Climate Change, Health, and Equity: A Guide For Local Health Departments

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Preface

The health of Americans faces two great challenges: climate change and health inequities.

Climate change affects the health of every community. Beyond its direct health impacts (such as heat illness), climate change increases food insecurity, worsens air pollution, reduces our access to clean water, displaces people from their homes, and causes widespread social and economic disruption. Dr. Jim Yong Kim, President of the World Bank, said that climate change "threatens our fragile existence on this planet."

Health inequities and climate change are deeply interconnected. Climate change acts as a threat multiplier, exacerbating poverty, environmental degradation, and political instability. Like health inequities, climate change is a problem rooted in the structures, systems, and values of our society and economy. Eliminating health inequities and resolving climate change requires an intersectoral and transformational approach.

Many climate solutions offer huge health benefits. In fact, many strategies to reduce climate pollution are the same strategies that we must implement to reduce health inequities.

Climate change is a public health emergency: The health and well-being—and possibly the very survival—of the communities we serve is in danger, as witnessed by the increased occurrence of disastrous wildfires and extreme weather events. Our actions now (or lack thereof) will affect the magnitude of climate impacts and the extent to which our communities thrive in the face of climate change and recover in the aftermath of climate-related disasters.

Climate change is a global phenomenon, but people and communities at the local and regional level experience its consequences. Local public health departments have a critical role in addressing this urgent threat, just as they have done in facing other emergent threats to the health of the public, and a responsibility to expand public health practice to address climate change.

We can do what public health has done for so many other threats: educate and inform, develop and use the scientific evidence, partner with community organizations and sister agencies, advocate for policy and systems change, and take on the powerful interests that put profits over people and impede the transformational change needed to achieve equity and a healthy climate for all. We hope this Guide will be useful to every local health department striving to address climate change, health, and equity as joined and urgent issues.

Georges C. Benjamin, MD
Executive Director
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Introduction

Local public health departments (LHDs) across the United States are working proactively to address health inequities, an endeavor that requires intentional change in public health practice. While the services that public health provides to individuals in communities remain vitally important, local health departments are broadening their scope to support systems change across the many sectors that shape community environments (such as transportation and land use, agriculture and food, and criminal justice systems) and the economic, physical, and social conditions in which we live, work, learn, and play. LHDs are also beginning to address the historical and structural determinants of health (such as racism, power, and disenfranchisement) that have led to and reinforce persistent inequities.

Now, public health needs to apply this expanded scope to climate change. Our actions now will determine the magnitude of future impacts, how quickly they occur, and the extent to which our communities can thrive in the face of climate change.

Key Messages about Public Health and Climate Change

Climate change and health inequities are the defining public health issues of our time, and they are inextricably interconnected.

1. **Climate change disproportionately impacts the health of low-income communities and communities of color.** The same physical, social, economic, and services environments that are associated with poor health outcomes for low-income communities and communities of color also increase exposure and vulnerability to the health impacts of climate change. People in low-income communities and communities of color generally experience greater burdens from pre-existing health conditions which increase susceptibility to climate-related health threats. These communities are often historically disenfranchised, lacking the political and economic power and voice to ensure that decision makers take their perspectives, needs, and ideas fully into account. This lack of power contributes to health inequities and constrains the ability of low-income communities and communities of color from building climate resilience and to contributing fully to climate change solutions.
2. **Climate change and health inequities share the same root causes.** The same systems (e.g. transportation, food and agriculture, energy) that are major sources of climate pollution also shape the living conditions that comprise the social determinants of health. These systems are shaped by current and historical forces that include structural racism and the persistent lack of social, political, and economic power of low-income communities and communities of color.
3. **Addressing climate change and health inequities requires transformational change in our systems and communities.** Many climate solutions offer tremendous health benefits and opportunities to promote greater equity, which are vital to increasing climate resilience. But to assure that all Americans have opportunities for health requires that we preserve a healthy planet. We cannot have healthy people without healthy places, and we cannot have healthy places without a healthy planet.

1.1 Local Health Departments: Essential to Effective Response to Climate Change

Core public health values affirm that "*humans have a right to the resources necessary for health*," and that "*people and their physical environment are interdependent*."[1] Climate change threatens the fundamentals that sustain life and health—fresh water, food, clean air, shelter, and security. Everyone (and everywhere) is affected, although climate change exacerbates local and global inequities. We must address climate change to fulfill the very definition of public health: "what we, as a society, do collectively to assure the conditions for people to be healthy."[2]

LHDs have a professional and ethical responsibility to address the climate crisis. The role of LHDs is to apply the same foundational public health tools and approaches that are used to address any emergent health crisis, grounded in core public health values such as equity, prevention, and preparedness.

Why Local Health Departments?

- There is ample evidence and scientific consensus that climate change is happening now, is largely due to human activities, and is amenable to action to slow its pace and reduce its impacts. Failure to act on climate change now risks catastrophic consequences for the health and well-being of people around the world and even more so for future generations.
- LHDs are on the front lines and see the impacts of climate change on communities as the changes are happening. A 2008 national survey found that nearly 70% of U.S. local health officials believed that their jurisdiction had already experienced climate change, and that number is surely higher today.[3]
- LHDs are the only local government entity with a duty to protect health and provide a trusted and credible voice. They can help policymakers and the public understand the breadth of climate health impacts, and the urgent need for climate action. By linking health equity and climate change, public health leaders can show how transformative changes can protect people and build healthy and equitable communities in the era of climate change.
- LHDs work in and have deep connections to the communities that are most impacted by climate change. LHDs can support genuine participation of community members in decisions about how local governments respond to climate change.
- While it's true that most LHDs currently have limited capacity, expertise, or funding to work on climate change, the magnitude of the public health threat requires engagement now. Public health has a long history of confronting emerging problems despite limited resources.
- LHDs have a proven track record of succeeding against powerful forces to protect health from complex threats (e.g. success in tobacco control and auto safety). These successes rest in part on public health's commitment to confront cultural, economic, political, structural, and corporate forces that shape the environments that determine health. With similar commitment and effort, LHDs can play a powerful role in addressing climate change and its impacts on health.

Every local health department is different in size, structure, geographic location, community and political context, and capacity, and there is no “one size fits all” approach to the integration of climate change into LHD practice.

This Guide connects what we know about climate impacts and climate solutions with the work of LHDs, and provides examples of how LHDs can put climate change into public health practice. The Guide is neither a step-by-step “how to” nor a comprehensive catalog of how to address climate change. It is intentionally redundant so that readers can access information from various entry points based on their roles and interests. We hope the Guide will help you integrate climate change into the public health practice of your LHD.

Health Equity and Climate Change

2.1 Fundamentals of Health Equity and Climate Change

It is hard to overstate the connections between climate change, health, and equity. The following framework (Figure 2.1.1) outlines these critical connections. See Appendices 1 and 2 for other foundational frameworks—including the Healthy Communities Framework, A Public Health Framework for Reducing Health Inequities, and others—that have informed action on climate change, health and equity.

- *The root causes and upstream drivers of climate change and health inequities are often the same:* Our energy, transportation, land use, housing, planning, food and agriculture, and socioeconomic systems are at once key contributors to climate pollution and key shapers of community living conditions. The powerful institutions largely responsible for constructing these systems influence and are influenced by social inequities such as class and race.
- *The health risks and impacts of climate change are not equally or fairly distributed across people, communities or nations.* The impacts of climate change on health are significantly moderated by individual and community vulnerability and resilience. Two critical components of climate vulnerability are pre-existing health status and living conditions. In the United States, these factors are shaped by economics and the distribution of money, power, social policies and politics at the global, national, state and local levels.[1] They differ by place, race, and income, as a result of inequities in the distribution of money and power, historical disinvestment in some communities, discriminatory practices and policies over time, structural racism, higher pollution burdens, and lesser access to resources for health. Therefore, low-income communities and communities of color are disproportionately affected by the health impacts of climate change.
- *Climate change exacerbates existing health and social inequities.* Climate change worsens environmental conditions (e.g., ozone pollution) associated with chronic illness and injury and causes social and economic dislocations that most impact disadvantaged communities.
- *Interventions that act on upstream shared systemic causes can most effectively address both climate change and health inequities.* Interventions to address climate change and health inequities range from upstream structural, policies, and systems changes to downstream treatment, rehabilitation, and disaster recovery efforts. Interventions along the entire spectrum are needed to protect and promote health in the era of climate change. However, upstream solutions have the greatest benefits, providing primary prevention and promoting healthy, equitable, sustainable, and resilient communities.[7]
- *Building political and economic power and voice are essential components of climate resilience.* Especially for historically disenfranchised low-income communities and communities of color, power imbalances have allowed the perpetuation of unhealthy living conditions associated with health inequities and climate vulnerability. The lack of power and voice constrains the ability of communities to respond to climate change impacts and contribute local knowledge to climate solutions. Building community power is required to transform systems to foster health.

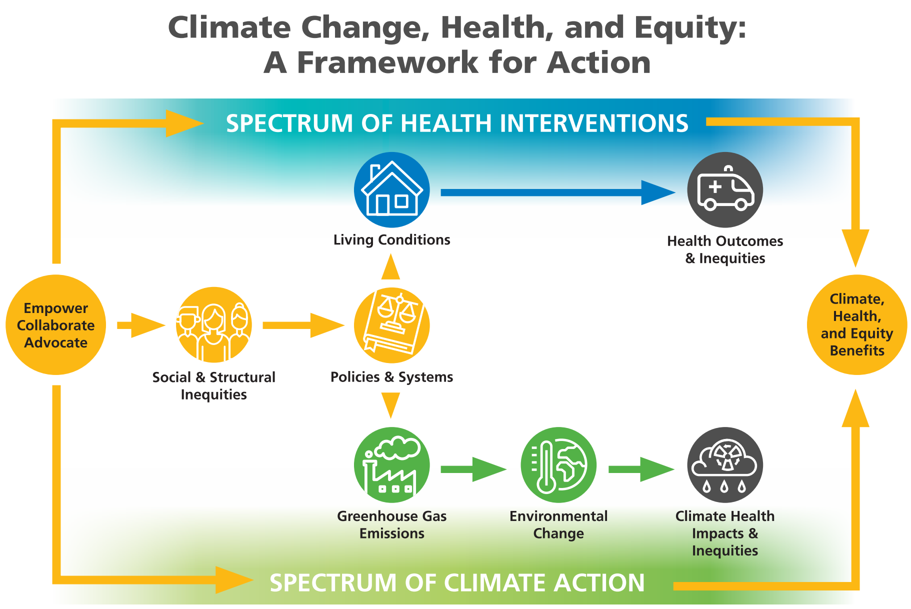
Health Equity: Some Definitions

Health equity means that everyone has a fair and just opportunity to be as healthy as possible. This requires removing obstacles to health such as poverty, discrimination, and their consequences, including powerlessness and lack of access to good jobs with fair pay, quality education and housing, safe environments, and health care.[2]

Systems, social and structural inequities, and institutional power impact our environment, living conditions, behavior, and how we function as a society.

- **Systems**[3] are a collection of parts—physical structures, people, and organizations—that interact to provide an important function. Farms, farmers, packing plants, food inspectors, restaurants, and truckers all play a role in our food system. Social and structural inequities and powerful institutions interact to shape the systems that determine living conditions, human impacts on the climate, other environmental impacts, and health outcomes.
- **Social and Structural Inequities**[4] refers to the historical disenfranchisement and unequal distributions of power, money, and resources that are often associated with class, race, ethnicity, place, immigration status, gender, and sexual orientation. These inequities are perpetuated by hierarchies in power through mechanisms rooted in key institutions and processes.[5]
- **Institutional Powers**[6] and authorities (such as corporations, governments, school systems, and large NGOs) make decisions that impact the physical environment and shape the societal distribution of health-promoting resources and opportunities (e.g. parks, grocery stores, education, childcare, medical care, jobs). People in institutions and their decisions and actions are influenced by social values and mores that perpetuate inequities.

Figure 2.1.1: Climate Change and Health



Intergenerational Equity

"We have been mortgaging the health of future generations to realize economic and development gains in the present."

The Rockefeller Foundation–Lancet Commission on Planetary Health

The actions of one generation affect the conditions of those that follow; climate change makes this more pressing than ever. Intergenerational equity means that fundamental rights and interests of future generations must be treated with equal value as the rights and interests of those living today. To ensure the survival and well-being of future generations we must sustain the most basic of earth's resources—clean water, clean air, healthy soil, and climatic stability.

Young people are establishing a legal framework for achieving intergenerational equity. *Juliana v. U.S.* is a youth-filed constitutional climate lawsuit asserting that government actions that cause climate change violate the youngest generation's constitutional rights to life, liberty, and property, as well as fail to protect essential public trust resources. Judges have upheld the case against efforts by the Obama and Trump Administrations to dismiss it.[8,9]

Global Climate Inequities: Responsibility and Burden

The smallest and least developed countries often bear the most harmful burden of climate change, although they have contributed the least to the problem. Industrialized nations are responsible for the majority of climate pollution. From 1850 to 2011, the United States, European Union, China, Russian Federation, and Japan emitted two-thirds of the global CO_2 emissions, and the United States was responsible for 27% of global greenhouse gas emissions (GHGE). China has emerged as the world's largest climate polluter. However, the United States ranks in eleventh place for per capita GHGE at 16.5 metric tons per capita[10]—more than three times the global average. China ranks 42nd (7.5 metric tons per capita) and India ranks 127th (1.7 metric tons per capita).[11]

The World Health Organization estimates that 99% of the disease burden from climate change occurs in developing countries, 88% of which occurs in children under five.[12] From January 1980 through July 2013 there were 2.52 million deaths globally due to climate-related disasters, 51% of which occurred in the 49 least developed countries.[13]

2.2 Climate Vulnerability and Resilience

Climate Vulnerability

Climate vulnerability is the degree to which people or communities are at risk of experiencing the negative impacts of climate change.[14] It is often tightly coupled with health and social inequities. Key components in climate vulnerability include exposure, sensitivity to threats, and capacity to adapt and respond.[15] See Table 1 for more details.

Table 2.2 COMPONENTS OF CLIMATE VULNERABILITY

Exposure to climate threats

- Geography and the nature of climate change impact particular locations differently.
    - Low-lying coastal communities are at greater risk of coastal flooding from sea level rise and tidal storm surges than communities at higher altitudes.
    - People living in flood plains are at higher risk of flooding with extreme precipitation.
    - Communities on or below steep hillsides are at risk of mudslides/landslides during extreme weather events.
    - Those living at the wilderness-urban interface are at higher risk of wildfires.
- Occupations can increase exposure to climate risks.
    - Outdoor workers such as agricultural, landscape, and construction workers are at greater risk of exposure to extreme heat.
    - First responders are at increased risk of death or injury during extreme events such as hurricanes or wildfires.

