information to a particular scenario, and identify and assess the costs and benefits of taking various actions, among other things.

future losses rather than waiting for an event to occur and paying for recovery afterward—can reduce the potential impacts of climate-related events.²⁷ To facilitate federal efforts, the federal government has issued the following orders, actions, and plans:

- **Executive Order 13514.** On October 5, 2009, the President issued an executive order calling for federal agencies to participate in the existing interagency Climate Change Adaptation Task Force.²⁸ Based on the task force’s recommendations, the Council on Environmental Quality within the Executive Office of the President issued implementing instructions for the executive order,²⁹ directing federal agencies to establish agency climate change adaptation policies, among other things.³⁰
- **The President’s Climate Action Plan.** In June 2013, the White House published a climate action plan detailing actions that federal agencies would take to prepare the nation for the impacts of climate change, among other goals.³¹
- **Executive Order 13653.** On November 1, 2013, the President issued an executive order to help prepare the nation for the impacts of

²⁷Implementing resilience measures creates additional up-front costs but could also confer benefits, such as a reduction in future damages from climate-related events. See GAO, *Budget Issues: Opportunities to Reduce Federal Fiscal Exposures Through Greater Resilience to Climate Change and Extreme Weather*, [GAO-14-504T](#) (Washington, D.C.: July 29, 2014).

²⁸Executive Order 13514, *Federal Leadership in Environmental, Energy, and Economic Performance* (Oct. 5, 2009). This Executive Order was revoked by Executive Order 13693 on March 19, 2015; however, an Executive Order issued in 2013 directed agencies to continue developing, updating, and implementing agency adaptation plans. Executive Order 13653, *Preparing the United States for the Impacts of Climate Change* (Nov. 1, 2013).

²⁹The Council on Environmental Quality coordinates federal environmental efforts and works with agencies and other White House offices in the development of environmental policies and initiatives.

³⁰*Instructions for Implementing Climate Change Adaptation Planning in Accordance with Executive Order 13514 “Federal Leadership in Environmental, Energy, and Economic Performance,”* (Mar. 4, 2011).

³¹*The President’s Climate Action Plan* (June 2013).

climate change.³² Among other things, the order called on certain federal agencies to provide information, data, and decision-support tools on climate preparedness and resilience in support of federal, regional, state, local, tribal, and other efforts to prepare for the impacts of climate change. It also established a State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience to inform federal efforts to support climate preparedness and resilience.³³

- **April 2015 Administrative Actions.** On April 7, 2015, the White House announced a series of actions that the administration was taking to better understand, communicate, and address the health impacts of climate change, as well as commitments made by private sector entities and institutes of higher learning to further our knowledge in this area. Among other things, the administration expanded the resources available for analyzing the climate change impacts on health. (App. II provides a summary of these actions.)
- **June 2015 Climate and Health Summit and Administrative Actions.** On June 18, 2015, the White House hosted a summit on climate change and health, which included the participation of the President, the Surgeon General, and the HHS Assistant Secretary for Preparedness and Response.³⁴ At the summit, the administration announced a set of actions to protect communities from the health impacts of climate change that cannot be avoided. (App. III provides a summary of these actions.)

In addition, USGCRP has undertaken efforts to support scientific research with the goal of improving understanding of and response to climate change and its impacts on the United States. To help address climate change impacts on human health, USGCRP coordinates an Interagency Crosscutting Group on Climate Change and Human Health (CCHHG);

³²Executive Order 13653, *Preparing the United States for the Impacts of Climate Change* (Nov. 1, 2013).

³³The task force consisted of 26 governors, mayors, county officials, and tribal leaders from across the United States, and was co-chaired by the Chair of the White House Council on Environmental Quality and the Director of the White House Office of Intergovernmental Affairs.

³⁴The recording of the summit is available online at <https://www.whitehouse.gov/blog/2015/06/18/public-health-climate-summit>.

officials from CDC, NIH, and NOAA chair this group. The mission of CCHHG is to promote and protect the nation’s public health by leading and coordinating federal scientific activities related to climate change and human health, from basic research through public health practice. CCHHG’s activities include working to address key gaps in understanding of the health–related impacts of climate change and developing informational resources.³⁵

Federal Agencies Have Undertaken Various Activities to Enhance Understanding of Climate Change Risks to Public Health

Federal agencies have undertaken activities to enhance understanding about the risks that climate change poses to public health, including supporting and conducting research on or related to these risks. Agencies have also provided some data and decision support resources, such as guidance and tools, for state and local officials and others to use in examining public health-related risks from climate change and potential actions to address these risks. Agencies have also communicated about such risks through reporting and outreach efforts to public health officials and the general public.

Supporting and Conducting Research on or Related to the Risks Climate Change Poses to Public Health

To enhance understanding of the risks that climate change poses to public health, many of the federal agencies included in our review have supported and conducted research on or related to these risks. While governmentwide data on funding for such research is not available, NIH, which awards financial assistance for research, reports that it awarded about \$6 million to support research on the health impacts of climate change in fiscal year 2014.³⁶ This amount comprised a relatively small portion—about 0.025 percent—of the approximately \$24 billion that NIH awarded for research that year. Some of this research originated from an NIH funding opportunity—a solicitation for exploratory research projects on the health impacts of climate change—through which the agency awarded a total of about \$8.3 million for research from fiscal year 2011 through fiscal year 2014 for 21 projects. One of these projects, for

³⁵Additional federal agencies participating in the CCHHG are the U.S. Departments of Agriculture, Defense, Interior, State; EPA; National Aeronautics and Space Administration; the Smithsonian Institution; and the U.S. Agency for International Development.

³⁶Examples of funded projects include a study examining the health risks of heat and air pollution, and a study examining the impacts of extreme heat on inner-city minority children with asthma and older adults with chronic obstructive pulmonary disease.

example, examined the relationship between climate change and pediatric asthma.³⁷ NIH officials told us that the agency has not issued additional funding opportunities for research on climate change. These officials said that they hoped researchers who received awards from this opportunity would be better positioned to submit proposals in the future through NIH's most common submission process, in which researchers submit unsolicited proposals based on the program interests of one or more of the agency's institutes or centers.³⁸

In addition to NIH, other federal agencies, such as the National Aeronautics and Space Administration (NASA), have also conducted or supported research on or related to the risks that climate change poses to public health, including by making awards for relevant research projects and providing financial support for research teams or postdoctoral students conducting relevant work. For example, NASA made an award to aid in the development of climate change indicators related to heat waves in urban areas through its 2012 research announcement entitled "Research Opportunities in Space and Earth Sciences" that intended to, among other things, facilitate the application of scientific knowledge to management decisions.³⁹ Indicators developed through this program may be used by health officials to identify urban areas with increased vulnerabilities to health impacts due to a lack of cooling green spaces and other factors. Additionally, EPA sponsored a review of the effects of climate change on the indoor environment and health, which concluded, among other things, that climate change may worsen existing indoor

³⁷The funding opportunity for exploratory research was issued in 2010 by National Institute of Environmental Health Sciences with the participation of the Fogarty International Center, National Cancer Institute, National Center on Minority Health and Health Disparities, National Heart, Lung, and Blood Institute, National Institute on Aging, National Institute on Biomedical Imaging and Bioengineering, National Institute of Child Health and Human Development, National Institute of General Medical Sciences, National Library of Medicine, and the Office of Behavioral and Social Sciences Research.

³⁸NIH reported awarding a total of about \$28 million for research on the health impacts of climate change for fiscal year 2011 through fiscal year 2014, which includes nearly all of the projects funded through the NIH solicitation for research proposals, as well as other unsolicited research. For this period, NIH also reported awarding about \$579 million for research on exposures or conditions that are related to climate, such as research on melanoma. Because these categories are not mutually exclusive, funding for some research is included in both groups.

³⁹An indicator is an observation or calculation that allows scientists, analysts, decision makers, and others to track environmental trends, understand key factors that influence the environment, and identify effects on ecosystems and society.

environmental problems that are known to exacerbate illnesses such as asthma and allergies, and create new problems that have adverse health impacts.⁴⁰

Officials from some of the federal agencies included in our review told us that while their agencies have conducted or supported research that is useful for advancing understanding of climate change impacts to public health, the link to this topic is often indirect. For example, federally-funded research about health impacts from natural disasters, such as floods, does not always explicitly consider the associated impacts from climate change but can help advance understanding of these impacts, according to federal officials we spoke with. Appendix IV provides additional examples of research on or related to the risks of climate change to public health that some of the federal agencies included in our review have conducted or supported.

Providing Data and Decision Support Resources for Examining Risks

Federal agencies have provided some data and decision support resources—such as guidance and tools—that state and local officials, and others, can use to examine public health-related risks from climate change and potential actions to address these risks. Table 3 provides examples of these data and decision support resources.

⁴⁰Institutes of Medicine, *Climate Change, the Indoor Environment, and Health* (Washington, D.C.: 2011).

Table 3: Examples of Federal Data and Decision Support Resources for Examining the Risks That Climate Change Poses to Public Health

Federal agency	Description of data or decision support resource
Environmental Protection Agency (EPA)	EPA published a software tool in 2010—referred to as the Climate Resilience Evaluation & Awareness Tool—to assist drinking water and wastewater utility owners and operators in understanding and addressing potential climate change risks at their utilities to continue to protect public health, among other reasons.
Department of Health and Human Services (HHS)	In December 2014, HHS published a best practices document to promote resilience of health care facility infrastructure to climate change impacts—primarily from extreme weather events, as part of its Sustainable Climate Resilient Health Care Facilities Initiative. To help users implement the guidance, the agency subsequently published an online toolkit with links to individual tools. In June 2015, HHS released its emPOWER map, an online interactive tool that displays information about vulnerable populations that rely on electricity-dependent medical equipment, to support state, local, and community partner emergency planning and response activities.
National Aeronautics and Space Administration (NASA)	NASA collects data on land surface temperature and other climate-sensitive environmental factors that may affect public health by, among other mechanisms, impacting the range of animals that can transmit harmful diseases to humans. The agency reports some data online and provides other data upon request.
National Oceanic and Atmospheric Administration (NOAA)	NOAA’s National Weather Service and its partners collect environmental data and provide decision support services to aid decision makers in their examination of the potential public health impacts of weather, water, and climate events.
U.S. Global Change Research Program (USGCRP)	In 2013, USGCRP introduced the Metadata Access Tool for Climate and Health, or MATCH, an online clearinghouse that provides links to thousands of government-held datasets related to health, the environment, and climate science.

Source: GAO. | GAO-16-122

Users of these data and decision support resources may include public health officials or decision makers with responsibility for managing systems that are necessary for protecting public health, such as hospital administrators or wastewater management system operators, among others. Other users may include researchers, community organizations, or other interested individuals. The following are two key interagency mechanisms that federal agencies leverage to provide climate and health data and decision support resources to potential users:

- **Data.gov.** In April 2015, data.gov, the federal government’s site for open data, launched a theme page on climate and health that provides information about data sources and tools maintained by federal agencies.⁴¹ The site includes links to data on climate, weather,

⁴¹Executive Order 13653 directed the establishment of a data.gov portal on climate issues. The portal’s theme page on climate and health is available online at <http://www.data.gov/climate/humanhealth/>.

and health from many federal agencies. One data source included on the theme page is CDC's National Environmental Public Health Tracking Network, which includes heat-related health data, including national data on the number of extreme heat days and future projections of extreme heat.⁴² Another data source included on the theme page is NOAA's Climate Data Online, which includes data on precipitation amounts, as well as a mapping tool and other decision support resources.

- **The U.S. Climate Resilience Toolkit.** The toolkit is an online portal that is intended to help individuals, communities (including tribal nations), and others respond to risks from climate change. Human health is one of the topics highlighted in the toolkit.⁴³ One tool available in the toolkit is the Agency for Toxic Substances and Disease Registry's Social Vulnerability Index, which uses U.S. Census Bureau variables to identify communities that may need support in preparing for climate-related or other hazards or recovering from disasters, and includes a mapping feature and downloadable data. Another tool available in the toolkit is a software package developed by EPA that allows users to predict levels of disease-causing pathogens at specific beach sites, where outbreaks can result from climate change-related effects such as warming waters and intense precipitation.⁴⁴

CDC has also developed some decision support resources intended to help state and local public health officials identify and address risks from climate change. In June 2014, CDC officials authored a journal article which described a five-step risk management framework that the agency developed for health officials to use in preparing for the health effects of

⁴²The network—which is part of CDC's National Environmental Public Health Tracking Program—is a system of integrated health, exposure, and hazard information and data from a variety of national, state, and city sources. CDC makes awards to 26 state and local health departments to develop local tracking networks, which feed into the national network.

⁴³The U.S. Climate Resilience Toolkit was developed in 2014 by a partnership of federal agencies and organizations in response to the President's Climate Action Plan and Executive Order 13653. The toolkit's page on human health is available online at <http://toolkit.climate.gov/topics/human-health>.

⁴⁴EPA's tool, Virtual Beach, helps users to predict levels of disease causing pathogens such as *Escherichia coli* and enterococci at freshwater and saltwater beaches.

climate change.⁴⁵ In July 2014, CDC issued a more detailed guide for health departments on how to assess the vulnerability of their constituent populations to the health impacts of climate change—a critical step for health departments in planning for climate change risks to public health, according to CDC.⁴⁶ The guide includes a case study detailing how CDC conducted a vulnerability assessment on heat impacts in the state of Georgia. In addition, CDC’s National Environmental Public Health Tracking Program published a communication toolkit in 2012 that focuses on the relationship among climate change, public health, and extreme heat—which is the only climate change-related area for which the tracking network provides data.⁴⁷ Among other things, the communication toolkit provides health officials and other potential users with key messages and tips for using social media to communicate effectively about this topic.

Communicating through Reporting and Outreach

Federal agencies in our review have communicated information about the risks that climate change poses to public health through reporting and outreach efforts directed at multiple audiences, such as public health officials and the general public. In several key communication efforts, federal agencies have collaborated to report on what is known about these risks. For example, in the third NCA published in May 2014, USGCRP reported on the impacts of climate change on the United States, including risks to human health. The report was the result of a large multiagency effort that included the 13 agencies participating in the USGCRP as well as other agencies that chose to support the production of the report.⁴⁸ It includes a chapter on human health—prepared collaboratively by officials from several federal agencies participating in CHHG, as well as experts from outside the federal government—summarizing what is known about how climate change threatens human health and well-being, populations that are at greatest risk, the extent to

⁴⁵G.D. Marinucci, et al., “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, no. 6 (2014).