Sensitivity and susceptibility to climate threats

- Individual characteristics may increase susceptibility to climate risks. For example, older individuals and children have increased susceptibility to heat stress.
- Pre-existing health conditions and baseline prevalence of climate-sensitive diseases. (Differences in rates of these conditions and diseases often reflect health inequities.)
    - Those with asthma or chronic obstructive pulmonary disease (COPD) are at greater risk of respiratory illness from increased ozone, wildfire smoke, and increased pollen.
    - People with obesity, diabetes, cardiovascular disease, and mental illness are more susceptible to heat impacts.
    - Immunosuppression increases the risk of climate-related infectious disease.
- The baseline status of environmental quality intersects with climate impacts and subsequent health outcomes. For example, people living in areas with high baseline levels of air pollution are more vulnerable to increased ozone levels due to rising temperatures.

Capacity to adapt to and respond to climate threats

- Differential access to resources, which means that low-income individuals, households, and communities are less likely to
  - afford air conditioning to reduce heat risk, or to cope with rising food prices related to climate impacts on agriculture;
  - have insurance or financial resources to rebuild or relocate after an extreme weather event; or
  - enjoy the resources required to build infrastructure that promotes climate resilience and adaptation.
- Conditions of the built environment, such as
  - aging water and sewage infrastructure that leave some communities more prone to severe flooding and potential for water contamination;
  - few trees and parks in some neighborhoods increases risk from heat.
- Socially mediated capacity to reduce risk and to prepare and respond effectively.
- Disinvestment in public health and emergency response infrastructure and safety net resources limits the capacity for preparedness and response.
- Variable levels of social cohesion which reduces health impacts of climate change and builds social and political will to invest in climate action.

2.3 Race, Ethnicity, and Climate Change

Each of the subsections below have an Appendix with additional information about the effects of climate change on the health of the populations discussed (see Appendix 3).

African Americans

African American communities have lower income, less education, and poorer health status than non-Hispanic White communities overall, largely due to the legacy of slavery and historical discriminatory practices in housing, education, employment, and healthcare.[16] These inequities contribute to greater vulnerability to climate impacts.

- African Americans are more likely to live in neighborhoods with few trees and more heat-trapping pavement.[17] The rate of heat-related deaths in African Americans is 150–200% greater than that for non-Hispanic Whites.[18]
- African Americans have a 36% higher rate of asthma incidents and are 3 times more likely to die or visit the emergency room from asthma-related complication than non-Hispanic Whites.[19]
- One out of five of African American families live in poverty, compared to one out of fifteen White families. During an extreme weather event, these households have a smaller cushion against property damage or injuries, further complicated by lack of access to medical care and insurance.[20]

Native Americans and Alaska Natives

Historical policies, such as colonization and genocide, the Indian Removal Act of 1830, and residential schools for Native American children have led to present-day social and health inequities in Native American and Alaskan Native communities, including loss of traditional lifestyles, persistent poverty, substandard health services, and lack of access to electricity, running water, and communication technologies.[21,22]

- Traditional Native Americans and Alaska Natives (NA/AN) diets and subsistence hunting and fishing are at risk due to climate change.[23,24]
- NA/AN communities lack access to clean, potable drinking water at higher rates than others.[25] Warmer water temperatures may exacerbate already-high rates of diarrhea-associated hospitalizations for Native American and Alaskan Native children.[26]

Latinos/Hispanics/Latinx

The three terms "Latinos" "Hispanics" "Latinx" are used here, but in the remainder of the document, "Latinos" will be used for ease of use. Latino communities have lower income, less education, and poorer health status than non-Hispanic White communities overall, largely due to historical discriminatory practices in housing, education, employment, and healthcare.[27]

- Nearly 1 in 2 Latinos live in counties with poor air quality. Latino children are twice as likely to die from asthma as non-Latino whites, and Latino children living in areas with high levels of air pollution have a heightened risk of developing Type 2 diabetes.[28,29,30]
- Over 1.8 million Latinos live within a half-mile radius of oil and gas development.[31]

Native Hawaiians and Pacific Islanders

Historical practices such as colonization and trade, the aggregation of census and health data, and a history of military testing have led to present-day social and health inequities that increase climate-related health risks in Native Hawaiian and Pacific Islander communities.[32]

- Scientists project that by 2100, Hawai‘i and some Pacific islands will experience about 1ft–2.5ft higher sea-level rise when compared to global averages.[33]
- A higher proportion of Pacific Islanders in the United States live in counties with pollution exceeding the federal air quality standards when compared with Asians and other racial groups.[34]
    - Native Hawaiian and Pacific Islander communities experience high rates of asthma, expected to worsen as climate change worsens air quality.[35]

2.4 Community Climate Resilience

Climate resilience is "the capacity of a community to anticipate, plan for and mitigate the risks— and seize the opportunities—associated with environmental and social change" brought about by climate change.[36]

Earlier definitions framed resilience as the ability to "bounce back" from a stress or shock, possibly to unhealthful and inequitable conditions.[37] "Bouncing back" resilience might allocate resources to maintain the status quo or make marginal changes that do not fundamentally reduce vulnerabilities across the whole of a community. "Bouncing forward" resilience is characterized by greater openness and adaptability; it strives to see climate change as an opportunity to change social, economic, and political structures to promote equity and sustainability and to invest in systems changes that promote health and well-being.[38]

The characteristics of vulnerability and resilience may coexist at the same time. For example, a neighborhood may be exposed to high levels of air pollution but also have a strong local food system and a high-quality community clinic. Improving the underlying health status and structural and system determinants of health is one of the most effective strategies to build climate resilience. See examples below of how LHDs can advance health equity and build community climate resilience.

A climate-resilient community:[39]

- Is committed to the transformative change required to build a healthy, equitable, and sustainable community.
- Takes action to build individual and collective capacity to respond proactively to and influence social, economic, and environmental change.
- Nurtures diversity, respects the experience and knowledge of all community members, and proactively engages all segments of a community in understanding and responding to change.
- Is organized in a way that provides capacity to recognize and act on problems and to learn from experience.
- Fosters social cohesion and collaboration across networks through bonding, bridging, and linking.
- Builds community capitals including economic, social, built, political, and environmental capitals.
- Supports investment in physical infrastructures and services that meet the needs of all residents.
- Recognizes the value of environmental resources and works to protect, enhance, and maintain them.

2.5 What LHDs Can Do: Health Equity and Climate Resilience

Building resilience to climate change and addressing social and health inequities requires addressing the systemic causes of these challenges through collaboration and shared decision-making with impacted communities, community-based organizations, and other stakeholders across sectors. Below is a set of recommended actions LHDs can take to advance health equity and climate resilience within their current programs. For additional actions by climate impacts and LHD programs and functions see Sections 4, 6, and 7 respectively. For a comprehensive review of LHD action to advance health equity see Human Impact Partners Health Equity Guide.[40]

Assessment and Surveillance

- Include health and social inequities and vulnerabilities in climate and health vulnerability assessments.
- Improve data about vulnerable populations and health and social inequities and use it in planning and prioritization for climate and health programming.
  - Acknowledge missing data and data limitations that may limit ability to assess particular sub-groups.
- Highlight the most striking inequalities in data and publications and the root causes of these inequalities to provide clear, consistent, and widespread messages to decision makers, affected communities, partners, and the general public about the existence of and need to address health inequities.
- Use community-based participatory research or "citizen science" or "community science" and qualitative methods (e.g., surveys, interviews, focus groups) to identify indicators for climate and health vulnerability assessments and in data collection and interpretation.
  - Multnomah County Health Department (Oregon) contracted with a community-based organization, Coalition of Communities of Color and Portland State University Planning Department to create a climate and health tool and interactive map to inform LHD action and guide future jurisdiction investments. Community members were instrumental in selecting indicators included in the tool. See Section 7.1—Surveillance.

Intersectoral Collaboration

- Build awareness of the connection between the social determinants of health, and the shared systems that create inequities and contribute to climate change with partner government agencies and elected officials. Advance a narrative that emphasizes the climate change, health, and equity nexus and the solutions that confer climate, health, and equity benefits.
- In collaboration with other agencies, include equity in assessments, research, and policy and program decisions to examine the climate, health, and equity impacts of proposed policies, projects, and programs.
- In collaboration with other jurisdiction agencies and intersectoral partners advance policies and programs that address the underlying determinants of health and inequities in access to resources and infrastructure.
  - Promote urban agriculture and local food systems (e.g. community gardens).
  - Prioritize infrastructure investments to improve climate resilience and heath equity in historically neglected communities (e.g. active transportation infrastructure, public parks and green space).
- Include climate, health, and equity language and data in jurisdiction plans, budgets, and assessments.
  - As part of the city's 2018 One New York Plan, the NYC Department of Health and Mental Hygiene worked collaboratively with other city agencies to include public health and health equity in the city's planning up until 2040, including for the city's transportation and food systems.[41]
- Work across sectors to agree upon common language related to climate change, health, and equity. See Section 7.3—Collaboration.

Community Engagement and Education

- Conduct a scan to assess potential interest in the issue of climate change, health, and equity including both current and potentially new partners.
- Conduct outreach to local Environmental Justice (EJ) groups, Community-based Organizations (CBOs), and community leaders to begin conversations regarding their interest and activities related to climate change, health, and equity.
    - Los Angeles County Department of Public Health contracted with a local EJ organization, Communities for a Better Environment, to conduct a workshop to gather community input on LADPH's extreme heat response plan. Community recommendations will be compiled and included in the response plan.
- Make an effort to meet potential CBO or community partners where they are and to develop an understanding of their current priorities, concerns and challenges, membership and constituency, strengths and resources, and level of interest in climate change and health equity.
- See Section 7.2—Engagement and Section 8—Communications.
    - The New Orleans Health Department partnered with Gulf Coast Center for Law & Policy to host community meetings to assess knowledge of the city's extreme weather response protocol, communicate impacts of climate change on health, identify community health service needs, and cultivate trust while prioritizing community action steps that address the intersection of climate and health.
- Recognize and acknowledge the inherent power dynamics between community members and government employees, people of color and White people, and people with different educational and socioeconomic backgrounds. Provide space and processes, such as agreed on ground rules for meetings and opportunities for one-on-one conversations, to address those dynamics.
- Identify strategies to build community capacity as you partner with CBOs and community members and leaders.
- Include community members in decision-making processes regarding LHD programs and investments.
- Establish fair and supportive mechanisms for participation when requesting CBO or community member participation in meetings or other partnership activities.
- Collaborate with CBOs and community members and leaders to develop culturally and linguistically appropriate materials for public information and dissemination and use an array of channels to ensure information reaches all members of the community.

Climate Change 101

Climate scientists are supplying a wealth of evidence about what is happening to the earth's climate and what it portends for our local environments, while other disciplines are identifying and developing effective interventions. Evidence-based public health practice requires that public health professionals apply evidence developed by epidemiologists, clinical researchers, and scientists across a broad range of other disciplines. You don't need to be a climate scientist to address the health risks of climate change or the health benefits of climate action. Our job is to draw on the science and apply it in public health practice.

97% of climate scientists agree that climate change is happening now and there is scientific consensus that is driven by human activity.[1]

Climate Change: One symptom of planetary health

While climate change is the greatest health challenge of our time, it is one of many disruptions to what is known as planetary health. Planetary health asserts that the scale and nature of human activity, including population growth, is pushing the limits of all the planet's resources to the brink of habitability. Human exploitation and consumption of Earth's resources are causing fundamental changes in the planet's biophysical processes, which include climate change, but also widespread pollution of air, water, and soils; rapid biodiversity loss; altering of carbon, nitrogen, and phosphorus cycles; pervasive changes in land use and land cover; and scarcity of resources critical to sustaining life, such as water and arable land.

"Each of these interacts with the others in complex ways, altering the quality of the air we breathe, the water we have access to, and the food we can produce. Rapidly changing environmental conditions also alter our exposures to infectious diseases and natural hazards such as heat waves, droughts, floods, fires, and tropical storms. These… ultimately affect every dimension of our health and wellbeing, including nutritional outcomes, infectious disease, non-¬communicable disease, displacement and conflict, and mental health outcomes…We need to expand the realm of public health to include how we manage our planet's natural systems: the types of cities we construct, how we produce energy, how we feed ourselves, and how well we protect our marine and terrestrial biodiversity. In the context of planetary health, the boundaries between public health and nearly every other facet of human activity become more porous. In short, we need a new paradigm."

Dr. Samuel Myers, November 2017[4]

3.1 What Is Climate Change?

- **Weather** is the temperature, humidity, precipitation, cloudiness, and wind that we experience in the atmosphere at a given time in a specific location. Weather forecasts are generally accurate over days to weeks. Climate is the average weather over a long time period (30–50 years) in a region.
- **Climate variability** refers to natural variation in climate that occurs over months to decades. El Niño, which changes temperature, rain, and wind patterns in many regions over about 2–7 years, is an example of natural climate variability. **Climate change** is a systematic change in the long-term state of the climate over multiple decades or longer.[2]

Climate scientists use statistical tests to ascertain that observed changes in climate are not within the range of natural variability. The 2017 Fourth National Climate Assessment states that "there are no alternative explanations supported by the evidence that are either credible or that can contribute more than marginally to the observed patterns."[3]

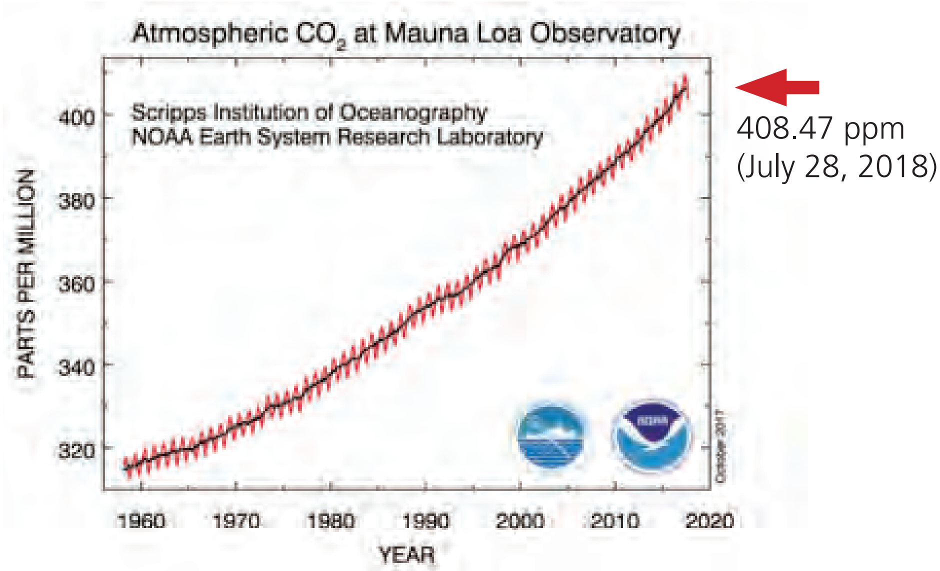
3.2 Greenhouse Gas Emissions Cause Climate Change[5]

Climate change is caused by a change in the earth's energy balance. The earth is gaining energy as the atmosphere increasingly stores more of the sun's energy than it radiates or reflects back into space.