⁴⁶Centers for Disease Control and Prevention, *Assessing Health Vulnerability to Climate Change: A Guide for Health Departments* (2014).

⁴⁷The communication toolkit, entitled “Climate Change, Extreme Heat, and Health: A Tool Kit,” is available online at http://ephracking.cdc.gov/docs/CDC_ClimateChange_Final.pdf.

⁴⁸Melillo, Richmond, and Yohe, eds., *Climate Change Impacts in the United States: The Third National Climate Assessment*.

which public health actions can help address these risks, and opportunities to improve human health while combating climate change.⁴⁹ CCHHG is expanding upon this information in a report that is intended to provide a comprehensive, evidence-based, and, where possible, quantitative estimation of observed and projected climate change related health impacts in the United States. The report, referred to as the USGCRP Climate and Health Assessment, is being developed through a multiagency effort and is expected to be finalized in 2016.⁵⁰ The American Public Health Association, with the support of CDC, recently reported on threats that climate change poses to human health, and how state and local public health departments have responded to these threats using CDC resources.⁵¹ In addition to preparing reports, federal agencies have also reported on the risks that climate change poses to public health through their websites and through social media, and federal officials have reported on these risks in peer-reviewed journal articles and other publications.⁵²

Federal agencies have conducted outreach to inform public health officials, as well as the general public, about the risks that climate change poses to public health. Some ways in which federal agencies have recently done so include the following:

- In August 2014, HHS held a departmentwide briefing on climate change risks to public health.⁵³

⁴⁹G. Luber, et al., Ch. 9: Human Health. *Climate Change Impacts in the United States: The Third National Climate Assessment*, J.M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, eds. U.S. Global Change Research Program (Washington, D.C.: U.S. Government Printing Office, 2014).

⁵⁰Additional information about USGCRP's Climate and Health Assessment can be found at <http://www.globalchange.gov/health-assessment>.

⁵¹American Public Health Association, *Adaptation in Action: Grantee Success Stories from CDC's Climate and Health Program* (Washington, D.C.: March 2015).

⁵²For example, CDC's website includes information on climate change effects on health; see <http://www.cdc.gov/climateandhealth/effects/default.htm>. In addition, EPA has posted information about climate impacts to human health to its Facebook page; see <https://www.facebook.com/EPA/videos/vb.39637302228/10152857564172229/?type=2&theater>.

⁵³This briefing is available online at <http://videocast.nih.gov/summary.asp?Live=14490&bhcp=1>.

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- In December 2014, CDC addressed climate change in its Public Health Grand Rounds—a publicly-available webcast that is intended to foster discussion on major public health issues.⁵⁴

In addition, senior officials within HHS and EPA have also conducted outreach on certain occasions about the risks that climate change poses to public health. In April 2015, the Surgeon General spoke publicly about climate change impacts to health following a roundtable discussion on the topic with the President, the EPA Administrator, and others, and also used social media to solicit and respond to questions about health impacts from climate change. The EPA Administrator has also communicated about these risks to a variety of audiences, citing climate change as among the most significant threats to public health.⁵⁵ App. V provides additional information about federal activities related to climate change risks to public health.

State and Local Health Departments Have Used CDC and Other Federal Resources to Address the Risks That Climate Change Poses to Public Health

Selected state and local health departments included in our review have used a CDC climate and health award that addresses the risks that climate change poses to public health, as well as other federal resources, to address and plan for the public health risks from climate change.

⁵⁴This presentation is available online at <http://www.cdc.gov/cdcgrandrounds/archives/2014/december2014.htm>.

⁵⁵EPA, “Speeches by Date,” Administrator Gina McCarthy, *Keynote Remarks at the University of Michigan Environmental Law and Public Health Conference, As Prepared*, <http://yosemite.epa.gov/opa/admpress.nsf/8d49f7ad4bbcf4ef852573590040b7f6/ac6b9218ba9e1e2885257bf2005a41cb!OpenDocument> (accessed April 2, 2015).

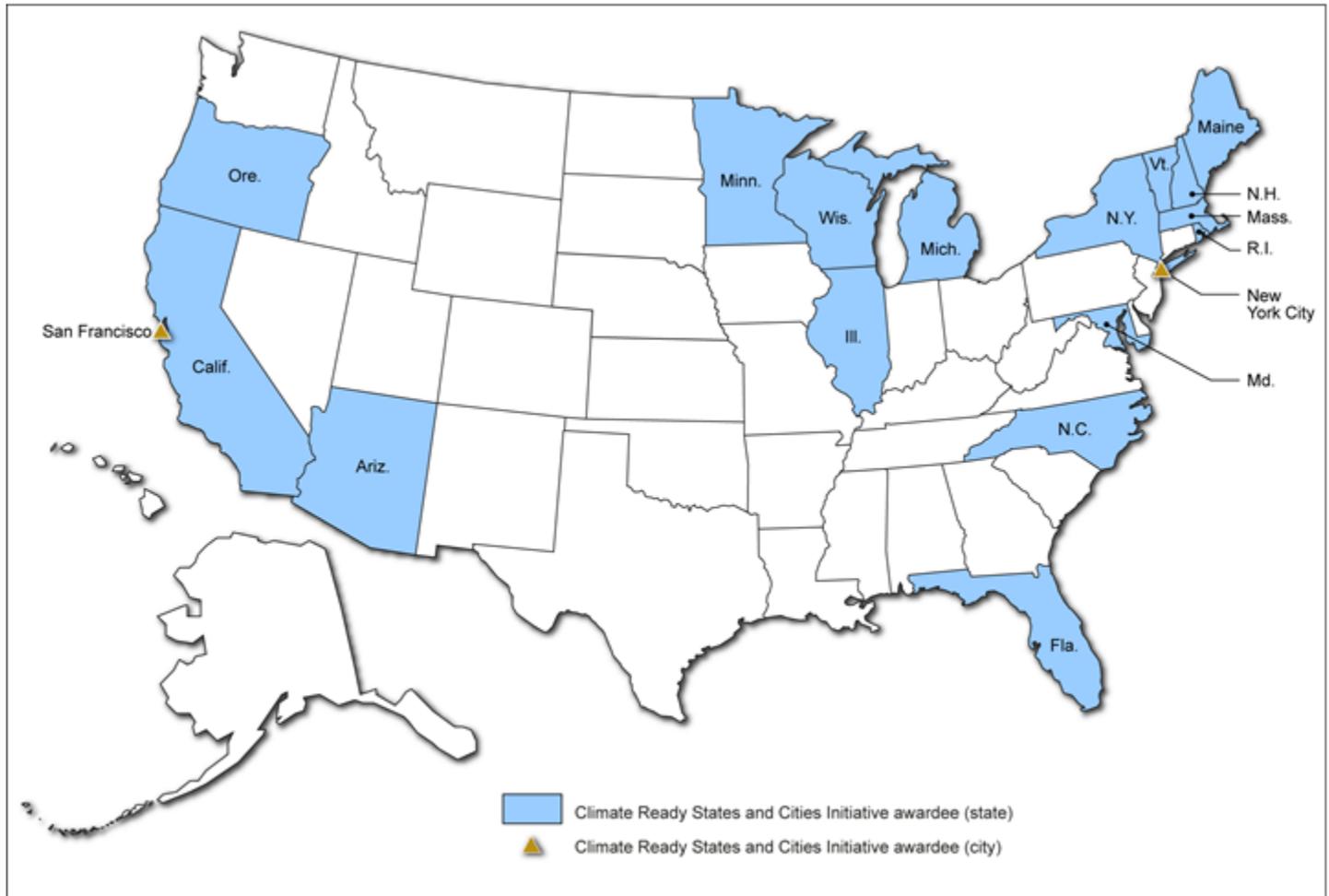
Selected Health Departments Have Used a CDC Award to Directly Address and Plan for the Risks That Climate Change Poses to Public Health

Sixteen state and two local health departments have used awards from CDC's Climate Ready States and Cities Initiative to address and plan for the risks that climate change poses to public health.⁵⁶ The initiative is the federal government's primary investment in supporting state and local health departments in addressing the risks that climate change poses to public health, and is the only HHS financial resource that has been offered to state and local public health departments that directly targets these risks. In fiscal year 2014, Initiative awards to state and local health departments totaled \$3.6 million, with individual awards averaging about \$200,000.⁵⁷ Figure 2 displays Initiative awardees as of fiscal year 2015.

⁵⁶In conducting this work, we spoke with officials from all 18 health departments receiving the award—who we refer to as awardees—about the activities they have conducted related to climate change and public health.

⁵⁷In fiscal year 2014, individual awards ranged from \$173,000 to \$250,000. According to CDC officials, funding for awardees varies by award cycle, as awardees are funded under two cooperative agreement mechanisms—a fiscal year 2012 agreement funded 8 awardees for 4 years, through fiscal year 2016, and a fiscal year 2013 agreement funded 10 awardees for 3 years, through fiscal year 2016.

Figure 2: CDC Climate Ready States and Cities Initiative Awardees, Fiscal Year 2015



Sources: Centers for Disease Control and Prevention; Map Resources (map). | GAO-16-122

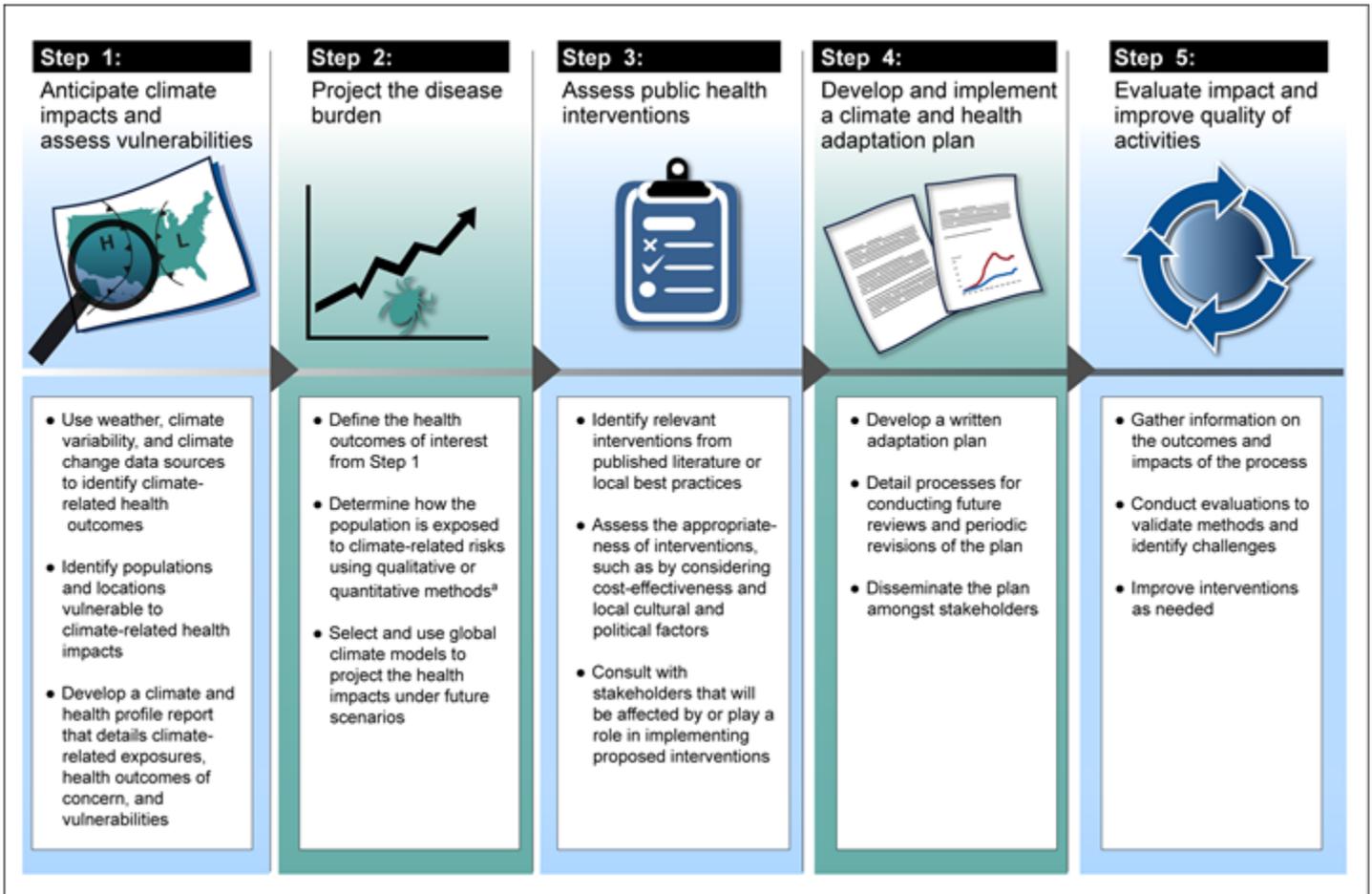
CDC’s Climate and Health Program administers the Climate Ready States and Cities Initiative. Under the initiative, CDC program staff are substantially involved in program activities, above and beyond routine grant monitoring. CDC activities for this program are described as providing ongoing guidance, resources, consultation, technical assistance, and training related to awardee activities.

Under the initiative, CDC requires awardees to implement CDC’s Building Resilience Against Climate Effects (BRACE) framework—a five-step risk management process intended to help public health departments identify

and prepare for the public health impacts of climate change by, among other things, incorporating atmospheric data and climate projections into public health planning. To implement the framework, CDC requires awardees to work with internal and external stakeholders to forecast climate trends, identify disease risks and vulnerable populations, and develop action plans for addressing these risks, among other things. Figure 3 describes the five steps of the framework and provides examples of activities that can be included in its implementation.⁵⁸ CDC officials told us that they developed the BRACE framework to assist state and local health departments in preparing for the public health impacts of climate change. (App. VI provides information on the types of activities undertaken by awardees in implementing the BRACE framework, and app. VII provides information on activities by other selected state and local health departments).