Since the Industrial Revolution started over 200 years ago, human activities have added very large quantities of greenhouse gases (GHG), also called climate pollutants, into Earth's atmosphere through the burning of fossil fuels (e.g., coal, oil, gas). These GHG act like a greenhouse to trap the sun's energy and heat, rather than letting it reflect back into space.[6] Without these GHG the earth's atmosphere would be too cold for life, but when the concentration of GHG is too high, too much heat is trapped, and the earth's temperature rises outside the range of natural variability.

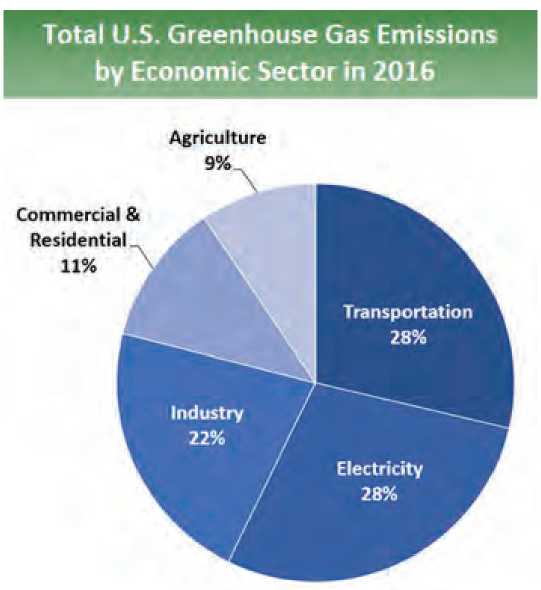
Carbon dioxide (CO_2) is the primary GHG from human activities—accounting for 81.6% of all U.S. GHGE in 2016—and is responsible for the greatest amount of warming to date.[7] The main human activity that emits CO_2 is the combustion of fossil fuels (coal, natural gas, and oil) for electricity production, transportation and industrial processes that together account for more than 80% of the CO_2 released into the atmosphere.[8] Our planet has not experienced CO_2 levels as high as now since approximately 3.5 million years ago when Earth was about 2.3°C warmer and sea levels 33–65 feet higher (Figure 3.2.1).[9] CO_2 has a long half-life, so the "climate effects of CO_2 released into the atmosphere will persist for tens, if not hundreds, of thousands of years into the future."[10]

Figure 3.2.1: Atmospheric CO_2 at Mauna Loa Observatory[11]



Other important GHG such as methane, nitrous oxide, black carbon, and various fluorinated gases are emitted in smaller quantities than CO_2, but they trap more heat in the atmosphere than CO_2 traps.[12] The ability to trap heat is measured as Global Warming Potential (GWP). As the most common and abundant greenhouse gas, CO_2 has a GWP of 1; all other GHG warming potentials are compared to it. Fluorinated gases, for example, have GWPs thousands of times greater than CO_2, meaning that pound-for-pound, these gases have a much stronger impact on climate change than CO_2.[13] (See Appendix 4 for a summary table of GHGE in the United States, their main sources, and their GWP and half-life in the atmosphere.) GHGE come from a variety of sources, but major sources include transportation, agriculture, and energy production (Figure 3.2.2).

Figure 3.2.2: Percentage of U.S. GHGE by Economic Sector, 2016[14]



Short-Lived Climate Pollutants

Greenhouse gases with a high global warming potential but a short lifetime in the atmosphere are called "short-lived climate pollutants" (SLCP), or "super-pollutants". Key SLCP include methane, black carbon, and some fluorinated gases. Because of the combination of a short half-life and high GWP, the climate change impacts of the SLCP are "front-loaded"—more of the impacts from SLCP occur sooner, while the full weight of impacts from CO_2 will be felt later. Methane, for example, comprises 10% of total U.S. GHGE and primarily comes from animal agriculture, food decomposition, and the extraction, distribution, and use of natural gas.[15]

Reducing emissions of short-lived climate pollutants may "buy time" while we make the transition away from carbon-polluting systems. Cutting global levels of SLCP significantly by 2030 will:[16]

- cut global warming in half, or 0.6°C, by 2050 and by 1.4°C by 2100;
- prevent 2.4 million premature deaths globally each year.

The Carbon Budget and the Urgency of Climate Action

For many years, there was a scientific consensus that holding global average temperature increases of 2°C (3.6°F) above pre-industrial levels would be "safe," meaning that although climate impacts would be significant, they would be manageable. However, far worse impacts of warming are occurring at a current average global temperature increase of 1.1°C (2°F) than had been anticipated. There is now great concern that if greenhouse gas emissions continue unabated, the Earth's temperature will rise about 4°C (2.7°F) by the end of the century with potentially catastrophic consequences for life on earth. In 2015, nearly 200 nations agreed in the Paris Agreement that the risks of catastrophic climate change are significantly reduced if we can keep global temperatures from rising more than 1.5°C (2.7°F).

Because GHG persist in the atmosphere for many years, the magnitude of warming and other climate impacts is not determined by emissions in any one year or from any one source, but rather by the total GHG in the atmosphere produced cumulatively and globally over time.[18] Scientists can calculate how much warming will result from different cumulative amounts of GHG in the atmosphere.

The "carbon budget" is the amount of carbon dioxide that can be emitted and still have a reasonable chance of remaining below a particular rise in global temperature. To remain below a 1.5°C rise, total global emissions cannot exceed 240 billion tons of carbon from now forward. This is our current "carbon budget."[19] Despite growing research into technological solutions to capture and remove CO_2 levels in the atmosphere, there is currently no known safe and effective way to remove emitted greenhouse gases from the atmosphere on a global scale. Reducing greenhouse gas emissions is thus the only known effective way to prevent using up our carbon budget. The longer we wait to reduce carbon pollution, the more drastic the action that will be required to remain within our carbon budget.

Runaway climate change: Climate scientists are concerned that some climate impacts may take on a life of their own, through positive feedback loops or surpassing of tipping points. For example, collapse of the West Antarctic Ice Sheet could lead to very rapid sea level rise, or melting of permafrost could lead to large releases of methane that would further increase warming through a positive feedback loop. Likewise, the whiteness of ice gives it high reflectivity, especially compared to the dark ocean water. As Artic ice melts, less heat is reflected by ice, more is absorbed by the ocean, leading to further warming and rising of sea levels.[17]

3.3 Human Activities Cause Climate Change

While GHGE are the proximate cause of climate change, the production and release of these gases into the atmosphere is primarily the result of human activity, embedded in key systems such as energy, transportation, agriculture, and our consumption-driven economy. These systems are also key contributors to health outcomes and health inequities (See Sections 2—Health Equity and 4—Health Impacts). For example:

- Transportation systems determine how people and goods get from place to place, affecting physical activity, traffic injuries, air pollution, and GHGE. Fuel prices, pedestrian and bicycle infrastructure, and access to public transit influence driving behavior. Transportation systems impact access to jobs and services, and the loss of farmland and habitat.[20]
    - The transportation sector contributed 28% of all U.S. GHG emissions in 2016.[21]
    - Transportation is one of the fastest-growing sources of domestic GHGE and accounts for nearly half of the increase in total U.S. emissions since 1990.[22]
    - On-road vehicles were responsible for the vast majority (83%) of transportation-related GHGE; passenger cars and light-duty trucks contribute 60% of these emissions.[23]
- Agriculture and food systems determine the cost of and access to different kinds of food and nutrition; what crops are grown, and how; water usage, soil health and depletion; deforestation, and biodiversity loss. Industrialized animal production generates methane from livestock manure, antibiotic resistance from the overuse of antibiotics to increase animal growth, and water contamination from the excessive application of nitrogen fertilizers and pesticides. Corn and soy subsidies reduce meat prices and increase meat consumption.
    - Agriculture was responsible for 9% of total U.S. GHGE in 2016, 52% of methane emissions, and 84% of nitrous oxide release.[24]
    - When fertilizer use, refrigeration, transportation, and land use changes, such as deforestation and soil depletion, are taken into account, our food and agriculture systems account for about one third of global GHGE.[25]
- Energy systems provide for heating, lighting, and cooking, but the incomplete combustion of carbon also produces significant air pollution (e.g. from indoor cook stoves in poor countries, and from coal-fired power plants around the world). An estimated seven million deaths are associated with air pollution every year—one in eight of total global deaths.[26] Coal and uranium miners are at very high risk of occupational illness and injury, and mining often causes irreparable damage to water sources and natural habitats.[27,28]

  - Electricity production contributes 28% of U.S. GHGE.[29]
  - Electricity generated from renewables releases about 1/20th the GHGE of coal over the full life cycle.[30] Switching from fossil fuels to clean, renewable energy is a critical path to the reduction of greenhouse gas emissions.
- Economic systems distribute, allocate and determine access to wealth and resources, foster or alleviate wealth inequities, offer access to livelihoods and employment, and—in concert with social value systems—determine how much value we place on consumption of goods and/or non-marketable resources such as clean air, clean water, and open space.

3.4 Environmental Impacts of Climate Change

Climate change is causing five critical global environmental changes:[31]

- **Warming temperature of the earth's surface and the oceans:** The earth has warmed at a rate of 0.13°C per decade since 1957, almost twice as fast as its rate of warming during the previous century.
- **Changes in the global 'hydrologic' (water) cycle:** Over the past century there have been distinct geographical changes in total annual precipitation, with some areas experiencing severe and long-term drought and others experiencing increased annual precipitation. The frequency and intensity of storms increases as the atmosphere warms and is able to hold more water vapor.
- **Declining glaciers and snowpack:** Across the globe, nearly all glaciers are decreasing in area, volume and mass. One billion people living in river watersheds fed by glaciers and snowmelt may be impacted by early spring runoff and flooding and diminished water flows in late summer.
- **Sea level rise:** Warmer water expands, so as oceans warm the increased volume of water is causing sea level rise. Melting glaciers and snowpack also contribute to rising seas.
- **Ocean acidification:** Oceans absorb about 25% of emitted CO_2 from the atmosphere, leading to acidification of seawater.

Economic Toll of Climate Change

The health, social and economic costs of climate change are likely to be enormous. One recent study linked temperature rise to economic impacts on agriculture, crime, coastal storms, energy, and human mortality. Nationally, every 1°C (1.8°F) rise in average temperatures could cost 1.2% of gross domestic product and could raise death rates by 5.4 per 100,000. If unabated, climate change could cause damages that cost the poorest third of U.S. counties up to 20% of their income.[32] Another study estimated the health costs of just six climate-related events at $14 billion.[33] In 2017 alone, the U.S. experienced 16 billion dollar climate-related disasters ranging from wildfires to tropical cyclones to crop freezes.[34] The rising costs of climate-related damages to infrastructure and economic productivity are likely to have ripple effects on funding for health and social needs. In contrast, a global assessment that monetized the health co-benefits of climate mitigation found that the value of avoided mortality averaged $50–$380 per ton of carbon dioxide, which far exceeds projected abatement costs.[35]

These global changes result in what we experience as changes in our local weather and climate.

- Greater variability, with "hotter hots," "drier dries," and "wetter wets"
- Higher average temperatures and longer frost-free seasons
- Longer wildfire seasons and more intense wildfires
- Loss of snowpack and earlier spring runoff
- Recurrent coastal flooding with high tides and storm surges
- Worsening air quality: Higher temperatures increase production of ozone (a key contributor to smog) and pollen, as well as increasing the risk of wildfires
- Longer pollen seasons and more pollen production

3.5 Climate Change in the United States

Various regions of the U.S. will experience climate change differently. Figures 3.5.1 and 3.5.2 show climate change in the U.S. and its effect on weather-related events and temperatures.[36] For a more comprehensive view, see the Fourth National Climate Assessment.[37]

Figure 3.5.1: Climate Change Across the United States[38]

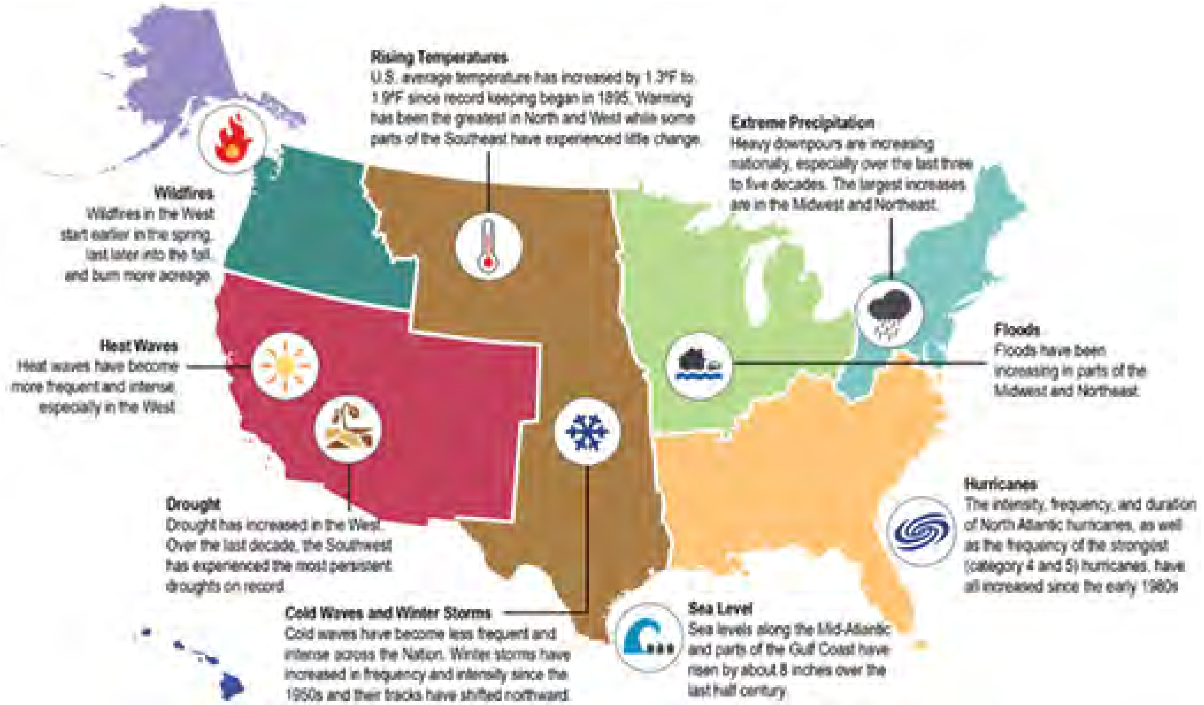
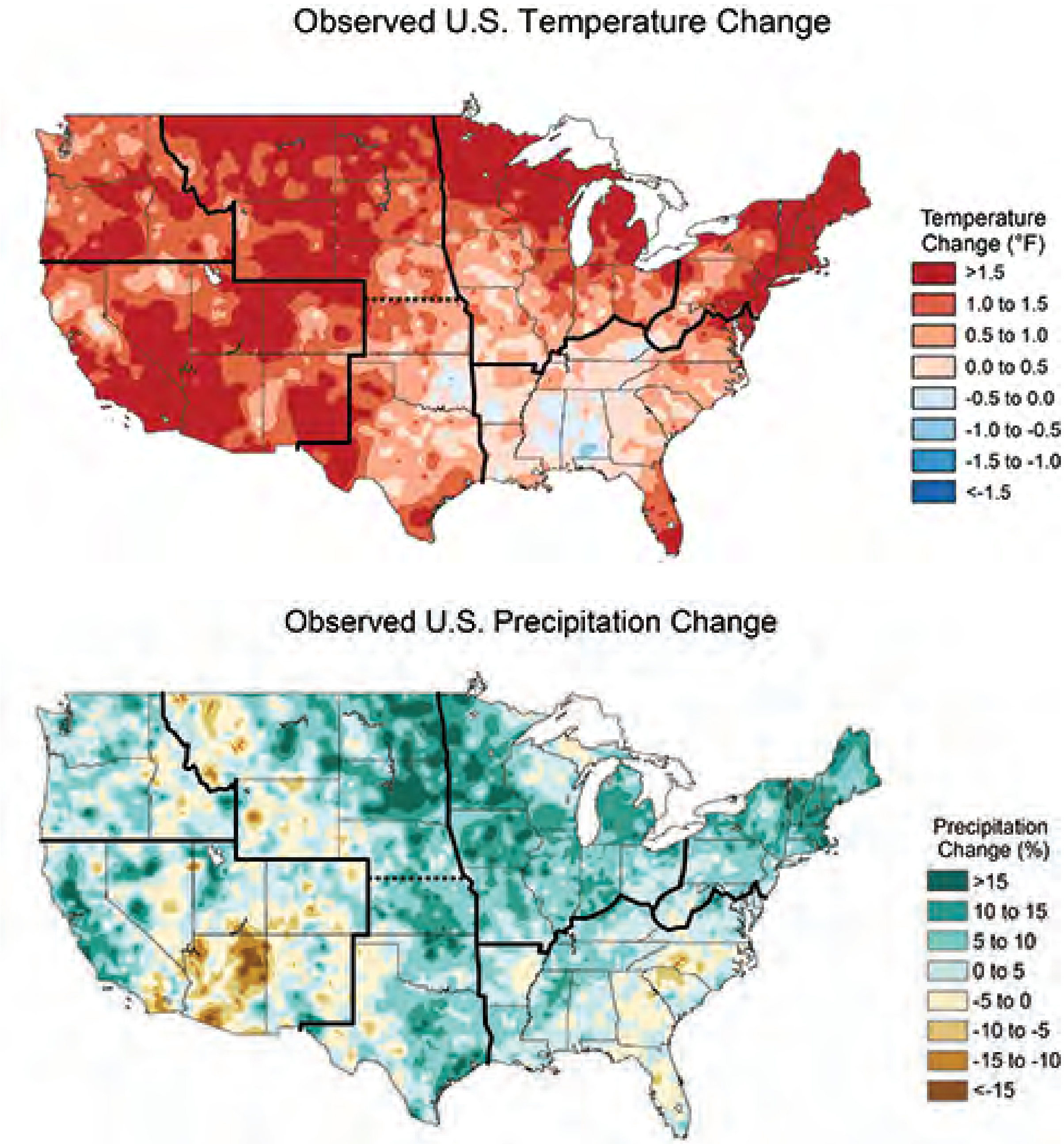


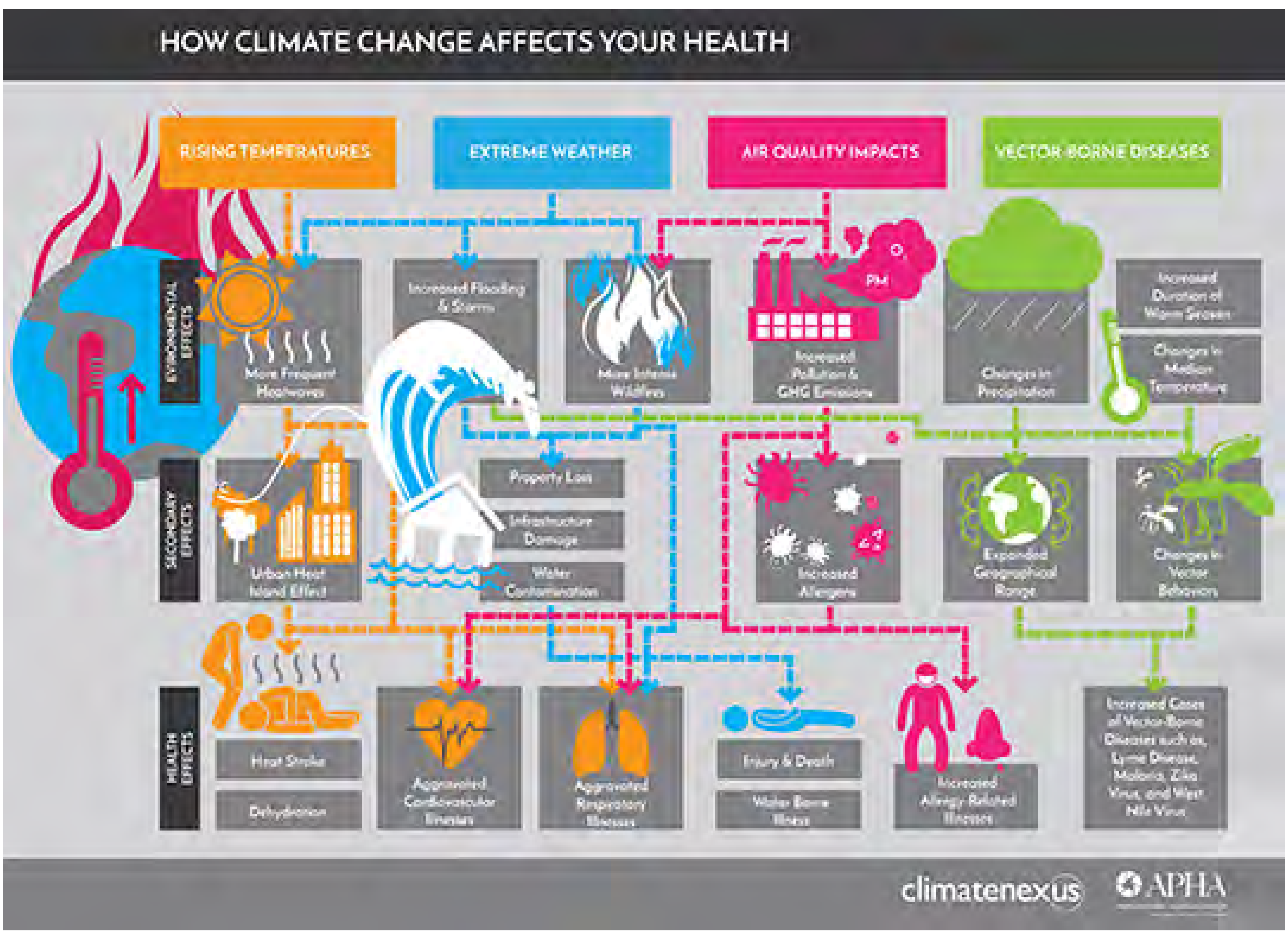
Figure 3.5.2: Observed Changes in Temperature and Precipitation in the United States Due to Climate Change (1991–2012 compared to 1901–1960)[39]



Every community is experiencing the impacts of climate change, albeit in different ways. These impacts will worsen as GHG accumulate in the atmosphere. To protect health, we must act to both reduce GHGE and prepare for the impacts of climate change.

Health Impacts of Climate Change

Climate change threatens the fundamentals that sustain life and health—fresh water, food, clean air, shelter, and security—and thus threatens the health and possibly the very survival of the communities that local health departments serve. Climate change is a global phenomenon, but it is people and communities at the local level that experience its consequences. Climate change exacerbates local and global health inequities because some people and communities bear an unfair burden of these health harms, including low-income communities, communities of color, native and tribal communities, the very young and very old, and those with chronic illnesses. This Section provides an overview of the health impacts of climate change.



APHA, Climate Nexus 2016

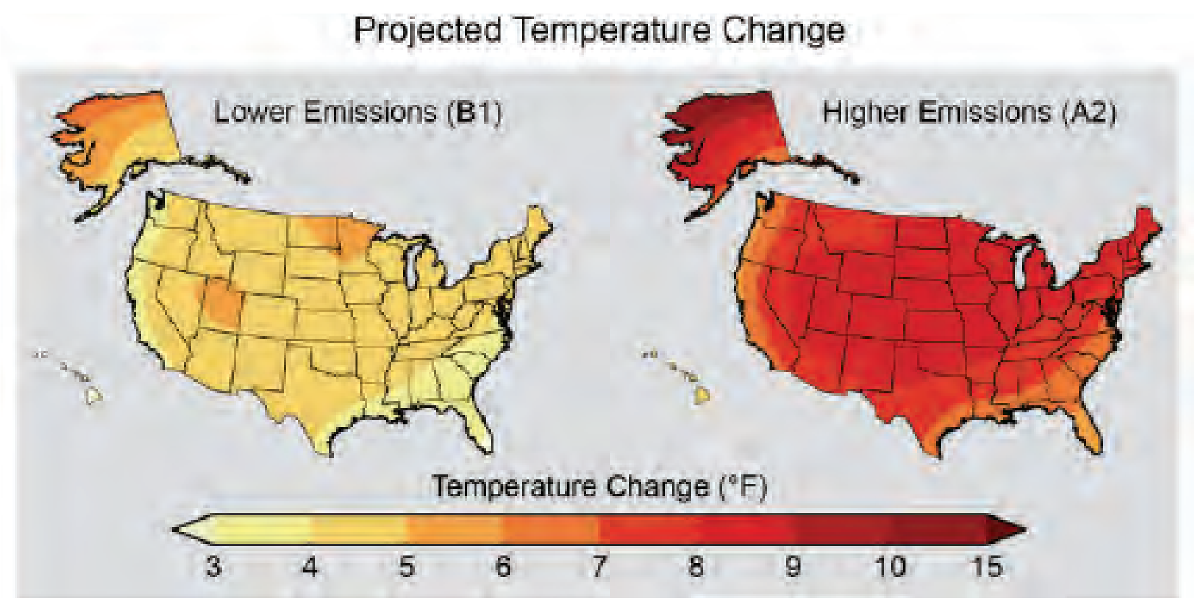
4.1 Extreme Heat

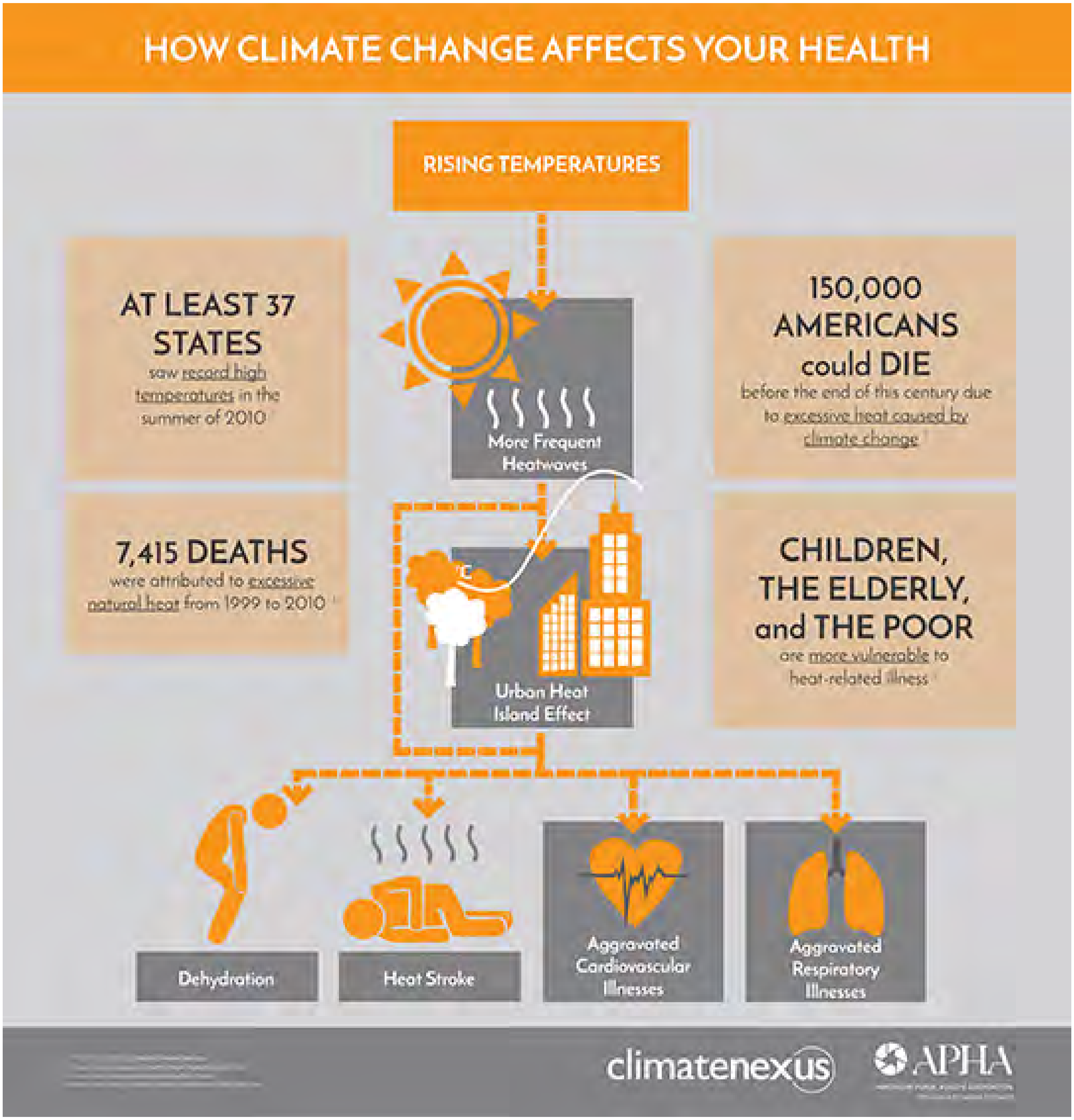
The CDC defines extreme heat as "summertime temperatures that are substantially hotter and/or more humid than average for that location at that time of year."[1] *Climate change increases extreme heat exposure.*

Climate Change Worsens Extreme Heat

- Seventeen of the country's eighteen warmest years on record have occurred since 2001.[2]
- In 2017, periods of extreme heat broke state records throughout the summer and fall. Every state had an annual average temperature that was warmer than usual.[3] Arizona, Georgia, New Mexico, North Carolina, and South Carolina had the warmest year on record.[4] There has been a dramatic increase in hot night-time temperatures in the U.S., reducing critical hours of relief during heat waves.[5]
- Different regions of the U.S. are expected to see varying levels of temperature increase due to climate change; average temperature is projected to increase by 3–5°F by the mid-2030s and 2.8–10.8°F by the end of the century.[6] See Figure 4.1.1.