⁵⁸Officials from CDC's Climate and Health Program told us that they make information about the BRACE framework available on the program's website and through a peer-reviewed journal article. See <http://www.cdc.gov/climateandhealth/brace.htm> and G.D. Marinucci, et al., "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, no.6 (2014).

Figure 3: Steps and Examples of Activities Conducted under CDC’s Building Resilience Against Climate Effects Framework



Sources: GAO analysis of Centers for Disease Control and Prevention information and Art Explosion (image). | GAO-16-122

Note: According to CDC officials, the Building Resilience Against Climate Effects (BRACE) framework is iterative and enables the incorporation of learning into future decisions by encouraging users to revisit prior steps to reevaluate risks and management priorities.

Note A: According to CDC, qualitative methods may be used to provide a general impression of how climate change may affect the risk for certain outcomes, at least capturing general climatic trends and environmental exposures, population vulnerability, and expected human health impacts. Quantitative methods may be used, for example, to quantify existing climate and health exposure pathways, or to project disease impacts.

Under the initiative, CDC requires awardees to complete a range of activities that complement their work implementing the BRACE framework. For example, CDC requires that awardees take steps to increase awareness among the public and decision makers about the

risks that climate change poses to public health, making use of available CDC resources.

Awardees provided examples of the types of guidance and support that CDC's Climate and Health Program has provided to assist them in implementing the BRACE framework and addressing climate and health information needs in their jurisdictions. For example, CDC created guidance for awardees on how to develop a Climate and Health Profile—a report detailing a jurisdiction's climate-related exposures, health outcomes of concern, and vulnerabilities of certain populations—a required component of the first step of the BRACE framework. CDC officials told us that they plan to issue guidance describing how to approach each step of the BRACE framework. As of June 2015, CDC has issued two guidance documents on the first step of the framework.⁵⁹ Awardees also told us about other types of support provided by CDC, including tools that CDC developed in response to awardees' specific requests for assistance, such as a database of peer-reviewed literature on climate change and public health impacts and a graphic summarizing the impacts of climate change to public health.⁶⁰ CDC has also organized several communities of practice among awardees as forums to discuss issues related to the implementation of the BRACE framework.⁶¹ According to CDC officials, some public health departments that have not received the Climate Ready States and Cities Initiative award have expressed interest in implementing the BRACE framework, and such departments are able to do so using the resources available on CDC's website.

Although awardees told us that they are in various stages of implementing the framework, they also noted that they have already observed a variety of benefits from the award. Specifically, awardees we spoke with told us that the CDC award has enabled them to work on

⁵⁹See Centers for Disease Control and Prevention, *Climate Models and the Use of Climate Projections: A Brief Overview for Health Departments* (2014), and Centers for Disease Control and Prevention, *Assessing Health Vulnerability to Climate Change: A Guide for Health Departments* (2014).

⁶⁰CDC also makes some of these resources available on its Climate and Health Program website, see http://www.cdc.gov/climateandhealth/site_resources.htm.

⁶¹According to CDC officials, as of May 2015, there are five communities of practice, related to vector-borne diseases, water-borne diseases, conducting vulnerability assessments, developing disease projections, and developing evaluation plans.

climate change and health issues in a formalized way that would otherwise not have been possible given, for example, competing priorities and limited staff time. According to our analysis of awardee reports to CDC, nearly all 18 awardees have created a climate and health program with dedicated staff within their departments to work on this issue, although doing so is not a requirement of the award. Awardees also reported that the program allows them to address specific needs in their jurisdictions and consider certain areas of interest while implementing the framework. For example, some awardees in state health departments told us that they have provided subawards to a small number of local health departments in their jurisdictions to participate in the implementation of the BRACE framework, such as by providing feedback on the usefulness of materials developed by the state, or to develop their own initiatives on or related to climate change and public health. Officials in these states told us that the award allows staff in the local jurisdictions to spend time considering the risks that climate change poses to public health and how these risks may impact existing priorities in their health departments. Additionally, some awardees have identified specific risks that climate change poses to public health and are interested in exploring these issues in further detail. For example, some awardees are examining potential health affects related to climate change impacts on food security—that is, the availability and affordability of nutritious and quality foods.

Furthermore, awardees told us that the CDC award has allowed for their programs to build relationships and engage with partners, such as officials from other departments in their jurisdictions or regional partners from federal agencies, in ways that could not be accomplished without such awards or without a formalized climate and health program. For example, officials from the New York City Department of Health and Mental Hygiene told us that through the department's climate and health program, they worked collaboratively with their regional National Weather Service office to study the appropriateness of the thresholds used to issue heat advisories and warnings. According to these officials, the National Weather Service had been using a Heat Health Watch and Warning System in addition to heat index forecasts to determine when to issue heat advisories and warnings; however, health officials were concerned that this method was not sensitive enough for use in predicting

public health outcomes during excessive heat events.⁶² The health department completed a retrospective study of heat-related deaths to evaluate metrics that could be used to estimate risks, and it found that maximum heat index is a useful metric for assessing public health risks due to hot weather in New York City. The officials said that they have changed the threshold at which warnings are set as a result of this study, and they have continued to develop a working relationship with the National Weather Service.

Selected Health Departments Reported Leveraging Other Federal Resources to Address and Plan for Risks

State and local public health officials we interviewed reported leveraging a variety of other federal resources, including funding and information sources, to address and plan for the risks that climate change poses to public health. In most cases, these federal resources were not specifically designed for addressing and planning for these risks, but the resources could be used in ways that support such efforts. State and local public health officials we interviewed most commonly mentioned leveraging resources provided by CDC's National Environmental Public Health Tracking Program to support their work in addressing and planning for the public health risks of climate change. CDC's Tracking Program made awards to 25 states and one city to develop local tracking networks, analyze data on local environmental exposures and related health outcomes, and supply selected data to a national tracking network.⁶³ The national network includes indicators on climate change, among other environmental hazards, related to extreme heat exposure.⁶⁴ State and local health officials we interviewed reported that this award provides an important core source of funding for data infrastructure and environmental

⁶²According to officials from the New York City Department of Health and Mental Hygiene, a Heat Health Watch and Warning System uses daily forecasts of the dominant local weather pattern to calculate predicted excess deaths from periods of excessive heat based on location-specific historical data.

⁶³CDC's National Environmental Public Health Tracking Network Reporting Tool is available online at <http://ephtracking.cdc.gov/QueryPanel/EPHTNQuery/EPHTQuery.html?c=-1&i=-1&m=-1>.

⁶⁴Specifically, these indicators use historical weather and health data to identify extreme temperatures, extreme heat days and events, deaths that might be related to heat, and conditions that make people vulnerable to heat. They also project future extreme heat events to help estimate the burden of heat-related illness in the next century. Data for these indicators and associated measures are available at the national, state, or county level, depending on the indicator and measure. According to CDC officials, the program is planning to adopt additional climate change-related indicators in the future.

health surveillance activities in their jurisdictions, which can be leveraged to include activities such as monitoring patterns of heat-related illness. Awards provided to state and local health departments for the tracking program vary; in fiscal year 2014, awards totaled \$22.6 million to participating states and localities, ranging from about \$500,000 to \$1.2 million, with an average award of about \$870,000.⁶⁵

State and local health officials also provided examples of how their jurisdictions have leveraged funding resources from other CDC programs to address and plan for the risks that climate change poses to public health. For example, state and local health officials told us that they have leveraged awards from CDC's Public Health Emergency Preparedness program—which provides state, local, tribal, and territorial health departments across the country with resources to build public health preparedness capabilities—to help consider climate change in emergency preparedness planning or develop systems that can be used to monitor climate-related public health risks. Awards provided to state and local health departments vary; in fiscal year 2014, for example, awards ranged from \$325,000 to approximately \$42.5 million, with an average award of approximately \$9.9 million and a total of about \$611.8 million.⁶⁶ Climate change is not a specific focus of the program, but CDC officials responsible for administering this program told us that awardees have flexibility in determining how to use the funds while meeting CDC's requirements.⁶⁷ State health officials also told us that they have used awards from CDC's National Institute for Occupational Safety and Health to consider the impacts of climate change on worker safety and health, such as by monitoring heat-related illnesses and deaths among worker

⁶⁵The program made 26 awards to state and local programs in fiscal year 2014 for a 3-year award cycle. Thirteen of the 18 Climate Ready States and Cities Initiative awardees also received National Environmental Public Health Tracking Network awards in fiscal year 2015.

⁶⁶CDC's Public Health Emergency Preparedness program makes awards to public health departments in all 50 states, four major metropolitan areas (Chicago, Los Angeles County, New York City and Washington, D.C.), and eight U.S. territories and freely associated states (American Samoa, Guam, U.S. Virgin Islands, Northern Mariana Islands, Puerto Rico, Federated States of Micronesia, Republic of the Marshall Islands, and Republic of Palau).

⁶⁷Specifically, awardees are required to build and sustain their public health preparedness capabilities according to standards developed by CDC. Awardees are also required to review their preparedness status annually by using information from a variety of sources, such as jurisdictional risk assessments.

populations or specific industries.⁶⁸ Officials from the National Institute for Occupational Safety and Health also noted that, while climate change is not a specific focus of the program, the award could be used to support activities in this area.

Some public health officials we interviewed also reported leveraging federal resources from agencies other than from CDC to address or consider the risks that climate change poses to public health. Specifically, officials provided examples of other awards and informational resources that they had used in their work on this issue. For example, an official from one state told us that the state used an award from U.S. Geological Survey to assess the vulnerability and health risks of the state's watersheds to flooding and drought under a changing climate. Some state and local health officials reported using the health and regional chapters of USGCRP's third NCA as key sources of information. Some officials also told us that they have relied on a variety of NOAA information resources, such as those provided through NOAA's National Centers for Environmental Information or through NOAA-funded Regional Integrated Sciences and Assessment teams.⁶⁹ For example, one state health official told us that the state has relied on support from a NOAA Regional Integrated Sciences and Assessment team to translate technical information about climate change. In conducting work to address the risks that climate change poses to public health, local health officials from one jurisdiction also provided an example of using demographic information from the American Community Survey—an official U.S. Census Bureau survey that is part of the Decennial Census Program—to identify populations in its locality that are vulnerable to the health-related impacts of climate change.

⁶⁸Through its State-Based Occupational Health and Safety Surveillance program, the National Institute for Occupational Safety and Health provides awards to 23 states to collect data on occupational safety and health hazards and effects, identify new sources of occupational safety and health data, conduct surveillance, interpret findings, and develop or recommend related interventions. According to officials from the National Institute for Occupational Safety and Health, the program awarded nearly \$6.5 million to state health departments in fiscal year 2014, with individual awards ranging from about \$100,000 to nearly \$900,000. Twelve of the 18 Climate Ready States and Cities Initiative awardees were also awardees of the State-Based Occupational Health and Safety Surveillance program in fiscal year 2014.

⁶⁹NOAA's Regional Integrated Sciences and Assessment teams are university-based research partnerships that help build the nation's capacity to prepare for and adapt to climate variability and change.

State and Local Health Officials Identified Multiple Challenges, Some of Which They Said Could Be Addressed by Federal Action

When asked to identify challenges related to their work planning for and addressing the risks that climate change poses to public health, state and local public health officials we interviewed identified challenges that we grouped into the three most frequently reported themes, noting that some of these challenges could be addressed by federal action, while others could not. According to state and local officials, they face challenges communicating about the risks that climate change poses to public health. Officials identified related opportunities for federal agencies to enhance public understanding of these risks. The officials also stated that they face challenges in identifying potential health risks of climate change, for example, as a result of research gaps. Officials said that federal agencies may be able to address this challenge by continuing to advance research and enhance decision support resources. Finally, state and local public health officials said they face other challenges that federal action may not be able to address, such as having insufficient data on health impacts in areas where agreements between states and hospitals limit access by health departments.

Selected Health Officials Face Challenges Communicating about the Risks That Climate Change Poses to Public Health and Identified Opportunities for Federal Action

According to our discussions with selected state and local health officials, officials face challenges communicating about the risks that climate change poses to public health, in part because of limited awareness about climate change as a public health issue. The officials also identified opportunities for federal agencies to address these communication challenges.

Challenges Identified

Selected state and local health officials told us during interviews, site visits, and small group discussion sessions that they face challenges resulting from limited awareness about climate change as a public health issue within their own health departments, among other state and local partners, such as other agencies in their jurisdictions, and among the public. As we have previously found, public awareness can play an important role in the prioritization of climate change adaptation efforts.⁷⁰ In

⁷⁰GAO, *Climate Change Adaptation: Strategic Federal Planning Could Help Government Officials Make More Informed Decisions*, [GAO-10-113](#) (Washington, D.C.: Oct. 7, 2009).

addition, if public health officials are aware of the risks that climate change poses to public health, they can better assess the importance of these risks and allocate resources appropriately. However, health department leadership and staff are often not aware of the public health impacts of climate change, or do not understand how the issue fits into the health department's priorities, according to state and local health officials.⁷¹ This observation is consistent with results from a 2012 NACCHO survey of 174 local health department officials, which showed that just over one-third of respondents thought that other relevant senior managers in their health departments were knowledgeable about the potential public health impacts of climate change.⁷²

Some local health officials also reported that officials from other sectors of government in their jurisdictions, such as environmental agencies responsible for climate change adaptation planning efforts, have a limited awareness of climate change as a public health issue. This has resulted in health officials having limited involvement in climate change adaptation planning within their localities, according to officials we interviewed. Some officials believe that progress has been made in this area in recent years, but, according to our review of a 2014 analysis of states' climate change adaptation planning activities, only about one-quarter of all states have incorporated public health considerations into their statewide climate change adaptation plans.⁷³

In addition, health officials told us that stakeholders and the public have limited awareness about climate change as a public health issue, in part because climate change has historically been framed as an environmental issue. State and local health officials discussed climate change impacts on health as an emerging issue that they became aware of within the last decade, in part as a result of educational efforts of the American Public Health Association. In 2008, for example, the association

⁷¹Some awardees of CDC's Climate Ready States and Cities Initiative told us that they have begun to provide briefings or trainings on climate and health issues for departmental staff.

⁷²National Association of County and City Health Officials. *Are We Ready? Report 2 Preparing for the Public Health Challenges of Climate Change* (Washington, D.C.: 2014).

⁷³According to our review of this analysis, 22 states have finalized climate change adaptation plans or have such planning underway. See Georgetown Climate Center, *State and Local Adaptation Plans*, <http://www.georgetownclimate.org/adaptation/state-and-local-plans> (accessed May 15, 2015).

made climate change a focus of its National Public Health Week, issuing communications to highlight climate change as a public health issue.⁷⁴

State and local health officials also told us that they face challenges in communicating or enhancing awareness about projected changes to local climate that can impact public health because of the complexity of the issue.⁷⁵ Specifically, officials told us that it is difficult to develop messages about climate change impacts on health because of uncertainties inherent in climate change projections. For example, officials from one state health department told us that the state has faced challenges describing climate projections for its jurisdiction in a way that is accurate but not overly technical, while adequately acknowledging the uncertainties of these projections. State and local health officials also said that it is challenging for them to communicate about the risks that climate change poses to public health because some of the potential effects have not yet been observed in their jurisdictions and, therefore, are not perceived by the public as risks. For example, officials in some states that do not frequently experience heat waves told us that they face challenges convincing their constituents that the risks of heat-related illnesses will increase. Officials told us that they have used a variety of strategies to attempt to interest their constituents and stakeholders in these risks, such as framing the issue as planning for emergency preparedness or severe weather events. However, state and local health officials find it difficult to communicate and bring attention to long-term issues, such as climate change, when

⁷⁴See American Public Health Association, *Climate Change Is a Public Health Issue* (Washington, D.C.: 2008), and American Public Health Association, *Climate Change: Our Health in the Balance. National Public Health Week 2008 Partner Toolkit* (Washington, D.C.: 2008).

⁷⁵In our previous work on climate change adaptation, we also found that climate change adaptation is a complicated issue to communicate with the public because the impacts vary by location and may occur well into the future. See [GAO-10-113](#).

there are more immediate public health concerns drawing attention, such as the 2014 Ebola virus outbreak.⁷⁶

Opportunities Identified

State and local health officials, as well as representatives from associations representing these officials, identified opportunities for federal action to help address challenges the officials face in communicating about the risks that climate change poses to public health. These opportunities were generally in two areas: enhancing public awareness on climate change as a public health issue, and providing guidance and tools on how to communicate about this issue.

Concerning enhancing public awareness, state and local health officials, as well as representatives from associations representing these officials, told us that federal agencies could help address this challenge by taking a sustained leadership role in enhancing public and stakeholder awareness and understanding. Specifically, officials told us that a federally-led public awareness campaign on this issue could assist in informing decision makers and the public. They also said a campaign could help and provide legitimacy to the work of public health officials in addressing and planning for these risks. Officials particularly pointed to the need for a sustained leadership role from HHS and its component agencies, which could draw on the department's experience from engaging in previous successful public health campaigns, such as the campaign to reduce tobacco use. In a November 2014 report, the President's State, Local, and Tribal Task Force on Climate Preparedness and Resilience also recommended actions that federal agencies should take to increase climate literacy and public awareness, among other things.⁷⁷ These actions included coordinating federal communications on climate change to develop clear, consistent and unified messages, and ensuring that communications

⁷⁶While Ebola did not present a significant risk to the U.S. public, two imported cases, and two locally acquired cases in health care workers were reported in the United States. According to ASTHO and NACCHO, state and local health departments worked to enhance preparedness in their jurisdictions, including by collaborating with health care providers in their jurisdictions to ensure they had adequate information on screening, isolating, and diagnosing potential patients, reiterating the importance of infection control procedures for health care givers, working with laboratories to provide guidance on safe handling of specimens, and creating and providing timely and consistent messages for the public about the disease.

⁷⁷President's State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience, *Recommendations to the President* (Washington, D.C.: Nov. 17, 2014). The task force was established by Executive Order 13653.

resources are accessible to state and local governments. (See app. VII for a summary of the task force’s health-related recommendations.)

Federal officials, including those from HHS, told us that they are taking steps to enhance public awareness. For example, as previously mentioned, the White House held a climate change and health summit in June 2015, which included the participation of the U.S. Surgeon General, the HHS Assistant Secretary for Preparedness and Response, and the EPA Administrator. In addition, CDC officials told us that through awards the agency provides, the FrameWorks Institute is developing a series of fact sheets for the general public that explain various impacts of climate change on human health.⁷⁸ In its 2014 Climate Adaptation Plan, HHS reported that it considers climate change to be one of the top public health challenges of our time, and it noted that its Office of the Assistant Secretary for Health will develop a climate change communication and outreach strategy to, among other things, promote outreach and awareness among its stakeholders about climate change and its impact on public health.⁷⁹ The plan further notes that outreach and communication to at-risk populations will be a significant part of this strategy, and that the department will leverage its comprehensive network of stakeholders involved in the receipt or delivery of health and human services to disseminate climate change and health information. HHS reported in its Strategic Sustainability Performance Plan that the strategy was to be developed by the fall of 2014.⁸⁰ In March 2015, a senior HHS official from the HHS component responsible for developing this strategy told us that limited progress had been made in developing the strategy, and that the strategy was not anticipated to be formalized in a written

⁷⁸The FrameWorks Institute is an independent nonprofit organization with a mission of advancing the nonprofit sector’s communications capacity by identifying, translating and modeling relevant scholarly research for framing the public discourse about social problems. As of August 11, 2015, these fact sheets had not yet been finalized. CDC is providing funding for this effort through a cooperative agreement with the American Public Health Association.

⁷⁹See HHS, *HHS Climate Adaptation Plan 2014* (Washington, D.C., July 3, 2014), p.7. A senior HHS official from HHS component responsible for developing this strategy also told us that the strategy is intended to have multiple goals, including communicating to the general public on the risks that climate change poses to public health, as well as multiple audiences such as health care providers, public health officials, and other decision makers.

⁸⁰See HHS, *Strategic Sustainability Performance Plan* (Washington, D.C.; July 17, 2014), p.50.

document. However, in July 2015, HHS officials told us that they plan to refine and document the strategy over the next 12 months.

Concerning guidance and tools, state and local health officials, as well as a representative from an association representing them told us it would be helpful if federal agencies, including CDC, developed communications guidance on a number of topics. For example, they said they could benefit from guidance on how to frame climate change as a public health issue or communicate based on best practices from the social sciences. They also suggested the development of communication tools, such as talking points or training on how to communicate about this issue. Because protecting public health requires the participation of a variety of stakeholders—including state and local public health departments and other state and local entities—enhancing stakeholder awareness and understanding about climate change as a public health issue could bolster state and local preparedness for the risks that climate change poses. In addition, as noted earlier in this report, enhancing awareness among the public and decision makers about the risks that climate change poses to health is a requirement of the Climate Ready States and Cities Initiative. According to state and local health officials, including Initiative awardees, communication guidance and tools would help them enhance stakeholder awareness and understanding of the risks climate change poses to public health.

CDC has developed limited guidance regarding communicating the risks that climate change poses to public health for state and local health officials. CDC has developed a toolkit related to communicating the connections between climate change, extreme heat, and health. However, the content of this document is focused on how awardees and partners of the National Environmental Public Health Tracking Network can use Tracking Network data to communicate about this issue, and is therefore not as applicable to a wider audience.⁸¹ CDC officials were not aware of any other agency guidance documents on communicating about

⁸¹Centers for Disease Control and Prevention, *Climate Change, Extreme Heat, and Health: A Tool Kit*, http://ephtracking.cdc.gov/docs/CDC_ClimateChange_Final.pdf (accessed May 1, 2015).

the risks climate change poses to public health.⁸² Officials from CDC's Climate and Health Program acknowledged that a commitment to communicating about the risks that climate change poses to public health is needed, and they identified some actions to help Climate Ready States and Cities Initiative awardees address this challenge, such as reviewing and sharing research findings on best practices for communicating about climate change and providing technical assistance to state and local health departments regarding communication upon their request. However, these officials also told us that they do not currently have plans to develop communication guidance for state and local health departments on how to communicate about climate change because they do not have the resources or capacity to develop such guidance at this time. CDC officials told us that they have been focusing on assisting awardees with resolving methodological and data issues related to implementing the BRACE framework, such as identifying models for use in developing projections of climate change in their jurisdictions.

As we noted earlier, the agency's Climate and Health Program supports state and local health department efforts to plan for and address the health risks posed by climate change. CDC's website states that the program's core functions involve translating climate change science to inform health departments and communities, serving as a credible leader in planning for the public health impacts of climate change, and creating decision support resources to assist officials in preparing for climate change.⁸³ As the administrator of the Climate Ready States and Cities Initiative, CDC is to provide ongoing guidance, resources, and technical assistance, among other things, related to awardee activities. Because CDC requires that awardees of this initiative take steps to enhance public awareness of the risks that climate change poses to human health, developing communications guidance would support their efforts. While CDC's current resources are focused on addressing methodological and

⁸²CDC has issued a document that describes the risks posed by extreme heat events, and includes some information that could be used in developing communications to the public about heat. However, this document is not focused on how to communicate on a broader level about the risks climate change poses to public health. Centers for Disease Control and Prevention, *Climate Change and Extreme Heat Events*, <http://www.cdc.gov/climateandhealth/pubs/ClimateChangeandExtremeHeatEvents.pdf> (accessed July 16, 2015).

⁸³The program has also identified priority actions to meet these core functions, such as communicating the health-related aspects of climate change, including risks and ways to reduce those risks, to the public, decision makers, and healthcare providers.

data issues related to the implementation of the BRACE framework, it is also critical for the agency to establish a plan describing when it will develop future communications guidance, to help ensure that health officials have the tools they need to effectively implement the BRACE framework and address required aspects of the award.

Selected Health Officials Face Challenges Identifying Potential Health Risks of Climate Change and Identified Opportunities for Federal Action

According to our discussions with selected state and local health officials, they face challenges identifying potential health risks from climate change and have identified related opportunities for federal action. Specifically, officials noted how gaps in research have made it difficult for them to understand and plan for potential health impacts. For example, some state and local public health officials said that limited research has been conducted on how climate change may affect certain aspects of public health, such as the spread of vector-borne diseases, the costs of climate change impacts on human health, and the effectiveness of specific management options. Other officials we interviewed told us that they had difficulty using some of the climate-related data that federal agencies have made available for decision makers. Officials we interviewed explained that they typically do not have the scientific or technical expertise to fully understand or use some federal data, particularly those related to climatology. Public health officials have generally not been trained in using geographic information systems, atmospheric data, and climate projections, according to officials.⁸⁴ In addition, conducting analyses with these data can be complex and time-intensive. Consequently, they said that the availability of technical assistance in using such data, as well as in translating the results so that officials can apply them at the local level, has been very helpful.⁸⁵

State and local public health officials we interviewed said that federal agencies could help address these challenges by continuing to advance the research they support, and by enhancing decision support resources,

⁸⁴According to HHS officials, geographic information systems can be used to overlay public health disease data with climatic datasets, such as temperature and precipitation information, to determine if associations exist.

⁸⁵We previously reported that future federal adaptation efforts could better focus on providing local climate change assistance, including with regard to translating climate data for decision makers. See GAO, *Climate Change: Future Federal Adaptation Efforts Could Better Support Local Infrastructure Decision Makers*, [GAO-13-242](#) (Washington, D.C.: Apr. 12, 2013).

including resources to assist decision makers in using federal datasets. State officials noted that an expansion of interagency research opportunities on the public health impacts of climate change, which is a crosscutting research area, could be helpful. State and local public health officials we interviewed said that federal agencies could also enhance the decision support resources they provide, including through technical assistance that would better position public health departments to effectively use available datasets. For example, a Climate Ready States and Cities Initiative awardee said that it would be helpful if CDC could provide awardees with programming language to assist them in using federal datasets to assess health vulnerabilities associated with climate change.

Officials from federal agencies told us about actions that they have taken or that they have planned that could help address some of these challenges. Specifically, federal officials have acknowledged the need for additional research on the public health impacts of climate change and have taken some steps to fill those needs. In 2010, an ad hoc interagency working group on climate change and health developed a white paper summarizing research needs on the human health effects of climate change.⁸⁶ The intent of this paper was to provide a baseline picture of research needs in this area that agencies could then build upon as new information became available, according to the paper. Subsequently, NIH officials analyzed the agency's portfolio of research on climate change and health, and summarized their results in an article published in 2013.⁸⁷ The article includes a discussion of challenges related to conducting this research and opportunities to advance the research, including opportunities to take a multidisciplinary approach through enhanced interagency research opportunities.⁸⁸ More recently, in an April 2015 *Federal Register* notice, EPA, on behalf of USGCRP, announced that a

⁸⁶Interagency Working Group on Climate Change and Health, *A Human Health Perspective on Climate Change: A Report Outlining the Research Needs on the Human Health Effects of Climate Change*.

⁸⁷C. Jessup, et al., "Climate Change, Human Health, and Biomedical Research: Analysis of the National Institutes of Health Research Portfolio," *Environmental Health Perspectives* 121, no. 4 (2013).

⁸⁸Among other things, the authors noted that research in this area requires multidisciplinary teams that can include meteorologists, climatologists, mathematicians, statisticians, computational scientists, and a diversity of health scientists, and most researchers are not cross-trained to meet these needs.

draft of the CCHHG assessment of climate change impacts on health was available for comment.⁸⁹ According to the CCHHG co-chairs, the report contains results that should advance the research in some needed areas, and is likely to include some information on research needs. The CCHHG co-chairs told us that they hope to use information on research needs included in the final assessment to help inform the development of a prioritized and focused research agenda for use in addressing research needs. CCHHG officials also told that they would like to continue to help foster a collaborative interagency approach to researching climate change impacts on health.

Federal agencies, such as HHS, EPA, and NOAA, have also recently taken steps to enhance data and decision support resources available to state and local decision makers, for example, by enhancing air quality surveillance and creating a national heat health information system. These enhanced resources may address some needs of state and local decision makers. CCHHG officials said that they have plans to solicit feedback from state and local decision makers about these enhanced decision support resources through town hall meetings and other mechanisms.

Selected State and Local Health Officials Face Other Challenges That Federal Action May Not Be Able to Address

According to selected state and local public health officials we interviewed, they face a range of other challenges related to planning for and addressing the health impacts of climate change that federal action may not be able to address. For example, they said that insufficient data and inadequate resources impede their ability to address or plan for these risks. While some federal programs collect local data and provide financial resources to selected states and localities, such as CDC's National Environmental Public Health Tracking Program, the federal government does not collect local data on climate impacts or health outcomes in all locations, and does not make awards to support the climate and health activities of all state and local health departments.