Figure 4.1.1: Projected change in average surface air temperature from 2071 to 2099 relative to 1970–1999 temperatures under a scenario that assumes substantial reductions in GHGE (B1) and a higher emissions scenario that assumes continued increases in global GHGE (A2)[7]





APHA, Climate Nexus 2016

Health Impacts of Extreme Heat

Heat already causes more deaths than any other natural disaster.[8]

- From 1999–2010, 7,415 people died from heat-related illness in the U.S., an average of 618 per year.[9] Extreme heat results in excess death and illness through heat stroke, heat exhaustion, and exacerbation of chronic illness. In addition, heat exposure triggers multiple physiological mechanisms that cause damage to the brain, heart, intestines, kidneys, liver, lungs, and pancreas.[10]
- Increased ozone levels from extreme heat exacerbate asthma, respiratory disease, and cardiovascular disease.[11]
- Heat stress and associated dehydration can exacerbate renal disease and may be linked to new epidemics of chronic kidney disease.[12]
- Exposure to extreme heat impacts mental health through increased incidence of disease, death, violence, aggression, suicide and higher rates of admission for those with a psychiatric condition. Persons with mental illness may have triple the risk of death during a heat wave.[13] In the U.S., there is an association between periods of extreme heat and increased rates of violent crimes in cities.[14]
- Some medications are sensitive to heat and may lose effectiveness or cause harmful side effects when exposed to heat.[15] Other medications alter individual tolerance to extreme heat, increasing the risk of heat illness.[16]
- Heat waves contribute to crop and livestock loss, resulting in rising food prices and increased food insecurity.[17,18]

Extreme Heat and Health Equity

- **Urban heat islands:** Low income and communities of color are more likely to be located in "urban heat islands"—dense urban areas with fewer trees, less green space, more buildings, higher energy use, and more impervious asphalt and concrete. These characteristics create urban heat islands where nighttime temperatures may be as much as 22°F higher than surrounding areas. These vulnerabilities often map onto areas of historical residential segregation.[19]
- **Race and ethnicity:** As of 2013, African Americans were 52% more likely, Asian Americans 32% more likely, and Hispanics 21% more likely to live in heat vulnerable areas of the U.S. compared with non-Hispanic Whites.[20]
- **Rural communities:** The risk of heat-related mortality may be about 3% higher in rural areas when compared to urban areas, potentially linked with less access to health care services, greater proportions of elderly people, many outdoor occupations, fewer media to share heat information, and less access to air conditioning and transportation.[21]
- **Working conditions:** Outdoor farmworkers are at greater risk of exposure to extreme heat, and from 1992–2006, heat-related deaths were 20 times higher among crop workers than the general U.S. population.[22] Occupational heat stress and chronic dehydration may lead to chronic kidney disease in outdoor workers.[23]

LHD Spotlight: Cooling Centers in Maricopa County, Arizona

In 2005, 35 individuals died over a 9-day period of extreme heat in Maricopa County.[29] MCDPH partnered with the Arizona Department of Health Services and Arizona State University to evaluate community access to and perceptions of cooling centers by surveying facility visitors and managers and observing use during an extreme heat event.

There are 58 private and public cooling centers in Maricopa County—locations that are air-conditioned or cooled and have been designated as a site individuals can go to during heat events.[30] The evaluation found that many cooling centers were open only on weekdays, primarily in community centers, senior centers, and religious institutions without clear or visible signs notifying the public of the availability of a cooling center.[31] Eighty-four percent of visitors were unemployed, 33% had no permanent residence, and 11% of those who indicated a permanent residence had no air conditioning at their place of living.[32]

Maricopa County subsequently developed a Heat Relief Regional Network—a partnership of municipalities, nonprofit organizations, and faith-based organizations—to mitigate heat health risks. The Network maintains a list of cooling centers and services on available maps and hosts trainings on heat illness prevention for facility managers.[33]

- **Social isolation:** Social, cultural, and linguistic isolation are all risk factors for heat illness.[24] In the European heat wave of 2003, elders living alone had the highest mortality rates.[25]
- **Physical or cognitive impairments:** Limited mobility increases the risk of isolation, and the ability to move to a cooler location. Cognitive impairment may limit the ability to recognize risk or seek assistance during an extreme heat event.
- **Age:** The very young and the elderly are less able to sense and adapt to changes in temperature, due to limitations in body temperature regulation.
- **Chronic Illness:** Those with conditions such as obesity, diabetes or renal, cardiovascular and respiratory diseases are at higher risk of heat illness, including exacerbation of complications related to their underlying illness.[26]
- **Air Conditioning Access:** A 2005 study found that African American households had 5.3% higher heat-related mortality rate than White households, and had half the access to central AC.[27]
- **Evolving Extreme Heat Geography:** People living in some regions of the U.S., such as coastal communities, may be especially vulnerable to extreme heat because they are not currently acclimatized to increased temperatures but will experience increased high heat days.[28]

World Health Organization's Core Elements of Heat–Health Action Plans[43]

1. Agreement on a lead body to coordinate a multi-purpose collaborative mechanism between bodies and institutions and to direct the response if an emergency occurs.
2. Accurate and timely alert systems.
3. A heat-related health information plan (what is communicated, to whom and when).
4. A reduction in indoor heat exposure, including medium- and short-term strategies and advice on how to keep indoor temperatures low during heat episodes.
5. Particular care for vulnerable population groups.
6. Preparedness of the health- and social-care systems (staff training and planning, appropriate health care and the physical environment).
7. Long-term urban planning to address building design and energy and transport policies that will ultimately reduce heat exposure.
8. Real-time surveillance and evaluation.

What Local Health Departments Can Do

See Sections 6—Programs and 7—Functions

Assessment and Surveillance

- Conduct a heat vulnerability assessment for your jurisdiction:
  - Use available data to identify and map vulnerable populations, neighborhoods with characteristics that increase temperatures, and the location and availability of cooling centers.
  - Share this information with partners including health care providers and institutions, community based organizations, schools, emergency management agencies, and social services agencies.
  - Share this information with residents and community-based organizations to foster awareness of heat illness prevention and to elicit suggestions for steps the community and local agencies might take to address heat vulnerability.
  - Use the heat vulnerability assessment to demonstrate the need for preferential greening in tree and park poor neighborhoods, urban heat islands, and areas with high numbers of people with individual or household risk factors for heat illness.
- Initiate heat illness syndromic surveillance and partner with local health care facilities to implement reporting on heat-related illness (See the Section 7.1—Surveillance).

Intersectoral Collaboration

Collaborate with parks, public works, sustainability offices, and community groups to support and fund the expansion of green space and green infrastructure that reduces ambient temperatures and provides access to cooler spaces, including tree canopy, parks, water features, and urban streams.

- Ensure preferential planting of less allergenic trees and plants.[34]
- Implement cool and green roofs programs and support related rebates for homes and businesses.[35]

Following are example recommendations for intragency initiatives to combat heat:

- Provide shading for transit stops, bike lanes, and sidewalks; provide access to cooling buses by working with transit agencies and public works.[36]
- Collaborate with law enforcement and emergency services to train police and first responders to recognize heat-related illness in vulnerable populations and ensure that heat response plan includes strategies to reach homebound individuals.
- Ensure that local codes require facilities such as assisted-living establishments monitor and automate air-cooling systems to remain within comfortable temperatures in all living and communal areas.[37]
- Establish relationships with local OSHA officials and employers to ensure that outdoor workers and others vulnerable to heat are informed, and that employers are aware of their responsibilities to prevent occupational heat-related illness, especially providing plenty of drinking water, shaded cool areas, and extended breaks for workers.[38] Adjust work schedules to reduce physical demands during the hottest times of day.[39]
- Use home visits to assess housing conditions and vulnerability of household members, provide heat health information, and make referrals to social service agencies and programs that provide financial support (rebates, bill-paying subsidies) for services that could prevent heat-related illness (air conditioning, tree planting, weatherization).
  - Work with utilities and other agencies to inform residents about and ensure enforcement of “disconnection rules” that prohibit electricity cut-offs.[40]
  - Connect clients and communities to resources for financial support in coping with heat, such as Low-Income Home Energy Assistance Program (LIHEAP).[41]
- Work with housing and social service agencies to integrate extreme heat assessments and education into home visiting programs.

Prepare for Extreme Heat Events

Implement early warning systems for extreme heat events by collaborating with local weather forecasters to use a standard terminology for heat health and agree on the threshold used. In addition, consider the following:

- Broadcast extreme heat conditions with information on preventing heat illness, checking on neighbors and family members, and access to cooling centers.
- Set up a phone line and webpage in multiple languages with information on cooling centers and heat illness prevention. Ask the media to publicize these outlets.

Extreme Heat Warning in Death Valley
Graeme Maclean, 2014

Outdoor Farmworkers
Andrew Reding, 2012

- Contact local facilities that serve vulnerable populations (e.g. nursing homes, senior centers, schools and child care providers, homeless services) to ensure protocols for extreme heat are in place and facilities are prepared for activation.
- Establish and evaluate cooling centers to assess the availability of cooling centers and cool sites in your jurisdiction. Ensure there is adequate outreach to communities and vulnerable populations informing them of facilities and cooling sites open during extreme heat events.
    - Work with public agencies and local businesses to make more air conditioned spaces available for extended hours during extreme heat events and make sure that cooling site facilities have adequate power to continue air conditioning.
    - Survey visitors and facility managers of cooling centers to evaluate services, utilization, capacity, and accessibility, including via public transit.[42]

Community Engagement and Education

Integrate climate change in materials and media messages for the public to increase awareness that climate change is a health issue. Here is an advisory from a webpage warning of extreme heat and health issues:

> **Extreme Heat**
>
> **Original:** Hot and humid summer weather can cause heat illness and even death. More Americans die from heat waves than all other natural disasters combined.[44]
>
> **Modified:** Hot and humid summer weather can cause heat illness and even death. ***As climate change causes increasing temperatures around the world, our area can expect to experience more heat events like this.*** More Americans die from heat waves than all other natural disasters combined.

- Conduct public awareness campaigns in multiple languages and via various media to educate communities about strategies to reduce neighborhood heat and prevention of heat illness. See the CDC's Tips for Preventing Heat Illness for more information.[45]
- Inform clients to check with their doctor about medications that increase the risk of heat illness (e.g. psychotropic medications, diuretics, tranquilizers, some medications for Parkinson's disease) and whether prescribed medications (e.g. insulin) may lose effectiveness if exposed to high temperatures. See Polk County, Iowa's medications and heat handout for an example.[46]
- Educate local clinicians on the health impacts of heat and how they can protect patients and community health during extreme heat, and provide materials for patient waiting rooms. See *A Physician's Guide on Climate Change, Health and Equity*.

For More Information

- CDC Extreme Heat Preparedness:
    - English site and materials
    - Spanish site and materials
- US EPA Heat Island Effect Website
- *US Climate and Health Assessment*, Chapter 2: Temperature-Related Death and Illness
- APHA and CDC's *Extreme Heat Can Impact Our Health in Many Ways*

From Surveillance to Engagement: Maricopa County Department of Public Health

Maricopa County Department of Public Health (MCDPH) engaged with diverse partners to host a series of workshops, Bridging Climate Change and Public Health, elevating the health and equity impacts of climate change for numerous partners.

Maricopa County might be considered "heat central" in the U.S. Phoenix, the largest city in the county, has an average of 110 days with temperatures over 100°F and 19 days over 110°F. Average daily temperatures in the Southwest are projected to rise 2.5–8°F by 2100. Maricopa County Department of Public Health (MCDPH) conducts surveillance of heat illness, including syndromic surveillance. From 2006 to 2014, Maricopa County experienced 691 heat-associated deaths. A 2015 rapid epidemiologic assessment of households revealed that although 95% of residents have central air conditioning, high electricity and maintenance costs prevent many from using it.

MCDPH maintains public cooling centers and hydration stations throughout heat season, and partners with community organizations to promote their use and warn the public about heat risks. Although the 2015 Maricopa County Multi-Jurisdictional Hazard Mitigation Plan identified the likelihood of increased intensity and duration of extreme heat days due to climate change, MCDPH did not refer to climate change in its public communications on heat.

MCDPH recognized that the homebound population is exceptionally vulnerable to extreme heat, and in early 2016 launched a project to assess their needs. In partnership with the Area Agency on Aging, the City of Phoenix Home Delivered Meals program, Arizona State University (ASU), and Maricopa County Human Services Department, MCDPH created a survey that was distributed to homebound individuals by meal delivery staff. Of the 1300 surveys distributed, 472 people responded. The survey identified the need to increase awareness of heat-related services, simplify the process for obtaining services, and make transportation to cooling centers more accessible for homebound individuals.

From Surveillance to Community Engagement

In November 2016, MCDPH convened a wide array of stakeholders for the first "Bridging Climate Change and Public Health" summit. MCDPH presented the results of the homebound survey and information on impacts of climate change on extreme heat and health. With 45 participating organizations, it set the stage for further discussion about collaborative efforts to address the challenges of climate change. Staff found a very high level of receptivity to the discussion. *"Most importantly, we no longer hesitate to use the term climate change—it has proven to be much more acceptable in our community than we had anticipated."*

Following a second summit in May 2017, MCDPH convened stakeholders to develop a formal [Bridging Climate Change and Public Health Strategic Plan] for Maricopa County. In a series of three meetings, community partners identified five strategic directions, including:

- Celebrate incremental success and climate and health champions.
- Promote community awareness and public education about climate and health.
- Foster environmental and climate action for a healthier community.
- Coordinate research and collaborative efforts to catalyze change.
- Develop a strategic and targeted communication plan.

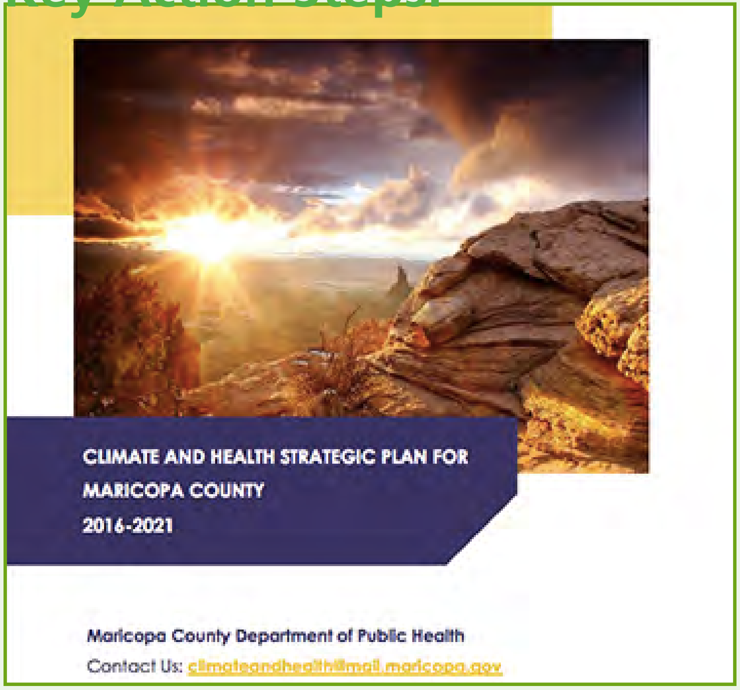
Future Work

MCPDH has received funding from the Arizona Department of Health Services Building Resilience Against Climate Effects (BRACE) program that will be used to implement the first Strategic Plan action step. Celebrating Success and Champions, will recognize Climate and Health Champions—local youth, citizens, schools, organizations, or businesses that are implementing sustainable solutions and/or ecofriendly practices or policies that promote health in the face of climate change. MCDPH sees the recognition of positive action as one more way to spread awareness about climate and health in Maricopa County.