⁸⁹The goals of the assessment, which is expected to be finalized in 2016, are to summarize the state of the science for climate change impacts to health, and to quantitatively assess observed and projected impacts for selected impacts. Release of this report and other federal actions discussed here were taken after we met with and obtained most information from state and local public health officials for this report. 80 Fed. Reg. 18619 (Apr. 7, 2015).

State and local public health officials told us that some environmental surveillance data that could help inform research on the health risks of climate change—such as data on air quality, water quality, and pollen—are often not collected by their states and localities given limited surveillance systems. Additionally, state and local officials explained that some health outcome data can be difficult to obtain. State officials explained that their access to health outcome data, such as the medical conditions cited for emergency room visits, is limited by agreements that states have with hospitals regarding the amount and type of information that hospitals will share with state officials.

Some state and local officials told us that their health departments did not have dedicated staff or funding to address and plan for climate change impacts or that their staff resources and funding were not sufficient for maintaining the ideal quality or quantity of work in this area. These statements are consistent with findings from NACCHO's 2012 survey of local health department officials, in which less than 10 percent of respondents said that their health departments had sufficient resources to effectively protect local residents from the health impacts of climate change, and less than 20 percent of respondents said their health departments had sufficient expertise to assess the potential impacts from climate change.⁹⁰

Conclusions

Federal agencies have taken steps to enhance understanding about the risks of climate change to public health. They have also supported state and local efforts to address and plan for these risks, in keeping with an executive order that calls on federal agencies to provide them with data, information, and decision support tools on climate preparedness and resilience. Nevertheless, state and local officials face challenges resulting from limited awareness of climate change as a public health issue among their own departments and the public. As we have previously found, public awareness can play an important role in the prioritization of work on climate change. HHS has acknowledged climate change as one of the top public health challenges of our time and is developing a climate change communication and outreach strategy, which has been delayed by over a year, but is expected to be finalized by July 2016.

⁹⁰National Association of County and City Health Officials. *Are We Ready? Report 2 Preparing for the Public Health Challenges of Climate Change* (Washington, D.C.: 2014).

CDC requires public health departments participating in its Climate Ready States and Cities Initiative to take steps to raise public awareness about the risks that climate change poses to public health, and also engage stakeholders in their planning. As the administrator of the Climate Ready States and Cities Initiative, CDC is to provide ongoing guidance, resources, and technical assistance to support state and local health department work on this issue. Although the agency has provided guidance on some topics, such as extreme heat events, it has not provided specific guidance on how public health departments should communicate about the risks that climate change poses to public health. Officials from CDC's Climate and Health Program acknowledged that a commitment to communicating about the risks that climate change poses to public health is needed. However, the agency does not currently have plans to develop guidance on this topic, as it has been focused on other priorities. Issuing such guidance would also be in line with the core functions of CDC's Climate and Health Program, which include translating climate change science to inform communities. By developing such guidance, CDC may help public health departments better meet the requirements of the Climate Ready States and Cities Initiative and better position all health departments to make progress in planning for the health impacts of climate change.

Recommendation for Executive Action

To enhance HHS's ability to protect public health from the impacts of climate change, we recommend that the Secretary of HHS direct CDC to develop a plan describing when it will be able to issue climate change communication guidance to state and local health departments, to better position relevant officials to effectively communicate about the risks that climate change poses to public health and address requirements of the Climate Ready States and Cities Initiative.

Agency Comments and Our Evaluation

We provided a draft of this product to HHS, EPA, NOAA, USGCRP, the Council on Environmental Quality, the Department of the Interior, and the National Science Foundation for comment. In its written comments, reproduced in appendix IX, HHS stated that CDC generally concurred with our recommendation. CDC noted its plans to develop and issue climate change communication guidance to state and local health departments after HHS finalizes its climate change communication and outreach strategy, which is expected by July 2016. CDC stated that it would use HHS's strategy to inform their development of guidance, and to build off of the same strategy. CDC said that the agency currently provides support and technical assistance to state and local health

departments regarding communication upon their request, and would continue to do so while HHS finalizes its strategy. CDC remarked that the agency is also working with partner and professional organizations to disseminate messages on the health impacts of climate change.

We also received technical comments from HHS, EPA, NOAA, USGCRP, the Council on Environmental Quality, the Department of the Interior, and the National Science Foundation, which we incorporated as appropriate

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies to the appropriate congressional committees; the Secretaries of Agriculture, Commerce, Defense, Health and Human Services, Homeland Security, the Interior, and the Smithsonian Institution; the Administrators of the Environmental Protection Agency and the National Aeronautics and Space Administration; the Director of the National Science Foundation; the Executive Director of the United States Global Change Research Program; and the Managing Director of the Council on Environmental Quality; as well as other interested parties. In addition, the report will be available at no charge on the GAO website at <http://www.gao.gov>.

If you or your staff members have any questions about this report, please contact J. Alfredo Gómez at (202) 512-3841 or gomezj@gao.gov, or Marcia Crosse at (202) 512-7114 or crossem@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix X.



J. Alfredo Gómez
Director, Natural Resources and Environment



Marcia Crosse
Director, Health Care

List of Requesters

The Honorable Barbara Boxer
Ranking Member
Committee on Environment and Public Works
United States Senate

The Honorable Patty Murray
Ranking Member
Committee on Health, Education, Labor, and Pensions
United States Senate

The Honorable Bernard Sanders
Ranking Member
Subcommittee on Primary Health and Retirement Security
Committee on Health, Education, Labor, and Pensions
United States Senate

The Honorable Michael F. Bennet
United States Senate

The Honorable Benjamin L. Cardin
United States Senate

The Honorable Al Franken
United States Senate

The Honorable Kirsten E. Gillibrand
United States Senate

The Honorable Martin Heinrich
United States Senate

The Honorable Robert Menendez
United States Senate

The Honorable Jack Reed
United States Senate

The Honorable Brian Schatz
United States Senate

The Honorable Jeanne Shaheen
United States Senate

The Honorable Tom Udall
United States Senate

The Honorable Elizabeth Warren
United States Senate

The Honorable Sheldon Whitehouse
United States Senate

Appendix I: List of Agencies and Stakeholders Interviewed

We interviewed officials from federal, state, and local government agencies, as well as representatives of stakeholder groups involved in public health and climate change.

Government Agencies

Federal Agencies and Entities

- 1) Department of Commerce, National Oceanic and Atmospheric Administration
- 2) Department of Defense, Defense Health Agency
- 3) Department of Health and Human Services
 - a) Office of the Assistant Secretary for Preparedness and Response
 - b) Centers for Disease Control and Prevention
 - c) Indian Health Service
 - d) National Institutes of Health
 - e) Office of the Assistant Secretary for Health
- 4) Department of Homeland Security
 - a) Federal Emergency Management Agency
 - b) Office of Health Affairs
- 5) Department of the Interior
 - a) Bureau of Indian Affairs
 - b) Office of Insular Affairs
 - c) U.S. Geological Survey
- 6) Environmental Protection Agency
- 7) National Aeronautic and Space Administration
- 8) National Science Foundation
- 9) Smithsonian Institution

10) United States Department of Agriculture

- a) Agricultural Marketing Service
- b) Animal and Plant Health Inspection Service
- c) Agricultural Research Service
- d) National Institute of Food and Agriculture
- e) Economic Research Service
- f) Forest Service
- g) Natural Resources Conservation Service
- h) Office of the Chief Economist

11) United States Global Change Research Program

12) Council on Environmental Quality

**State Public Health
Departments**

- 1. Alaska
- 2. Arizona
- 3. California
- 4. Florida
- 5. Hawaii
- 6. Illinois
- 7. Louisiana
- 8. Maine
- 9. Maryland
- 10. Massachusetts
- 11. Michigan
- 12. Minnesota
- 13. New Hampshire
- 14. New York
- 15. North Carolina

16. Oregon
17. Rhode Island
18. Utah
19. Vermont
20. Washington
21. Wisconsin

Local Public Health Departments

1. Baltimore (MD)
2. Benton County (OR)
3. Columbus (OH)
4. Dallas County (TX)
5. Houston (TX)
6. Multnomah County (OR)
7. New York City (NY)
8. Portsmouth (VA)
9. Salt Lake County (UT)
10. San Diego County (CA)
11. San Francisco (CA)
12. San Luis Obispo County (CA)
13. Shelby County (TN)
14. Summit County (OH)
15. Toledo-Lucas County (OH)
16. Washington County (MD)
17. Wicomico County (MD)

Stakeholder Groups

1. American Lung Association
2. American Public Health Association
3. Association of State and Territorial Health Officials
4. Council of State and Territorial Epidemiologists
5. George Mason University Center for Climate Change Communication
6. Georgetown Climate Center

-
7. Health Care Without Harm
 8. National Association of County and City Health Officials
 9. National Resources Defense Council
 10. Public Health Institute
 11. Trust for America's Health
 12. Yale Climate and Energy Institute
 13. Selected Lead Authors of the Third National Climate Assessment's
Chapter on Human Health¹

¹Each of the individual chapters of the third National Climate Assessment were developed by a team of convening lead authors and lead authors.

Appendix II: Summary of Actions Announced by the Administration in April 2015 to Address the Health Impacts of Climate Change

In April 2015, the administration announced a series of actions and commitments that were intended to enhance the nation's ability to understand, communicate, and reduce the health impacts of climate change.¹ Specifically, the administration announced the following 12 actions that it plans to take to address this issue:

1. hosting a climate change and health summit at the White House;
2. issuing a report highlighting actions taken by state and local leaders to reduce the impact of climate change on public health;²
3. releasing a health care facilities toolkit consisting of fact sheets, checklists, case studies, and other resources to assist local decision makers in promoting resilient health care infrastructure;³
4. circulating a draft climate and health assessment report that is intended to synthesize the best available information on the public health impacts of climate change;⁴
5. holding a community, culture, and mental health workshop to identify factors that enhance resilience to climate change;
6. integrating climate considerations into the Department of the Interior's health and safety policies;
7. hosting a climate and health data challenge, whereby coders, analysts, and researchers will use available government datasets to generate insights into unresolved questions about the health impacts of climate change;
8. offer climate and health data to participants during the national day of civic hacking (June 6, 2015) to encourage participants to develop new climate and health solutions;

¹The White House, "Administration Announces Actions To Protect Communities From The Impacts Of Climate Change" (Washington, D.C.: Apr. 7, 2015).

²American Public Health Association, *Adaptation in Action: Grantee Success Stories from CDC's Climate and Health Program* (Washington, D.C.: March 2015).

³The Sustainable and Climate Resilient Health Care Facilities Toolkit is available online at <http://toolkit.climate.gov/tool/sustainable-and-climate-resilient-health-care-facilities-toolkit>.

⁴The draft assessment report was published for public comment in April 2015. 80 Fed. Reg. 18619 (Apr. 7, 2015).

9. improving air quality data with the Environmental Protection Agency's release of six new village green stations that measure air quality and meteorological data;
10. challenging researchers to develop new models to forecast epidemics of dengue and other infectious diseases through the consolidation of federal and nonfederal data sets;
11. awarding prizes to those who have developed predictive modeling capabilities that can assist government and health organizations to predict the spread of chikungunya, a vector-borne disease; and
12. measuring nutrient pollution through a competition whereby federal datasets are leveraged to develop educational and decision support resources.

Additionally, the administration announced that it has secured commitments with 14 businesses and other organizations to collect and share data regarding the health impacts of climate change. For example, Microsoft has committed to improve vector-borne disease surveillance capabilities by developing and deploying drones that are capable of collecting large amounts of mosquitos and automatically analyzing them for various pathogens. Finally, the administration announced that a coalition of deans from 30 medical, nursing, and public health schools had committed to train their students to address the health impacts of climate change.

Appendix III: Summary of Actions Announced by the Administration in June 2015 to Address the Health Impacts of Climate Change

In June 2015, the administration announced a set of actions and commitments that were intended to protect our communities from the health impacts of climate change.¹ Specifically, the administration announced the following actions to address this issue:

1. creation of a map tool by the Department of Health and Human Services to improve the ability of health officials and emergency managers to rapidly identify residential areas where people who depend on electricity to power life-critical durable medical equipment live;
2. development of a national integrated heat health information system by the Centers for Disease Control and Prevention and the National Oceanic and Atmospheric Administration, which is intended to provide a suite of decision support resources that better serve public health needs;
3. launch of a climate and health innovation challenge series by the National Institutes of Health and others to promote innovative approaches and highlight technologies available for understanding the health implications of climate change and improving resilience to adverse effects;
4. creation of a climate change impacts subcommittee within the Federal Interagency Working Group on Environmental Justice, and the workgroup's launch of a climate justice initiative that is focused on incorporating equity into climate adaptation planning;
5. announcement of a local climate and energy webcast series on climate change, heat islands, and public health, to be hosted by the Environmental Protection Agency;
6. plans to highlight examples of policy actions related to children's health during national Children's Health Month;
7. a commitment by CDP, a private organization, to release publicly disclosed data from 61 U.S. cities that summarize the climate risks that the cities are facing and the actions they are taking to improve resilience; and

¹The White House, "Fact Sheet: Obama Administration Announces Actions to Protect Communities from the Health Impacts of Climate Change at White House Summit" (Washington, D.C.: June 23, 2015).

**Appendix III: Summary of Actions Announced
by the Administration in June 2015 to Address
the Health Impacts of Climate Change**

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8. an expansion in the number of medical, public health, and nursing schools that have committed to educate and train their students about the risks of climate change to public health.

Appendix IV: Examples of Climate Change and Health Research Conducted or Supported by Federal Agencies

Federal agencies conduct or support research on a range of topics that can enhance understanding of the risks that climate change poses to public health. In conducting our work, we interviewed officials from some federal agencies involved in the United States Global Change Research Program’s Interagency Crosscutting Group on Climate Change and Human Health. Specifically, we spoke with officials from those agencies whose focus was on understanding climate change risks to populations within the United States. Table 4 provides examples of research some of the federal agencies involved in this group have conducted or supported on or related to the risks that climate change poses to public health.

Table 4: Examples of Federal Agencies Supporting or Conducting Research on or Related to the Risks That Climate Change Poses to Public Health

Federal agency	Examples of agency actions to support or conduct research
Environmental Protection Agency (EPA)	<ul style="list-style-type: none"> Through its Science to Achieve Results program, EPA has made research awards to assess climate change impacts to health, including those related to air and water quality as well as impacts to tribal populations. For example, one project reviewed the relationship between extreme weather events and combined sewer overflows, which can enhance understanding of how climate change may affect risks from water-borne diseases associated with such overflows. Another project assessed a tribe’s vulnerability to waterborne disease risks. EPA has conducted research on how weather events associated with climate change—including heat, flooding and droughts—alter the risk of health impacts associated with air and water pollution, heat exposure, allergens, and water-borne and infectious diseases. For example, the agency’s National Health and Environmental Effects Research Laboratory has conducted research on how the combination of air pollutants and elevated temperatures affect human health, including in populations that may be especially sensitive to such effects. EPA has published information on observed trends in health-relevant indicators of climate change, including changes in high and low temperatures, heat-related mortality, Lyme disease, length of the ragweed pollen season, and extreme weather events.
Department of Health and Human Services (HHS)	NIH has made research awards on or related to climate change and public health. For example, beginning in FY 2013, NIH made an award for a research project on climate change and heat-related morbidity among vulnerable populations in Atlanta.
National Aeronautics and Space Administration (NASA)	NASA assisted the New York City Panel on Climate Change in researching the impacts of climate change on New York City and the surrounding metropolitan region, including impacts to public health.
National Oceanic and Atmospheric Administration (NOAA)	<ul style="list-style-type: none"> Some of NOAA’s regional research teams (referred to as Regional Integrated Science and Assessment teams) have partnered with local decision makers to provide actionable information related to the health impacts of climate change. For example, the team for the Great Lakes region has worked with local decision makers to develop a tool intended to help decision makers examine options for reducing morbidity and mortality related to extreme heat events in Michigan under changing climate conditions. NOAA’s Ecological Forecasting Roadmap team partners with federal and state decision makers to integrate climate information into predictions for harmful algal blooms and pathogens such as <i>vibrio parahaemolyticus</i>.

Appendix IV: Examples of Climate Change and Health Research Conducted or Supported by Federal Agencies

Federal agency	Examples of agency actions to support or conduct research
National Science Foundation (NSF) [Note A]	Since 2000, NSF has led a collaborative effort with other federal agencies to solicit proposals for research on the ecology and evolution of infectious disease. Among other things, the influence of environmental factors such as climate is listed as a factor that researchers may wish to consider as they design their work. Through this program, NSF made a research award focused on examining why the occurrence of Lyme disease varies significantly across regions of the eastern United States where blacklegged ticks, which transmit the disease to humans, are found. The researchers intended, in part, to help advance predictions of how climate change could impact the risk associated with Lyme disease.
Smithsonian Institution	Researchers with the Smithsonian Institution have conducted research on the relationship between environmental factors, including rainfall and vegetation cover, and infestations of fleas, which are known vectors for a variety of pathogens, including plague.
U.S. Department of Agriculture	The Department's Agricultural Research Service has conducted research on the relationship between climate change and a variety of factors that can impact human health, including crop growth, levels of allergenic plant pollens, food availability, and water quantity.

Source: GAO. | GAO-16-122

Note A: NSF does not typically make awards for research on the cause, diagnosis, or treatment of physical or mental disease in human beings, as research in these areas is supported by the National Institutes of Health.

Appendix V: Examples of Federal Agency Activities on or Related to the Public Health Impacts of Climate Change

Federal agencies have conducted a range of activities related to understanding, communicating, and managing for the public health impacts of climate change. In conducting our work, we interviewed officials from 26 federal agencies, including some of those involved in the United States Global Change Research Program’s Interagency Crosscutting Group on Climate Change and Human Health. Specifically, we interviewed officials from agencies whose focus was on understanding or managing for climate change risks to populations within the United States. We also interviewed officials from the United States Global Change Research Program and the Council on Environmental Quality. Table 5 provides information about activities conducted by these selected agencies.

Table 5: Examples of Activities Conducted by Selected Federal Agencies on or Related to Public Health Impacts of Climate Change

Department and component agency or office		Summary of work related to climate change and health	Examples of activities
Department of Commerce	National Oceanic and Atmospheric Administration (NOAA)	Collects and provides data, collaborates in research, and develops decision support resources to aid decision makers in examining and addressing the potential health impacts of climate-related events.	<ul style="list-style-type: none"> • Develops climate change projections, including those used in the third National Climate Assessment. • Maintains the Climate.gov portal, which includes scientific information and materials about climate change, including impacts to public health. • Works with public health officials through its National Weather Service to revise thresholds for issuing heat alerts, and through its Climate Program Office to understand and provide climate information as part of an integrated heat health information system. • Through its National Weather Service, works with federal, state, and local authorities to support hospital and community preparedness efforts. • Developed the Coastal Flood Exposure Mapper, a tool that allows users to access maps showing populations, places, and natural resources exposed to coastal flood hazards.
Department of Defense	Defense Health Agency	Routinely assesses and addresses health risks to personnel through disease surveillance activities, including health risks related to extreme heat and cold.	Plans to review and, as needed, modify health surveillance programs to better integrate climate change considerations into the department’s efforts to address health and safety risks to its personnel.

**Appendix V: Examples of Federal Agency
Activities on or Related to the Public Health
Impacts of Climate Change**

Department and component agency or office		Summary of work related to climate change and health	Examples of activities
Department of Health and Human Services	Office of the Assistant Secretary for Health	Coordinates intra- and interagency activities related to climate change and health.	<ul style="list-style-type: none"> Plans to develop a climate change communication and outreach strategy. Held a departmentwide briefing on climate change and health in August 2014.
	Assistant Secretary for Preparedness and Response	Leads the department's efforts to prevent, prepare for, and respond to public health emergencies, some of which may stem from climate change.	<ul style="list-style-type: none"> Leads science preparedness efforts aimed at establishing and sustaining a research framework that communities can leverage to better identify, collect, and analyze data and information that may be available only before, during, or immediately following a public health emergency. Provides awards for examining the long-term recovery of health systems and communities impacted by Hurricane Sandy. Provides federal support, including medical professionals, through its National Disaster Medical System, to augment state and local capabilities during an emergency or disaster. Through its emPOWER map, provides data regarding vulnerable populations that rely upon electricity-dependent medical equipment, to support state, local and community partner emergency planning and response activities.

**Appendix V: Examples of Federal Agency
Activities on or Related to the Public Health
Impacts of Climate Change**

Department and component agency or office	Summary of work related to climate change and health	Examples of activities
Centers for Disease Control and Prevention	Works with state and local health departments through a variety of programs to enhance capacity to protect public health, including from the impacts of climate change.	<ul style="list-style-type: none"> • Through its Climate and Health Program, manages the Climate Ready States and Cities Initiative, which provides awards and technical resources to 18 state and local health departments to incorporate climate change considerations into public health planning, including by implementing a five-step risk management framework. • Supports a network of 26 health departments to collect and make available health, exposure, and hazard data, including on climate change indicators, measures, and data related to extreme heat, through the National Environmental Public Health Tracking Program. • Works with state and local health departments to prepare for and respond to public health emergencies, including by providing awards for emergency preparedness planning to all 50 states, eight territories, and four large cities. • Through its National Institute for Occupational Safety and Health, established a climate change initiative to, among other things, make recommendations for worker safety and health improvements related to climate change. The Institute also seeks to identify workers and facilities at an increased risk to severe weather events.
Indian Health Service	Provides primary health care and disease prevention services to American Indian and Alaska Native people.	Provided an award to the Alaskan Native Tribal Health Consortium to assess the impacts of climate change on sanitation facilities, including determining data gaps for health- and safety-related parameters.
National Institutes of Health	Funds research on the health impacts of climate change.	<ul style="list-style-type: none"> • Issued a trans-institute research solicitation in 2010 on the public health impacts of climate change that resulted in awards for 21 new research projects. • Led an ad hoc interagency working group in developing a white paper on research needs for health impacts that may be exacerbated by climate change. • Through its Worker Training Program, hosted a workshop on the health risks that hazardous waste workers face as a consequence of climate change.

**Appendix V: Examples of Federal Agency
Activities on or Related to the Public Health
Impacts of Climate Change**

Department and component agency or office	Summary of work related to climate change and health	Examples of activities
Department of Homeland Security Office of Health Affairs	Works with communities nationwide to prepare for and respond to emergencies, including by assisting officials in understanding health risks during emergencies.	<ul style="list-style-type: none"> • Developed a Community Health Resilience Initiative Guide and Toolset, which provides local decision makers with information needed to strengthen community resilience from a variety of impacts, including health impacts related to climate change. • Reviews climate change impacts to its field-based departmental workforce, such as those working for U.S. Customs and Border Protection. • Oversees the National Biosurveillance Integration Center, an interagency center that tracks patterns of disease, disease vectors, food- and water-borne pathogens, among other factors that could influence public health.
Federal Emergency Management Agency	Works to enhance the nation's capability to prepare for, protect against, respond to, recover from, and mitigate all hazards, including by providing data and tools.	<ul style="list-style-type: none"> • Provides data and tools such as the National Flood Hazard Layer, which allows users to identify base flood elevation and other data that can be used by local decision makers to identify vulnerable populations. • Provides awards to state, local, tribal, and territorial governments to enhance their ability to prevent, respond to, mitigate, and recover from all hazards, including those related to climate change.

**Appendix V: Examples of Federal Agency
Activities on or Related to the Public Health
Impacts of Climate Change**

Department and component agency or office	Summary of work related to climate change and health	Examples of activities
Department of the Interior U.S. Geological Survey	Provides scientific information to describe and understand the Earth and to minimize loss of life and property from natural disasters, among other functions.	<ul style="list-style-type: none"> • Through its Climate Science Centers, studies the impact of climate change on fish, wildlife, and their habitats to help decision makers address the impacts of climate change, some of which can impact human health and well-being. • Developed the Coastal Vulnerability Index, which provides a preliminary overview, at a national scale, of the relative vulnerability of the nation's coast to sea-level rise, a climate change impact that may affect public health, including mental health in impacted communities. • Provides the Disease Maps Web page, which includes seasonal tracking of seven vector-borne diseases in the United States and territories, including West Nile virus and dengue, which may be impacted by climate change.
Bureau of Indian Affairs	Provides awards for some tribes to conduct climate change adaptation planning, training, and capacity building, which could help these tribes address related risks to public health.	Provided an award to a regional tribal community partnership in southeast Alaska to monitor beaches and shellfish for toxins from harmful algal blooms.
Office of Insular Affairs	Coordinates federal policy in the territories of American Samoa, Guam, the U.S. Virgin Islands and the Commonwealth of the Northern Mariana Islands.	Hosted its first stakeholder meeting on climate change in June 2015 for federal officials and leaders from the territories that the office engages with to discuss climate change adaptation efforts in those territories.

**Appendix V: Examples of Federal Agency
Activities on or Related to the Public Health
Impacts of Climate Change**

Department and component agency or office	Summary of work related to climate change and health	Examples of activities
Environmental Protection Agency	Collects and disseminates environmental data, studies the impact of environmental exposures on human health, and provides decision support resources to state and local decision makers that can assist them in preparing for the impacts of climate change, among other functions.	<ul style="list-style-type: none"> • Developed a community edition of its Benefits Mapping and Analysis Program, an open-source computer program that helps users estimate the health impacts and economic value of changes in air quality. • Provides awards for Pediatric Environmental Health Specialty Units to educate health professionals and others about environmental health risks, including some that may be exacerbated by climate change. • Provides awards to states and tribes for drinking water and wastewater system projects that can help address some risks from climate change, such as from altered precipitation and runoff patterns. • Worked with the Institute for Tribal Environmental Professionals at Northern Arizona University to develop a national training program and online resources to assist tribal leaders in developing adaptation plans to prepare for the impacts of climate change, including human health impacts.
National Aeronautics and Space Administration (NASA)	Through its Applied Sciences Program, partners with public and private organizations on ways to apply agency data in their decision-making activities.	<ul style="list-style-type: none"> • Collects and analyzes remote sensing data, including data on air quality, extreme weather, biodiversity, and changes in land cover, which may be used by decision makers to assess climate change impacts on health. • Working with NOAA's National Weather Service, provided awards for projects in three U.S. cities to develop more effective heat advisory thresholds by using NASA land surface data to identify extreme hotspots and data about morbidity and mortality to identify neighborhoods at the highest risk for health effects from heat waves.

**Appendix V: Examples of Federal Agency
Activities on or Related to the Public Health
Impacts of Climate Change**

Department and component agency or office	Summary of work related to climate change and health	Examples of activities	
National Science Foundation	Funds a wide array of scientific research that could be useful in understanding climate change and, less directly, its impacts on human health.	<ul style="list-style-type: none"> • Provided awards for research on climate change and oceans, such as impacts on rising ocean temperatures and increased ocean acidity resulting from absorption of atmospheric emissions, which alter the characteristics of the most fundamental organisms of the ocean food chain. • Provided awards for research on how people make decisions, including those related to climate change, during times of uncertainty. • Provided awards for research on the ecology and evolution of infectious disease, including research related to the spread of Lyme disease in ticks. 	
Smithsonian Institution	Provides knowledge about nature and culture through research, collections, exhibitions, and education efforts, among other functions.	<ul style="list-style-type: none"> • Hosted a 1-day symposium in October 2014 on climate and health, among other topics, which included a panel on health in a changing climate. • Planned and organized a June 2014 webinar on food security in the Arctic, which included a discussion of challenges to food security posed by climate change. 	
U.S. Department of Agriculture	Office of the Chief Economist	Coordinates the department's responses to climate change.	Initiated an evaluation of possible changes to the food system, and thus to food security outcomes, as a result of changes in weather and climate, both historically and over the next 25 to 100 years.
	Agricultural Research Service	Conducts research on agricultural problems of high national priority, and provides information to ensure high-quality, safe food and assess the nutritional needs of Americans, among other functions.	Helped support research on improving models for evaluating the effects of climate change and adaptation on crop production, a topic that could be useful for understanding how climate change may affect food availability and prices, which may impact human health.
	Animal and Plant Health Inspection Service	Administers the Animal Welfare Act and carries out wildlife damage management activities, among other functions.	During emergencies, including any that may be caused or exacerbated by climate change, supports the evacuation of people with their pets, which officials told us was essential because some people will not evacuate without their pets.