Learn More

- Bridging Climate Change and Public Health Strategic Plan
- Bridging Climate Change and Public Health
- Maricopa County Heat Surveillance

Key Action Steps:



- Conduct surveillance on climate-related health impacts.
- Identify a vulnerable population of focus and work with diverse partners to more effectively reach that population, including assessing climate-related health needs.
- Utilize surveillance results to engage the public on climate and health.
- Host a summit or workshop to talk about climate, health, and equity connections; provide a structure for community and stakeholder input to identify actions to protect health.
- Develop a Climate and Health Strategic Plan with other local agencies and stakeholders.

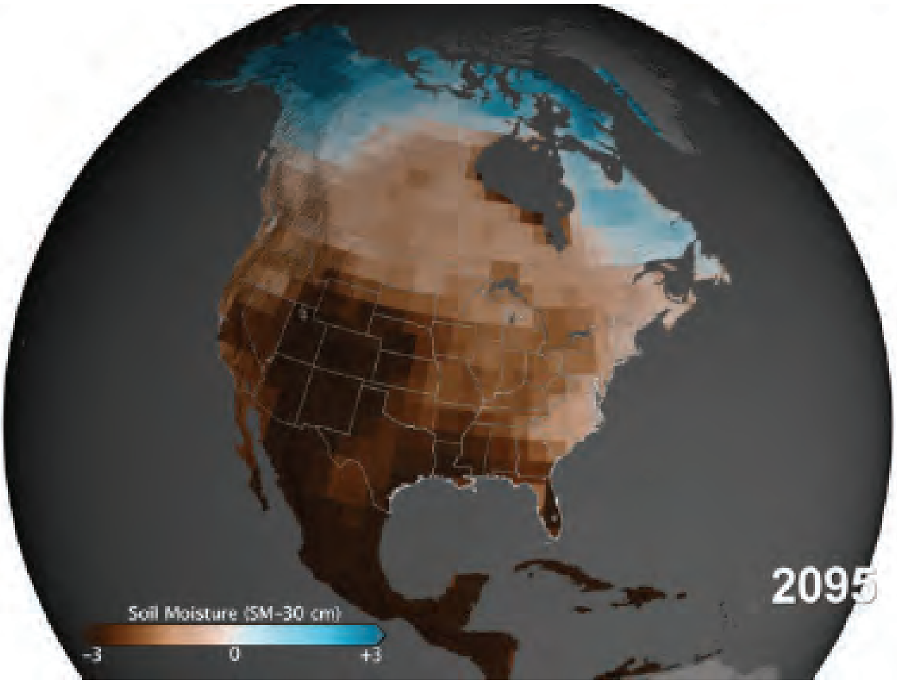
4.2 Drought

Climate Change Increases Drought Frequency and Intensity

Drought is a deficiency of rainfall over a period of time, resulting in a water shortage for some activity, group, or environmental sector.[1] Climate change is increasing the frequency, severity, and duration of droughts: A NASA analysis found that, with current greenhouse gas emission trends, the Southwest and Central Plains of the U.S. have an 80% likelihood of megadroughts that could last decades between the years 2050 and 2099 (Figure 4.2.1).[2]

- With emissions cuts, the chance of megadroughts in these regions decreases to 60%.[3]
- While the U.S. Dust Bowl in the 1930s lasted a decade, NASA analyses have found that future droughts throughout the U.S. may last at least 30 to 35 years, resulting in the driest periods of these regions in the last 1,000 years.[4,5]
- Water consumption and withdrawal of water from surface and underground water aquifers is increasing, and leading to greater pressure on limited water resources.[6]

Figure 4.2.1: Soil moisture 30 cm below ground projected through 2095 for high emissions scenario RCP 8.[7]



2013 Drought in Texas
Bob Nichols, USDA, 2013

Extensive Tree Die-Off in Sierra National Forest Wildland Urban Interface
U.S. Forest Service, Pacific Southwest Region 5, 2016

Health Impacts of Drought

People need water to drink, cook, grow food, and for sanitation and hygiene. Severe drought may reduce water access (including through strict conservation measures) so that water for these purposes is limited. Drought can cause these health risks:

- Lower crop yields and increased crop loss contribute to rising food prices and amplify food insecurity, associated with increased risk of chronic diseases.[8]
- The affects of drought on physical health, food security, economic livelihood, social stability, and forced migration can have serious mental health impacts.[9]
- Drought can increase the concentration of industrial chemicals, heavy metals, and agriculture runoff contaminants in groundwater, increasing the risk of toxic exposure if communities increase reliance on groundwater sources as surface water diminishes.
- As communities draw on groundwater, land sinking puts infrastructure like roads, aqueducts and levees at risk of permanent damage.[10]
- Drought increases over-pumping of groundwater that contributes to seawater intrusion and increased groundwater salinity[11] (See Section 4.6—Sea Level Rise).
- Dry vegetation and increased heat from drought are associated with more frequent wildfires, which have widespread health impacts (See Section 4.3—Wildfires).[12]
- Drought increases the risk of infectious and vector-borne disease. The risk of Valley Fever increases as soil dries out and dust is dispersed in the air.[13] Due to increased household water collection during drought, increased pools of stagnant water in storm water and sewer pipes can bring mosquitoes closer to human populations and increase vector-borne disease transmission.[14] As animals seek water, they and the insects they host may move closer to where people live, increasing the likelihood of human exposures (See Section 6.2—Infectious Disease).[15]
- Due to crop loss and lower yields, drought can cause displacement and mass migration for agriculture workers. By 1940, the Dust Bowl had forced 2.5 million people out of the Plains states.[16]

Drought and Health Equity

- **Poverty:** Those with limited financial resources are vulnerable to food and water insecurity from rising food and water prices associated with drought and crop loss.[17]
- **Agricultural Workers:** Farmers and communities are more vulnerable to the adverse economic impacts of drought, and to the mental health impacts.[18]
- **Rural Communities:** Poor rural communities are disproportionately reliant on small water systems or private drinking water wells, and thus at increased risk of water shortages or exposure to contaminated well water.[19]
- **Tribal Communities:** Native communities are already facing impacts of long-term drought on their agriculture and livestock, springs, medicinal and culturally important plants, and drinking water supplies.[20] Native communities are more likely to lack access to clean, potable drinking water than other groups in the U.S.[21]
- **Chronic Illness:** Lack of safe drinking water can exacerbate pre-existing renal disease.[22] Food insecurity is associated with higher risks of chronic illness such as diabetes and hypertension (See Section 4.8—Food Security).
- **Race and Ethnicity:** African American and Filipino populations are at increased risk of contracting dust-related Coccidioidomycosis (Valley fever).[23] Eighty percent of U.S. farmworkers identify as Hispanic, and this group is more vulnerable to economic impacts of extended periods of drought.[24]

What Local Health Departments Can Do

See Sections 6—Programs and 7—Functions

Assessment and Surveillance

- Work with water utilities and other agencies to conduct a drought vulnerability assessment.[33]
    - Assess climate impacts on likelihood of drought, the projected impact on agriculture/farming, inventory of well owners, community water sources, water pricing, and water insecurity.
    - Identify vulnerable populations and community assets.
    - Monitor water price increases and assess impacts on low-income residents.
    - Scale mosquito monitoring to correspond to changes in precipitation and identify where nesting sites may proliferate due to drought.
    - Increase groundwater and surface water quality monitoring during drought for increased concentration of contaminants and increased salinity in areas at risk of saltwater incursion.
- Survey households using the Community Assessment for Public Health Emergency Response (CASPER) methodology to understand the drought's impact on household water use, water access, conservation behaviors, hygiene, work, budgets, and health to plan programming and response to needs of your jurisdiction (See Section 7.1—Surveillance).[34]
- Enhance monitoring of water quality and contamination during drought.[35]

LHD Spotlight: Understanding the Impacts of Drought in Tulare County, CA[25]

Tulare County, California is a rural agricultural community in California's San Joaquin Valley and may be a harbinger of what increased drought looks like. As the worst California drought in recorded history lingered on, private wells in Tulare County started to run dry. By November 2015, 1,308 wells had run dry, affecting over 6,000 residents.[26]

- Thousands of agricultural workers lost their jobs as thousands of acres of farmland were fallowed.
- Local food banks and other services were overwhelmed.
- Local emergency rooms reported a 25% increase in respiratory disease visits.[27]
- The community saw a rise in illnesses such as West Nile Virus and Valley Fever and twice the statewide rate of diarrheal disease in 2013.[28,29]
- Throughout the county, there were rising levels of stress, anxiety, depression, and other mental health concerns.[30]

To better understand how the drought was impacting communities within its jurisdiction, the Tulare County Health and Human Services (TCHHS) Agency partnered with the California Department of Public Health's Division of Environmental and Occupational Disease Control to survey residents using the Community Assessment for Public Health Emergency Response (CASPER) methodology. TCHHS representatives went door-to-door within clustered regions of the county to gather responses to a survey assessing 1) household demographics, 2) drought knowledge and practices, 3) water access and use, 4) conservation practices, 5) related employment and health impacts, and 6) emergency communication preferences.[31] This informed TCHHS about vulnerable communities in their jurisdiction and how to improve drought-related communications.

Many of the residents surveyed were undocumented and were thus afraid to report that their taps had run dry, providing TCHHS with vital information on vulnerability within the community to improve their outreach efforts. In some communities, a third of the households requested Spanish for emergency communications. These surveys highlighted potential entry points for programmatic action, such as improving conservation behaviors or ensuring better hygiene practices.[32]

Intersectoral Collaboration

- Work with local water agencies/suppliers to develop protocols to ensure that water price increases do not lead to water shutoffs that impact health and well-being.
- Work with local water agencies and suppliers to prepare community drinking water delivery plans to supplement drinking and hygiene supplies in vulnerable areas.[36] Provide alternate water supplies, including hauled water and bottled water.
- Collaborate with parks and recreation, public works, and community groups to support rain water catchment and grey water reuse.

- ○ Educate community members about safe and healthy water conservation.
- ○ Ensure water from community rain barrels is clearly marked for non-potable uses and ensure individuals installing home rainwater systems are informed about safe usage.
- ○ Promote the use of screens and other mosquito deterrents for water storage vesicles to prevent the spread of mosquito-borne illness.

- Work with local water agencies to assess permit requests for new wells or requests to dig existing wells deeper to prevent additional draws on local water resources in drought prone areas.[37]
- Support improvement of existing water systems to ensure adequacy of access to safe and clean drinking water, such as: establishing connections to adjacent public water system, replacing or rehabilitating wells, increasing access to temporary treatment systems.

Prepare for Droughts

- Prepare for an influx of public health service requests with prolonged drought.[38] Anticipate extra resources for vector control.
- Collaborate across agencies and community groups to build support for initiatives that protect ever more precious water from contamination (e.g. nitrate contamination policies, reducing pesticide use) to reduce the likelihood of enhanced contamination.[39]

Community Engagement and Education

- Integrate mentions of climate change in materials and media messages for the public, to increase public awareness that climate change is a health issue. Opportunities include public health alerts, health advisory announcements, and educational materials and campaigns related to drought. For example:

Drought

Original: Drought can cause significant mental health impacts on residents, especially in rural communities that depend upon farming and ranching as a basis of economic support. Risk of stress, depression, suicide, and substance abuse may increase during a drought.[40]

Modified: Drought can cause significant mental health impacts on residents, especially in rural communities that depend upon farming and ranching as a basis of economic support. Risk of stress, depression, suicide, and substance abuse may increase during a drought. California ***is likely to experience extended periods of drought in coming decades due to climate change***.

- Conduct public awareness campaigns—in multiple languages and via various media—and educate clients and communities on the rising risks of drought due to climate change, health risks associated drought, and how to prevent them, including:
  - ○ Use language-appropriate outreach to inform residents of available drought assistance, including behavioral health, public health, and food assistance services.[41]

- Disseminate information on water conservation during routine facilities inspections and home visits.[42]
- Communicate the importance of hand hygiene and educate clients on alternatives that can be used when water is limited.[43]
- Discuss how prolonged drought may increase West Nile Virus incidence and how to avoid transmission: use of insect repellent, clothing, window screens, destruction of breeding habitat, avoiding outdoors during peak hours.
- Educate communities on Valley Fever and how to avoid transmission: avoiding areas and activities with high dust exposure (construction or dusty fields, gardening, etc.), staying indoors with windows closed on windy and dusty days, and ensuring good indoor air filtration.
- Educate communities about how to access and wear respirators, such as an N95 mask if activities in areas with poor air quality cannot be avoided.
- Discuss the social and psychological impacts of drought and refer clients to mental health services.

- Provide well owners with information on testing wells more frequently during drought when there is less water to dilute contaminants.[44,45]
- Educate local clinicians on the health impacts of drought and how they can best protect patient and community health during droughts. For more information see *A Physician's Guide on Climate Change, Health and Equity*.