Appendix V: Examples of Federal Agency Activities on or Related to the Public Health Impacts of Climate Change

Department and component agency or office	Summary of work related to climate change and health	Examples of activities
Economic Research Service	Conducts economic research and provides information related to issues including agriculture, food, and the environment.	Issues a Cost Estimates of Food-borne Illnesses data product, which includes data about the costs of major food-borne illnesses in the United States, including for illnesses that may increase as a result of climate change.
Forest Service	Aims to achieve quality land management by, among other things, protecting and managing national forests and helping states and communities to use their forests wisely.	Provides an online climate change resource center for land managers and decision makers interested in learning more about climate change and what they can do. The site focuses on forests and other ecosystems, but includes some information related to human health.
National Institute of Food and Agriculture	Provides leadership and funding for programs that advance agriculture-related sciences.	Provided awards for basic and applied research related to climate change, such as research on how climate change may affect the water quality functions of on-site wastewater treatment systems, and identifies climate change as a priority research area for research it manages.
Natural Resources Conservation Service	Provides farmers and ranchers with financial and technical assistance to voluntarily enact conservation measures.	Through its National Water and Climate Center, monitors and provides information on droughts and water supplies critical for both agricultural and urban uses.
U.S. Global Change Research Program	Aims to build a knowledge base that informs human responses to climate and global change through coordinated and integrated federal programs of research, education, communication, and decision support resources.	Included a health chapter in its third National Climate Assessment, published in May 2014, and, through its Interagency Crosscutting Group on Climate Change and Human Health, initiated a scientific assessment of the human health impacts of climate change, a draft of which was released for public comment in April 2015.
Council on Environmental Quality	Coordinates federal environmental efforts and works closely with agencies and other White House offices in the development of environmental policies and initiatives.	<ul style="list-style-type: none"> • Co-chaired the State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience, which published a final report in November 2014 that included recommendations for federal action on climate change and public health. • Reviewed federal agencies' climate change adaptation plans, which include information on how climate change could impact the health and well-being of their employees.

Source: GAO. | GAO-16-122

Appendix VI: Examples of Activities Conducted by Awardees of CDC's Climate Ready States and Cities Initiative

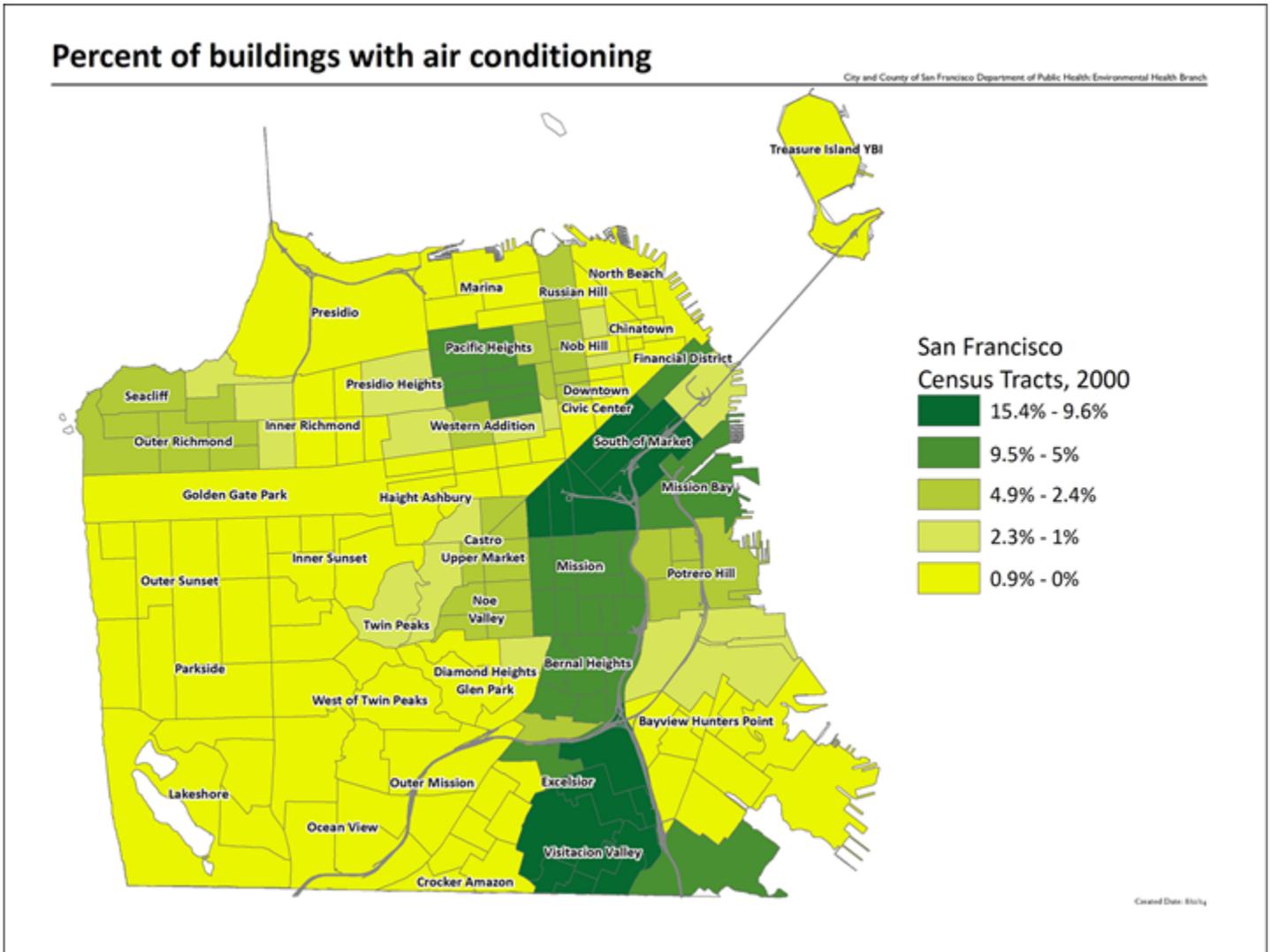
State and local health officials from the 16 state and two local health departments receiving awards through the Center for Disease Control and Prevention's (CDC) Climate Ready States and Cities Initiative told us that they have conducted a variety of activities to address and plan for the risks that climate change poses to public health. These activities support awardees' efforts to implement CDC's Building Resilience Against Climate Effects (BRACE) framework—a five-step risk management approach intended to help public health departments identify and prepare for the public health impacts of climate change by, among other things, incorporating atmospheric data and climate projections into public health planning. Examples of these activities include the following:

- **Developing community vulnerability and resilience indicators.** Awardees have developed indicators to measure community vulnerability and resilience. Florida, for example, developed indicators to identify relationships between measures of social and medical vulnerabilities, such as age and access to health care facilities, with risks to climate-related hazards in the state including hurricane winds and wildland fire.¹ Officials from the city of San Francisco also created a series of community resilience indicators to provide quantitative measurements of vulnerability to climate change stressors in the city, by neighborhood.² Indicators were developed in a variety of categories, including in areas related to the environment, health, housing, and the economy, and then mapped by census tract. See figure 4 for an example of a map developed to display areas of vulnerability to extreme heat based on the percentage of buildings with air-conditioning.

¹See C. Emrich, D. Morath, G. Bowser, R. Reeves, *Climate-Sensitive Hazards in Florida: Identifying and Prioritizing Threats to Build Resilience against Climate Effects*. http://www.floridahealth.gov/environmental-health/climate-and-health/_documents/climate-sensitive-hazards-in-florida-final-report.pdf (accessed September 10, 2014).

²See San Francisco Department of Public Health. San Francisco Climate & Health Profile. http://www.sfclimatehealth.org/wp-content/uploads/2015/01/SFDPH_ClimateHealthProfile_FinalDraft.pdf (accessed April 15, 2015). According to officials from San Francisco, information sources used to develop the indicators included data from the U.S. Census Bureau and the American Community Survey, and many of the indicators are based on those established by the University of South Carolina's Social Vulnerability Index, which measures the social vulnerability of U.S. counties to environmental hazards. Data used in the development of the indicators were also made available for researchers, decision makers, and the public, in an effort to promote transparency and encourage the development of tools to address climate change.

Figure 4: Example of a Community Resilience Map Illustrating Vulnerabilities to Extreme Heat in San Francisco



Source: San Francisco Department of Public Health (image). | GAO-16-122

Note: According to the San Francisco Department of Public Health, in housing stock without other forms of ventilation, air conditioning can prevent the health effects of extreme heat. Residents in buildings with centralized air conditioning units are at far lesser risk of heat stress. In multiunit buildings without centralized air, personal units often place the financial burden of cooling on low-income residents and incentivize disuse.

- **Enhancing surveillance.** Some awardees described taking efforts to enhance the amount and type of surveillance data they collect. For example, Vermont developed Web-based tools for the public to report

surveillance information related to the spread of ticks and algal blooms. Specifically, through its interactive tick tracker, the public can share information about where and what kinds of ticks have been observed, in order to better prevent the occurrence of tick bites in others.

- **Incorporating climate change into emergency preparedness planning.** Awardees told us that they have incorporated climate change considerations into emergency preparedness planning, such as by developing plans for hazards related to climate change, which can include heat waves or other extreme weather events. For example, Arizona created outreach materials on extreme heat and flooding emergencies to support local health departments. In addition, the state provided technical assistance to a county to create an extreme weather response plan, which included responding to extreme heat events. Illinois also incorporated climate change considerations into emergency preparedness planning by requiring that local health departments demonstrate that they are planning for an increase in the frequency and severity of extreme weather events in order to obtain public health emergency preparedness funding from the state.
- **Developing communication materials.** Awardees have developed communication materials to share information on the risks that climate change poses to public health in their jurisdictions, such as through websites for their Climate and Health programs. Officials from one county receiving funds through California's Climate and Health Program told us that its jurisdiction developed a climate change communications campaign for the purpose of educating health department staff and the community. As part of this effort, county health officials developed public service announcements to air on county-based radio stations—in English and in Spanish—that explain climate change and health-related topics, such as food, transportation, and energy.
- **Engaging communities.** Awardees described efforts to engage communities, particularly those vulnerable to the risks that climate change poses to public health. For example, officials from New York City described conducting focus groups with seniors and their caregivers to obtain their perspectives on awareness of heat warnings, prevention behaviors, and air-conditioning prevalence and use during heat waves. Officials from San Francisco also reported holding town hall style meetings with community groups from selected neighborhoods to discuss issues related to climate and health,

including heat, sea level rise, and vulnerable populations in these specific areas.

- **Partnering with academic institutions.** Awardees reported forming partnerships with academic institutions to, among other things, develop vulnerability assessments and translate climate science information. In some cases, these partnerships were the result of the health department providing a small amount of funding to the university to conduct these assessments, according to officials. For example, officials from Maryland told us that they are collaborating with researchers at the University of Maryland to develop vulnerability assessments and develop county-level projections of the burden of disease from climate change on particular health impacts, such as asthma and waterborne illness. Maryland officials noted the importance of partnering with the University to conduct this work, given the limited resources of the health department and difficulties associated with hiring staff to conduct this assessment.
- **Collaborating with other state or local entities.** Awardees have developed relationships with other state or local departments in conducting activities related to addressing and preparing for the risks that climate change poses to public health. Awardees mentioned that these partnerships help others gain a better perspective of the health impacts of climate change, which will help them to consider health impacts as they make decisions in their respective fields. Awardees also noted that they have shared information with partners or worked collaboratively on projects. For example, officials from the Michigan Department of Community Health reported partnering with the state's Department of Environmental Quality to receive data on topics related to air or water quality. Some awardees also noted the importance of developing partnerships with their state climatologist to provide their health departments with technical assistance in interpreting climate data.

Appendix VII: Activities of Other Selected State and Local Health Departments Related to Preparing for the Public Health Impacts of Climate Change

Officials from some of 13 state and local health departments that we interviewed that have not received an award through the Centers for Disease Control and Prevention's (CDC) Climate Ready States and Cities Initiative have conducted some activities related to addressing and planning for the risks that climate change poses to public health, to the extent that they have resources available.¹ Some of these state and local health department officials began working on this issue as a result of receiving leadership direction to do so, whereas others did so in the absence of leadership direction, because they believe it is an important issue or because they have identified the need to acknowledge the issue based on knowledge of climate change risks in their jurisdictions.

While some departments have conducted work in this area, others did not have the resources to begin or sustain a robust level of activity. State and local health officials told us that they have few staff to work on such activities, and that those staff also have other assignments and responsibilities. Efforts related to preparing for climate change risks to human health are often conducted in an ad hoc manner compared to those receiving awards through CDC's Climate Ready States and Cities Initiative. Some officials also told us that they have partnered with or received support from academic institutions and nonprofit organizations, which has been beneficial in beginning their work in this area since they have few resources to devote to this issue within their health departments.

State and local health departments not receiving the award that have begun planning for the risks that climate change poses to public health have undertaken activities such as conducting research on health impacts associated with climate change, such as heat-related illness or asthma, participating in workgroups, holding forums to raise awareness, and producing reports. Among the state and local health departments that we interviewed, Alaska and Washington were among those not receiving the CDC initiative award that had undertaken a number of activities directly related to preparing for the public health impacts of climate change.

¹According to these officials, resources used to conduct this work include federal and state funding sources, as well as partnerships with academic institutions or nongovernmental organizations.

- **Alaska.** Officials from the Alaska Department of Health and the Alaska Native Tribal Health Consortium—a nonprofit tribal health organization—told us that they have engaged in a number of activities to address and plan for the risks that climate change poses to public health, given that Alaska residents are already seeing climate change impacts to their health and livelihoods. The state’s Department of Health is in the early stages of developing a health impact assessment that seeks to identify the potential costs of climate change to health, ways in which to minimize adverse health effects, and ways in which to maximize potential health benefits. The results of this assessment will serve as a baseline for future climate change planning and preparedness activities in the state. Officials from the Department of Health were also involved in studying an outbreak of *vibrio parahaemolyticus* in July 2004, due, in part, to rising ocean temperatures.² The Alaska Native Tribal Health Consortium has also conducted activities related to climate change and health. Through an award provided by HHS’s Indian Health Service, the center has conducted assessments to understand the broad range of community impacts from climate change, including changes in disease, mental health, food and water security, and infrastructure. The center is integrating the results of these assessments into construction design, operations, and maintenance considerations for specific health facility improvements, such as new filtration systems for water treatment plants. The center also developed a Local Environmental Observers network, consisting of tribal environmental, natural resources, and health professionals, to enhance monitoring of unusual events that are climate change-related or climate-sensitive. Observations are mapped on a Google maps platform and are communicated through an electronic newsletter to provide information to decision makers on current risks.³

²Specifically, in July 2004, over 60 passengers aboard cruise ships near Alaska became ill after eating raw oysters, resulting in one of the largest known outbreaks of *vibrio parahaemolyticus* ever reported in the United States. During this outbreak, Department of Health officials worked to study the disease and process oyster samples, and later published the results of their study. See J. McLaughlin, et al., “Outbreak of *Vibrio parahaemolyticus* Gastroenteritis Associated with Alaskan Oysters,” *The New England Journal of Medicine* 353, no. 14 (2005).

³The Local Environmental Observers network was developed by the Alaska Native Tribal Health Consortium’s Center for Climate and Health with funding from EPA and the Western Alaska Landscape Conservation Cooperative—a partnership of federal agencies and other stakeholders addressing climate change impacts on the nation’s landscapes.

Appendix VII: Activities of Other Selected State and Local Health Departments Related to Preparing for the Public Health Impacts of Climate Change

- **Washington.** The Washington State Department of Health has recently started to engage in activities related to climate change and health at the direction of its Secretary of Health, who identified climate change as a priority issue. The department is working to identify how to measure and track the impacts of climate change, particularly in the areas of food, water, and air quality, through its Washington Tracking Network, which is funded by CDC's Environmental Public Health Tracking Network. The department also conducted a survey to characterize local health jurisdiction's perceptions, activities, and needs related to climate change, and compared the results to similar surveys of local health departments on this topic.

Appendix VIII: Summary of Health-Related Recommendations Made by the President's Task Force on Climate Preparedness and Resilience

In November 2013, the President issued Executive Order 13653, *Preparing the United States for the Impacts of Climate Change*, which, among other things, established the State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience. The mission of the task force was to provide recommendations to the President and interagency council on how the federal government could, among other things, support state, local, and tribal preparedness for and resilience to climate change.

The task force issued a report to the President in November 2014, noting that the federal government has an essential and unique role to play in preparing for and responding to climate change impacts.¹ Its report includes 35 recommendations to the President across seven themes, and it also listed suggested actions that federal agencies could take to implement the recommendations. The themes addressed in the report are (1) building resilient communities, (2) improving resilience in the nation's infrastructure, (3) ensuring resilience of natural resources, (4) preserving human health and supporting resilient populations, (5) supporting climate-smart hazard mitigation and disaster preparedness and recovery, (6) understanding and acting on the economics of resilience, and (7) building capacity. Table 6 summarizes selected health-related recommendations and suggested actions listed across various themes of the report.

¹President's State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience, *Recommendations to the President* (Washington, D.C.: Nov. 17, 2014). The task force terminated 6 months after it provided its recommendations. In July 2015, the administration issued a progress report, providing examples of federal actions taken to address these recommendations. The White House, *Progress Report: Highlighting Federal Actions Addressing the Recommendations of the State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience* (Washington, D.C.: July 2015).

**Appendix VIII: Summary of Health-Related
Recommendations Made by the President's
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Resilience**

Table 6: Summary of Selected Health-Related Recommendations and Suggested Actions from the President's State, Local and Tribal Leaders Task Force Report on Climate Preparedness and Resilience

Theme	Recommendation	Examples of suggested actions to address the recommendation
Preserving human health and supporting resilient populations	Address the needs of vulnerable populations	<ul style="list-style-type: none"> Develop guidance and tools to identify those most at risk the effects of climate change. Ensure that federal programs that serve vulnerable populations (for example, housing and senior assistance programs) evaluate how climate change will impact needs and service delivery.
	Improve capacity to protect public health	<ul style="list-style-type: none"> Expand and build on the Centers for Disease Control and Prevention's (CDC) Climate-Ready States and Cities Initiative, to include mechanisms for grantees to share their experience and best practices with nongrantees, including all local governments. Encourage recipients of CDC's Public Health Emergency Preparedness funding to consider climate change impacts when developing their required vulnerability assessments. Develop climate-sensitive health tracking and surveillance tools. Improve awareness of mental health impacts associated with climate change impacts, including by incorporating such impacts in preparedness and response planning.
	Assist communities in building food system security.	U.S. Department of Agriculture should work with the Department of Health and Human Services and others to support research on climate change-related risks to food supply chains.
	Improve disaster preparedness for communities most at-risk.	<ul style="list-style-type: none"> Provide enhanced access to predisaster training on federal response and recovery programs. Develop health-sensitive extreme weather event warning systems that enhance response activities for at-risk populations.
	Explore the federal role in addressing climate change-related displacement.	Establish a framework for responding to climate-related displacement.
Building capacity for resilience	Increase climate literacy and public awareness.	<ul style="list-style-type: none"> Ensure that senior federal health officials such as the U.S. Surgeon General and the Director of CDC draw attention to the public health impacts of climate change. Coordinate federal communications on climate change to develop clear, consistent, and unified messages, including on the impacts of climate change to human health, and ensure that communications tools are provided to state and local governments.
Ensuring the resilience of natural resources	Combat the spread of invasive species, pests, and diseases.	Increase regional monitoring efforts, including by enhancing related research, identification, interagency coordination, and education efforts.

Source: President's State, Local and Tribal Leader's Task Force Report on Climate Preparedness and Resilience, Recommendations to the President (Washington, D.C.: Nov. 17, 2014). | GAO-16-122

The task force also developed five overarching principles for all federal agencies to consider as a means to advance climate preparedness and resiliency. These include:

1. Require consideration of climate-related risks and vulnerabilities as part of all federal policies, practices, investments, and regulatory or other programs.
2. Maximize opportunities to take actions that have dual benefits of increasing community resilience and reducing greenhouse gas emissions.
3. Strengthen coordination and partnerships among federal agencies, and across federal, state, local, and tribal jurisdictions and economic sectors.
4. Provide actionable data and information on climate change impacts and related tools and assistance to support decision making.
5. Consult and cooperate with tribes and indigenous communities on all aspects of federal climate preparedness and resilience efforts, and encourage states and local communities to do the same.

Appendix IX: Comments from the Department of Health and Human Services



DEPARTMENT OF HEALTH & HUMAN SERVICES

OFFICE OF THE SECRETARY

Assistant Secretary for Legislation
Washington, DC 20201

SEP 17 2016

Alfredo Gomez
Director, Natural Resources and Environment
U.S. Government Accountability Office
441 G Street NW
Washington, DC 20548

Dear Mr. Gomez

Attached are comments on the U.S. Government Accountability Office's (GAO) report entitled, "Climate Change: HHS Could Take Further Steps to Enhance Understanding of Public Health Risks" (GAO-15-729).

The Department appreciates the opportunity to review this report prior to publication.

Sincerely,

A handwritten signature in cursive script that reads "Jim R. Esquea".

Jim R. Esquea
Assistant Secretary for Legislation

Attachment

GENERAL COMMENTS OF THE DEPARTMENT OF HEALTH AND HUMAN SERVICES ON THE GOVERNMENT ACCOUNTABILITY OFFICE'S DRAFT REPORT ENTITLED: CLIMATE CHANGE: HHS COULD TAKE FURTHER STEPS TO ENHANCE UNDERSTANDING OF PUBLIC HEALTH RISKS (GAO-15-729)

The U.S. Department of Health and Human Services (HHS) appreciates the opportunity from the Government Accountability Office (GAO) to review and comment on this draft report.

GAO Recommendation

To enhance HHS's ability to protect public health from the impacts of climate change, we recommend that the Secretary of the HHS direct CDC to develop a plan describing when it will be able to issue climate change communication guidance to state and local health departments, to better position relevant officials to effectively communicate about the risks that climate change poses to public health and address requirements of the Climate Ready States and Cities Initiative.

HHS Response

The Centers for Disease Control and Prevention (CDC) generally concurs with GAO's recommendation and respectfully submits the following general comments.

- CDC currently provides support and technical assistance to state and local health departments regarding communication around the health impacts of climate change, at their request. For example, CDC is working with partner and professional organizations to disseminate messages on the health impacts of climate change.
- In order to develop a plan describing when we will be able to issue climate change communication guidance to state and local health departments, CDC is awaiting completion of the HHS climate change communication and outreach strategy, expected to be finalized by July 2016, to inform CDC's guidance and build off the same strategy.
- Once the HHS climate change communication and outreach strategy is developed, CDC will utilize that strategy to implement GAO's recommendation. This includes development of a plan and guidance that will map to HHS' climate change communication and outreach strategy. In the interim, CDC will continue to provide technical support to the states regarding climate change communication, as requested, while the HHS strategy is being finalized.

Appendix X: GAO Contacts and Staff Acknowledgments

GAO Contacts

J. Alfredo Gómez, gomezj@gao.gov or (202) 512-3841.

Marcia Crosse, crossem@gao.gov or (202) 512-7114.

Staff Acknowledgments

In addition to the individuals named above, Diane Raynes (Assistant Director), Mark Braza, Emily Hanawalt, Armetha Liles, Krista Mantsch, Cynthia Norris, Patricia Roy, Emily Ryan, Jeanette Soares, Andrew Stavisky, and Jennifer Whitworth made key contributions to this report.

Appendix XI: Accessible Data

Accessible Text and Data Tables

Data Table for Figure 1: Examples of Potential Health Impacts from Climate Change in the United States, by Region

Region	Description	States
Alaska	In rural Alaska, adverse health effects may occur as a result of disruptions to community water supplies and sewage systems as permafrost—frozen ground that can support infrastructure—continues to thaw.	Alaska
Great Plains	Allergies may become more common and severe as pollen seasons become longer due to more frost-free days.	Kansas, Montana, Nebraska, North Dakota, Oklahoma, South Dakota, Texas, Wyoming
Hawaii	The incidence of dengue could increase under projected climatic conditions that include rising temperatures and shifting rainfall patterns.	Hawaii
Midwest	Drownings and injuries may result from floods, which could become more common as the frequency and intensity of extreme precipitation events increases.	Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, Wisconsin
Northeast	West Nile virus and other vector-borne diseases may pose greater threats as suitable habitats for the Asian tiger mosquito increase due to a number of possible factors, including climate change.	Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, West Virginia
Northwest	Respiratory and cardiovascular illnesses could be worsened by smoke and particulate pollution from increased wildfires.	Idaho, Oregon, Washington
Southeast	The incidence of ciguatera fish poisoning, a foodborne illness, could increase as algae that cause the illness move northward with rising sea surface temperatures.	Alabama, Arkansas, Florida, Georgia, Kentucky, Mississippi, North Carolina, Louisiana, South Carolina, Tennessee, Virginia
Southwest	The incidence of heat stress and other illnesses aggravated by extreme heat, such as heart disease, could increase as temperatures rise.	Arizona, California, Colorado, Nevada, New Mexico, Utah

Sources: GAO analysis of U.S. Global Change Research Program's third National Climate Assessment; Map Resources (map). | GAO-16-122

Note: Impacts described for certain regions do not imply that they do or can occur only in those regions.

Data Table for Figure 2: CDC Climate Ready States and Cities Initiative Awardees, Fiscal Year 2015

States	Cities
Arizona, California, Florida, Illinois, Maine, Massachusetts, Maryland, Michigan, Minnesota, New Hampshire, New York, North Carolina, Oregon, Rhode Island, Vermont, Wisconsin	San Francisco, New York City

Sources: Centers for Disease control and Prevention; Map Resources (map). | GAO-16-122

Accessible Text for Figure 3: Steps and Examples of Activities Conducted under CDC’s Building Resilience Against Climate Effects Framework

- 1) **Step 1:** Anticipate climate impacts and assess vulnerabilities:
 - a) Use weather, climate variability, and climate change data sources to identify climate-related health outcomes;
 - b) Identify populations and locations vulnerable to climate-related health impacts;
 - c) Develop a climate and health profile report that details climate-related exposures, health outcomes of concern, and vulnerabilities.

- 2) **Step 2:** Project the disease burden :
 - a) Define the health outcomes of interest from Step 1;
 - b) Determine how the population is exposed to climate-related risks using qualitative or quantitative methods [Note A];
 - c) Select and use global climate models to project the health impacts under future scenarios.

- 3) **Step 3:** Assess public health interventions:
 - a) Identify relevant interventions from published literature or local best practices;
 - b) Assess the appropriateness of interventions, such as by considering cost-effectiveness and local cultural and political factors;
 - c) Consult with stakeholders that will be affected by or play a role in implementing proposed interventions.

- 4) **Step 4:** Develop and implement a climate and health adaptation plan:
 - a) Develop a written adaptation plan;
 - b) Detail processes for conducting future reviews and periodic revisions of the plan;
 - c) Disseminate the plan amongst stakeholders.
- 5) **Step 5:** Evaluate impact and improve quality of activities:
 - a) Gather information on the outcomes and impacts of the process;
 - b) Conduct evaluations to validate methods and identify challenges;
 - c) Improve interventions as needed.

Sources: GAO analysis of Centers for Disease Control and Prevention information and Art Explosion (image). | GAO-16-122

Note: According to CDC officials, the Building Resilience Against Climate Effects (BRACE) framework is iterative and enables the incorporation of learning into future decisions by encouraging users to revisit prior steps to reevaluate risks and management priorities.

Note A: According to CDC, qualitative methods may be used to provide a general impression of how climate change may affect the risk for certain outcomes, at least capturing general climatic trends and environmental exposures, population vulnerability, and expected human health impacts. Quantitative methods may be used, for example, to quantify existing climate and health exposure pathways, or to project disease impacts.

Agency Comments

Department of Health and Human Services

Page 1

Accessible Text for Appendix IX: Comments from the Department of Health and Human Services

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Page 2

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