For More Information

- *Preparing for the Health Effects of Drought: A Resource Guide for Public Health Professionals*
- CDC Drought and Health site
- *When Every Drop Counts: Protecting Public Health During Drought Conditions, A Guide for Public Health Professionals*
- Health effects of drought: A systematic review of the evidence
- NACCHO's *How Local Health Departments can Assist in Response to the California Drought*
- *US Climate and Health Assessment*, Chapter 4: Extreme Events
- APHA and CDC factsheet on extreme rainfall, drought, climate change, and health

N-95 Mask Fit Testing by Alamosa County Public Health
Alamosa County Public Health, 2010

Firefighters During Idaho Wildfire
U.S. Department of Agriculture, 2012

4.3 Wildfires

Climate Change Increases Wildfire Risk

Climate change causes higher temperatures, earlier snowmelt, and drier conditions that increase the frequency, intensity and duration of wildfires, as well as the length of wildfire seasons in the U.S.[1]

- Wildfire seasons are expected to be longer and stronger across the U.S. by 2050.[2] High fire years are likely to occur 2–4 times per decade by 2050, instead of once per decade, as was the average before 2010.[3]
- Increasing development at the wildland-urban interface places more homes and people at risk. In 2015, a USDA study assessed vulnerability in “wildland/urban interface” and found almost one-third of the U.S. population lived in the most vulnerable areas to wildfires.[4]
- Warmer temperatures and precipitation changes associated with climate changes are contributing to growth in bark beetle populations, leading to millions of dead trees across Western forests.[5] Unhealthy forests may contribute to more intense wildfires.[6]

Wildfires Worsen Climate Change

Wildfires contribute to global warming by releasing massive amounts of carbon into the atmosphere and reducing the amount of forest available to sequester carbon.[7] Up to 3% of annual U.S. greenhouse gas emissions come from wildfires.[8] Western forests are important carbon sinks, capturing 20–40% of U.S. carbon emissions.[9] The EPA estimates that U.S. wildfires emitted around 164.1 million metric tons of carbon dioxide in 2015, growing substantially from previous years, and accounting for 2% of the country’s annual CO_2 emissions.[10]

Health Impacts of Wildfires

- Wildfires are a major source of particulate matter (PM).[18,19] PM exposure increases the risk of cardiovascular disease and respiratory illnesses, and wildfires increase the risk of premature death, exacerbated asthma, bronchitis, chest pain, and negative birth outcomes from PM exposure.[20]

- Wildfire smoke can travel long distances and affect the health of people far downwind of the fire. Smoke from the 2002 wildfires in Quebec caused a 30-fold increase in PM2.5 in Baltimore, MD, which is nearly 1,000 miles downwind,[21] and pollutants from a 2004 Alaska wildfire were found in Europe.[22] Air quality in surrounding regions can also remain poor for weeks.[23]
- Wildfires also increase exposure to carbon monoxide, ground level ozone and toxic chemicals released from burning building materials or used to fight the fire.[24]
- Indoor air quality is impacted as smoke penetrates into homes, which is where the majority of exposure to wildfire particulate matter occurs for individuals sheltering in place.[25]
- Wildfires cause immediate harm through burns, traumatic injury, smoke inhalation, and heat stress; wildland firefighters are at particularly high risk.[26,27]
- Soil erosion and runoff from wildfires can contaminate water supplies far downstream from the fire site, negatively impacting the quality, quantity, and availability of safe freshwater supplies.[28]
- Wildfires can leave soils damaged and vulnerable to extreme erosion, which can lead to dangerous flooding and mudslides if heavy rains impact the area after the fire.[29]

Western Wildfires in 2017

- Wildfires burned 9,781,062 acres across the U.S., the 3rd largest acreage burned in a year in U.S. records, killing 54 people and costing over $18 billion in damage.[11,12]
- In Montana, a total of 2,420 fires burned 1.4 million acres, surpassing the previous record set in 2012 for the most area burned in the state for over 100 years.[13]
- In the fall, dozens of wildfires across the Pacific Northwest blanketed the region in thick smoke, creating states of emergencies in many areas.[14]
- There were 7,117 fires in California that burned 505,956 acres, more than double the previous five-year average (202,786 acres).[15]
- Five of the twenty most destructive wildfires in California history occurred in 2017.[16]
- Fires across Southern California in December burnt away vegetation, leaving soils vulnerable to flooding and erosion. In January 2018, heavy rains in these areas led to dangerous flooding and mudslides that killed more than 20 people.[17]

- Wildfires burn everything in their path, including dangerous chemicals (e.g. in pesticides, propane, gasoline, plastic, and paint) that can burn down to ash with very high concentrations of any toxic components.[30] Clean-up workers may be at highest risk of exposure.
- Wildfires stress health care and public health systems, including skilled nursing facilities, with evacuations, increased medical visits, and the need for emergency response resources.
- The stress, displacement, and loss of home and community associated with wildfires can cause significant mental health problems, including anxiety, depression, and PTSD.[31]

Wildfires and Health Equity

- **Age:** The very young and the very old are more sensitive to the air quality impacts of wildfires. For children, their developing respiratory systems make them vulnerable to long-term impacts of wildfire smoke, particulates, and ground level ozone.
- **Place:** Communities and households at the wildland-urban interface where human-built environments are adjacent to areas of wildland vegetation are at greater risk of wildfires.[32]
- **Socioeconomic Status:** Low-income households are less likely to have disaster insurance and have fewer resources to cope with or rebound from home and property loss or temporary displacement.
- **Race and Ethnicity:** African Americans have higher rates of asthma and cardiovascular disease that increase sensitivity to the health effects of smoke.
- **Tribal Communities:** Native American and Alaska Native populations living near forested regions are at increased risk of displacement, smoke-exposure, injury, and property loss, especially if more populated areas are prioritized for fire management response.[33]
- **Legal Status:** Undocumented families are not eligible for FEMA assistance and even those who are eligible may fear applying. Immigrants may also have concerns about accessing evacuation shelters and other relief services due to inadequate cultural and linguistic competency of service providers, and undocumented immigrants may fear legal repercussions of seeking services.[34]
- **Emergency Responders:** Firefighters, health care personnel and emergency responders are at increased risk for injury, death, and respiratory impacts of wildfires, as well as mental health affects due to trauma. Wildfire fire fighters are exposed to safety hazards, including burns, electrocution, ash, slips, trips and falls, falling trees, rocks, and vehicle accidents.[35,36]
- **Outdoor Workers:** Other outdoor workers (farmworkers, utility workers) are at risk for respiratory effects of smoke and pollution.[37]
- **Underlying Health Conditions and Status:** Individuals with pre-existing cardiac or respiratory disease are at risk of disease exacerbations due to wildfire smoke. The emergency conditions created by wildfires disrupt individuals' ability to adequately manage their health conditions.
    - People with disabilities (mobility, sensory, cognitive) may be at greater risk of injury or death during evacuations from wildfires.

What Local Health Departments Can Do

See Sections 6—Programs and 7—Functions

Assessment and Surveillance

Assess which neighborhoods and what critical infrastructure are vulnerable to wildfires. Wildfires can cause health problems in communities well downwind of a fire and air quality can remain poor for weeks.[38]

The EPA Community Health Vulnerability Index for wildfires includes: asthma prevalence in children and adults, chronic obstructive pulmonary disease, hypertension, diabetes, obesity, percent of population 65 years of age and older, and indicators of socioeconomic status.[39] Researchers recently mapped social vulnerability and biophysical vulnerability to identify communities at risk in the coterminous U.S., areas with high wildfire potential had, on average, *lower* social vulnerability to wildfires.

- Collaborate with local fire departments and forest services to identify areas vulnerable to wildfire.
- Work with local air quality control agencies to ensure that plans are in place for adequate monitoring of wildfire smoke, both at fixed stations and through low cost, portable monitors for rapid and localized monitoring as fires and winds shift.
- The data from these indices can be used alongside modeled air quality forecast data generated to develop maps of communities with vulnerable populations.
- Partner with local health care partners and facilities to develop systems for syndromic surveillance of smoke-related illness, and implement at the onset of a wildfire in your region or if smoke from afar is creating poor air quality (See Section 7.1—Surveillance).
- After a wildfire, survey households using the Community Assessment for Public Health Emergency Response (CASPER) methodolog[40] (See Section 7.1—Surveillance).

Intersectoral Collaboration

Collaborate with community-based organizations to inform vulnerable communities about climate impact projections for wildfire, and engage community residents in preparedness efforts. In addition, work with:

- Zoning departments to support land use policies that reduce development at the urban-wild land interface.[41]
- Building and code enforcement for strengthening building codes to ensure flame resistance for buildings in wildfire-prone areas.[42]
- Local forest service to support smart forestry management, e.g. controlled burns and thinning to manage overcrowded forests, which are more susceptible to wildfires.[43]
- Fire and air quality agencies to deploy air monitors that send information from the ground to satellites, which transmit real time data to web tools so people can remain informed about smoke levels and air quality during a wildfire.[44]
- Social services and health providers to provide HEPA filters to individuals at high risk for smoke-related illness, as smoke can penetrate homes during wildfires.[45]
- Local tribes to ensure Native communities know where shelters are located and how to access services following a wildfire.

Prepare for Wildfire Emergencies

Preparation for wildfire emergencies requires attention to what should happen before, during and after a wildfire event:

- Work with emergency management agencies to engage residents in neighborhood trainings including instructions on how to respond if a fire encroaches their property.
- Prepare evacuation and displacement plans. Include plans for shelters that are equipped to provide clean air, especially for vulnerable populations.

  - Establish and exercise plans to ensure that all community members receive information about evacuation orders and the location of shelters
- Plan for provision of fitted respirators and masks (P100 or N95)—and how to use them—for those in smoke-laden areas.
- When deciding on potential closures, consider pollutant levels inside schools and businesses and how they are likely to compare to those in homes—in some cases, schools may be safer for children.[46]
- Consider strategies to provide home air filtration (e.g. HEPA filters) for high risk individuals.[47]
- Coordinate with pharmacies to allow prescription refills for critical medications without renewed contact with physicians during emergencies.[48]

Be ready to provide information and support after a wildfire:

- Connect clients and communities with evacuation and relief centers and financial resources to help cope after wildfires. Vulnerable communities and undocumented individuals and others may be hesitant to access services. For an example of assistance for undocumented families after a wildfire, see the Undocufund site.[49]
- Work with social services and mental health agencies to assure access to mental health services, including for children.
- Provide guidelines for safely inspecting and reentering properties[50], and make this information readily available in emergency shelters, online, through media, in multiple languages, etc. Include information on health hazards associated with fire retardants and toxic ash, and about the potential for food contamination.[51]

Community Engagement and Education

Find opportunities to integrate mentions of climate change in materials and media messages for the public whenever relevant, to increase public awareness that climate change is a health issue. Opportunities include public health alerts, health advisory announcements, and educational materials and campaigns related to wildfires.

Wildfires

Original: Droughts and dry conditions throughout various times of the year increase the risk for wildfires. Careless use of fire in highly wooded areas can also dramatically increase the chance of a wildfire, which can then quickly spread across trees and dry brush and threaten homes and businesses that are in vicinity.[52]

Modified: Droughts and dry conditions throughout various times of the year increase the risk for wildfires. ***Wildfires are increasing in intensity in our area due to climate change.*** Careless use of fire in highly wooded areas can also dramatically increase the chance of a wildfire, which can then quickly spread across trees and dry brush and threaten homes and businesses that are in vicinity.

- Provide guidelines, in multiple languages and via various media, on how to reduce smoke exposure including the following example recommendations:[53]
    - Close up homes and buildings by shutting windows and doors
    - Set air conditioners to "re-circulate" settings to prevent smoky outside air from being drawn into the building
    - Use air cleaners and HEPA filters
    - Avoid vacuuming or other activities that can disperse dust
    - Reduce physical activity and drink plenty of fluids
    - Check the AirNow website (www.airnow.gov) for updated air quality information throughout the day as smoke patterns change due to wind and other conditions
    - Wear appropriate respirators and masks (P100 or N95) properly when outside or in smoke-laden areas and contact local emergency relief services for fitted respirators if needed.
- For clients and community groups in areas at greater risk of wildfire (e.g. in the WUI)
    - Educate clients about maintaining a "defensible" space clear of brush and trees.
    - Advise clients to create a personal and family emergency plan in case of evacuation from wildfire.
    - Create informational materials for parents and guardians of young children on the additional risks children face during and after a wildfire with information to protect them against smoke inhalation, chemical exposures, and other hazards.[54]
    - Provide air quality notifications after a wildfire and urge communities to limit outdoor exposure in times of heavy smoke pollution.

Educate local clinicians on the health impacts of wildfires and how they can best protect patient and community health during wildfires. For more information see *A Physician's Guide on Climate Change, Health and Equity*.

For More Information

- Oregon Health Authority Wildfires and Smoke Page (includes patient care guides)
- Washington Department of Health Wildfire Smoke page
- Centers for Disease Control Wildfire Emergency Response page
- EPA's Air Monitoring Toolbox

4.4 Air Quality

"The risks from air pollution are now far greater than previously thought or understood, particularly for heart disease and strokes… evidence signals the need for concerted action to clean up the air we all breathe."

Dr. Maria Neira, Director, WHO Department for Public Health, Environmental and Social Determinants of Health[1]

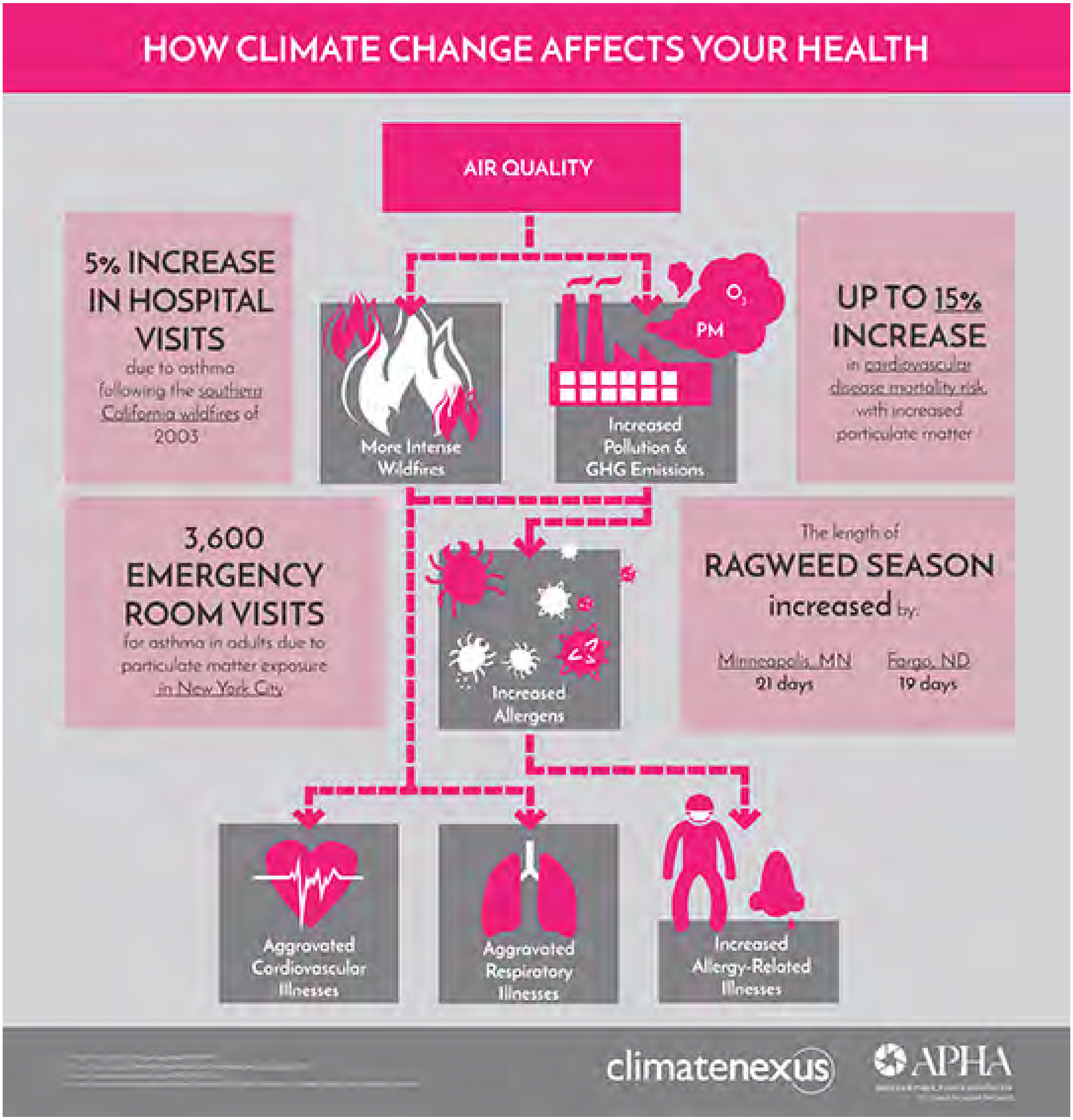
Climate Change Worsens Air Quality

- Climate change makes it difficult to attain national air quality standards for ground-level ozone, a major component of smog, because climate change is causing higher temperatures, which increase ozone formation, and increasing the frequency of stagnation events that create the worst ozone episodes.
  - Increased ozone levels due to climate change could result in thousands of additional illnesses and deaths per year in coming decades.[2]
- Climate change is increasing the frequency and intensity of wildfires, which can spread pollution and particulate matter over large distances, increasing the risk of premature deaths and respiratory and cardiovascular disease risks (See Section 4.3—Wildfires).[3]
- As droughts increase in frequency and severity due to climate change, increased dust levels from dried soil worsens air quality.
- Climate change also impacts indoor air quality, as intensified storms and flooding lead to excess moisture and mold production.
- Air conditioner use increases with higher temperatures and more extreme heat days, causing increases in air pollution from fossil fuel based electricity production.

Air Pollution and Health

There are 133.9 million people in the U.S. exposed to unhealthy levels of air pollution, and 41% of people in the U.S. live in counties with unhealthy levels of ozone or particulate matter.[4]

- Poor air quality exacerbates existing respiratory illness including asthma.[5]
- Increased ozone levels due to climate change could result in thousands of additional illnesses and deaths per year in coming decades.[6]
- Air pollution exposure is associated with higher risks of cardiovascular disease and lung cancer, and may be related to both low birth weight and preterm birth.[7,8]
- Poor air quality limits physical activity, which is important for cardiovascular and bone health, obesity prevention, and mental health.
- Mold exposure from flooding and excess indoor moisture is associated with upper respiratory tract symptoms, cough, and wheeze, and can exacerbate asthma.[9]



APHA, Climate Nexus 2016

Air Quality and Health Equity

- **Poverty:** Low-income households and communities of color are more likely to have neighborhood characteristics that increase exposure to climate change-related air pollution, such as proximity to roadways and polluting industries, lack of green space, and urban heat islands.
  - Those living in areas with a median household income of $20,000 or less experience rates of emergency room visits and hospitalizations for asthma that are four times higher than those in areas with a median income greater than $100,000.[10]
  - Low-income households, people of color, and non-English speaking and foreign-born persons are more likely to live near busy roadways, and therefore face worse air quality.
  - Lack of adequate coverage and health care can result in poorly managed disease for those with respiratory or cardiovascular illness.
- **Race and Ethnicity:** In the U.S., 11.2% of African Americans are currently diagnosed with asthma, (compared to 7.7% of Whites) and have an ED visit rate for asthma three times higher than Whites.[11] Nearly 1 in 2 Latinos live in counties frequently violating clean air and ozone standards, exacerbating air quality issues, and Latino children are twice as likely to die from asthma as non-Latino Whites.[12,13]
- **Age:** Children are particularly sensitive as their respiratory systems are developing and air pollution can cause permanent damage.
- **Chronic Illness:** Individuals with pre-existing chronic conditions, such as asthma, other respiratory disease, and cardiovascular disease, are at greater risk of disease exacerbation due to air pollution.
- **Health Insurance:** Lack of adequate coverage and health care can result in poorly managed disease for those with respiratory or cardiovascular illness.
- **Outdoor Work:** Outdoor workers—particularly those engaged in strenuous physical activity—may face higher risks due to air pollution.[14,15]

What Local Health Departments Can Do

See Sections 6—Programs and 7—Functions

Assessment and Surveillance

Identify and collect data to map air quality and identify key sources of air pollution. Collaborate with community based organizations and "community scientists" to use portable air quality monitors to learn about air quality in the community and enhance air quality monitoring. See the EPA Air Sensor Toolbox (See Section 7.1—Surveillance).[16]

Intersectoral Collaboration

Work with local and regional air quality agencies:

- Support strong air quality plans that tackle both air pollution and greenhouse gas emissions, for example through providing health data and communications support.[17]

- Develop an emergency and early warning system for communities at highest risk for increasing episodes of poor air quality with climate change:
  - Collaborate with environmental justice and other community groups to plan the warning system.
  - Prepare text and social media alerts in multiple languages to warn vulnerable individuals that air pollution levels are high so they can reduce their exposure and ensure they have needed medication.[18]
- Work with the air district and local community-based organizations to deploy inexpensive real-time air monitors that will provide online data on regional air pollution levels and more detailed information about air pollution "hot spots."
- Support and encourage city and county efforts to increase energy efficiency and renewable energy. Advocate for programs to allow lower-income homeowners and renters to benefit from rooftop solar and energy efficiency programs.
- Work with local and regional transportation and planning agencies to reduce transportation-related pollution, including from goods movement (See Section 5.1—Transportation).
  - Promotion of energy efficiency in both new and existing buildings.
  - Promotion of the switch from natural gas to electricity for space and water heating in buildings.
  - Expansion of urban heat island reduction and air quality improvement strategies such as tree planting and other urban greening, cool roofs, and cool pavements.
- Collaborate with parks, public works, and community-based organizations to increase the number and diversity of less allergenic trees planted in your jurisdiction and improve other urban heat island reduction strategies, to reduce local air pollution and heat-related ozone increases (See Section 5.4—Urban Greening).
- Work with local schools and school districts to reduce traffic-related air pollution exposure near schools:[19]
  - Adopt anti-idling policies for school buses, passenger vehicles and delivery trucks.
  - Site new schools away from traffic and in locations that enhance opportunities for biking, walking, and taking public transit to school
  - Plant trees to reduce air pollution and provide shaded places for students to be active and socialize, and consider use of trees and vegetation as barriers between schools and busy roadways.
  - Upgrade filtration systems used in classrooms.
  - Locate air intakes away from pollution sources
- Implement policies in your department (and encourage your jurisdiction to do the same across agencies) that reduce vehicle-miles-travelled for field staff and reduce automobile commuting for all staff (See Section 5.1—Transportation).

Prepare for the Air Quality Impacts of Climate Change

- Develop an emergency and early warning system for communities at highest risk for increasing episodes of poor air quality with climate change:
  - Collaborate with environmental justice and other community groups to plan the warning system.
  - Prepare text and social media alerts in multiple languages to warn vulnerable individuals that air pollution levels are high so they can reduce their exposure and ensure they have needed medication.[20]
  - Messages should include clear instructions to reduce exposure (i.e. stay indoors and limit physical activity).
  - Collaborate with local media sources to broadcast information on where the public can go for air quality-related information; broadcast air quality conditions, information to reduce impacts and related illness exacerbation, and encouragement to check on vulnerable neighbors and family members.
- Prepare plans for clean air shelters and disseminate information about clean air shelters to individuals who are at high risk of serious health complications from extended periods of poor air quality.

Community Engagement and Education

Look for opportunities to integrate mentions of climate change in materials and media messages for the public whenever relevant, to increase public awareness that climate change is a health issue. Opportunities include public health alerts, health advisory announcements, and educational materials and campaigns related to air quality. For example:

Air Quality
Original: Air pollution comes from a variety sources, including industrial sources, transportation, farming practices and even natural sources. Air quality on any given day is also impacted by a complex set of factors involving the weather and how pollutants interact with each other in the atmosphere.[21]
Modified: Air pollution comes from a variety sources, including industrial sources, transportation, farming practices and even natural sources. Air quality on any given day is also impacted by a complex set of factors involving the weather and how pollutants interact with each other in the atmosphere, ***and by climate change that is causing more pollen and more very hot days that increase air pollution***.

- Conduct public awareness campaigns in multiple languages and via various media and educate clients on the rising risks of poor air quality due to climate change.
- Encourage walking and biking on less busy roadways—even a block away from busiest roadways has less pollution.[22]
- Advise clients with asthma or other respiratory illness to check the Air Quality Index every day for unsafe ozone and particulate levels. Talk to clients about adjusting their activities and recreation when air quality is bad. For clients who smoke, encourage them to quit and provide resource support.
- Educate local clinicians on the health impacts of climate change and air quality and how they can best protect patient and community health during bad air days. For more information see *A Physician's Guide on Climate Change, Health and Equity*. Encourage clinicians to have posters in their facilities regarding climate change and asthma in children and adults.

For More Information

- American Lung Association State of the Air Report
- EPA Clean Power Plan site and Factsheet
- *Sneezing and Wheezing*—NRDC report on climate change, allergies, asthma and air quality
- *US Climate and Health Assessment*, Chapter 3: Air Quality Impacts
- APHA and CDC fact sheet on air quality and climate change

Interagency Collaboration: Multnomah County Health Department

Multnomah County Health Department (MCHD) in Oregon has a long-term focus on equity and a history of working with community-based organizations on place-based health initiatives, and with the regional land use and transportation planning organization and other agencies on climate adaptation. Many of MCHDs community partners work in environmental justice communities that are disproportionately vulnerable to climate health impacts.

In early 2016, MCHD built on an existing partnership with the Coalition of Communities of Color (CCC) to launch the Healthy Environments Data Indicator Project (HEDIP), in collaboration with Portland State University Planning Department. The project grew out of a request to improve community capacity to work with MCHD in designing health and environmental data collection, analysis, and tools of greater use to the community.

HEDIP created a climate and health tool that uses an interactive story board to display a series of brief narratives that accompany county maps of 20 indicators in four vulnerability domains: 1) demographics, 2) socioeconomic status, 3) existing health burden, and 4) air pollution from point sources. The indicators were also combined into a single score that was used to rank and map climate and health vulnerability for each of the 171 Multnomah County census tracts. CCC provided input into indicator selection and display. In a facilitated training with four CCC climate and environmental justice member organizations, MCDH reviewed the HEDIP findings and discussed the use of data to support policy and systems change.

Key Action Steps:

- Establish partnerships with local CBOs that represent communities that bear a disproportionate burden of climate and/or environmental impacts. (See Section 7.2—Engagement)
- Seek input from community partners on indicators, and share data and information to build CBO capacity to understand and use data to engage in local planning and policy advocacy.
- Translate climate and health vulnerability assessments into accessible, understandable formats.
- Use data to inform local and state policymakers about health vulnerabilities relevant to policy.

CCC developed and piloted two community-led climate and health workshops that covered climate, health, and justice concepts, and used the HEDIP tool to educate policy makers about the importance of addressing the needs of disadvantaged communities in state climate policy. These conversations informed the discussion of a proposed "Healthy Climate Bill" (SB1574) that would create a carbon trading market linked with GHGE reduction goals, and direct a portion of carbon auction revenues to projects that benefit disadvantaged communities. HEDIP served to illustrate a potential mechanism to identify disadvantaged communities.

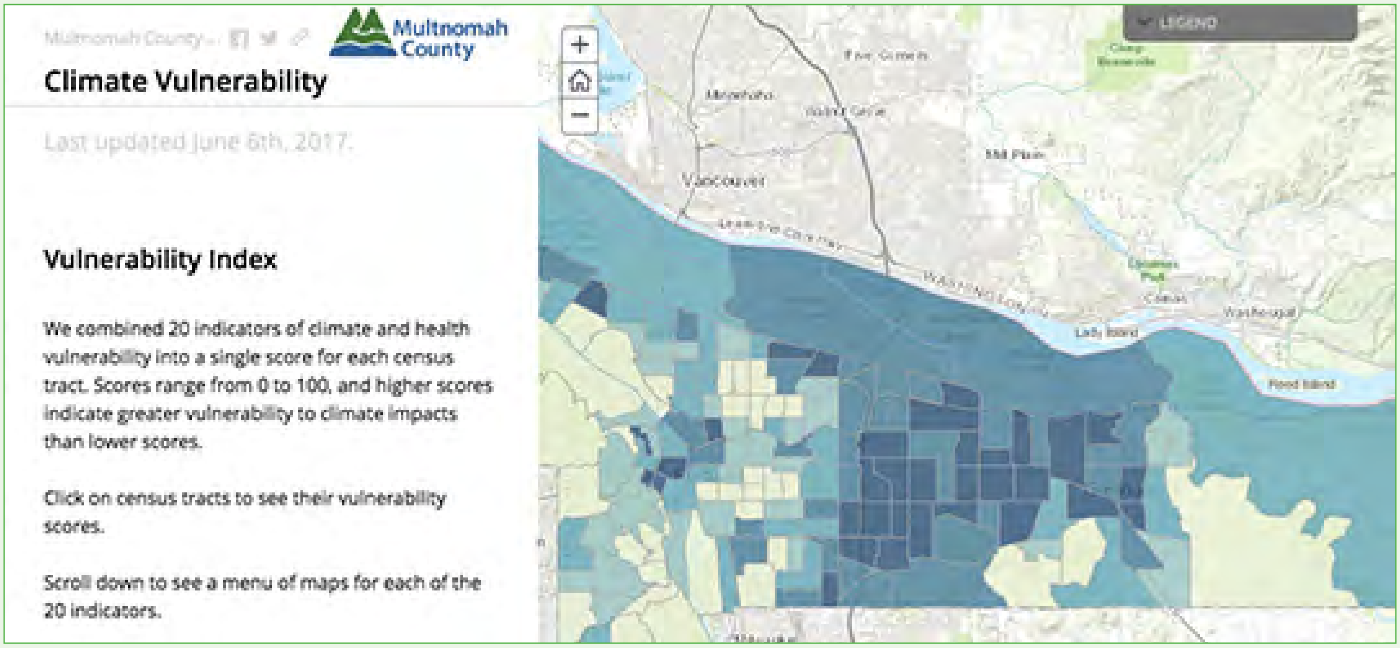
During this time, MCDH, CCC, and other stakeholders identified air pollution as a key priority. Further analysis by MCDH determined that transportation-related pollution and residential wood smoke burning contributed more pollution than point sources in Multnomah County. These analyses—with other HEDIP data—informed development of neighborhood climate and health profiles and policy briefs, and were used by MCDH to provide input into Multnomah County's analyses of 30 state legislative bills.

Future Work and Lessons Learned

MCHD continues to translate data into action, using the Integrated Transport and Health Impact Modeling Tool (ITHIM) to inform the Regional Transportation Plan (See Section 7.1—Surveillance). MCHD is now an active participant in an interdepartmental workgroup convened by the County Office of Sustainability to update and implement the county's climate action plan, and is providing technical assistance on the use of HEDIP climate vulnerability maps. For example, Transportation and Emergency Management are using the maps to inform planning efforts.

Learn More

- Multnomah County Climate Vulnerability Maps



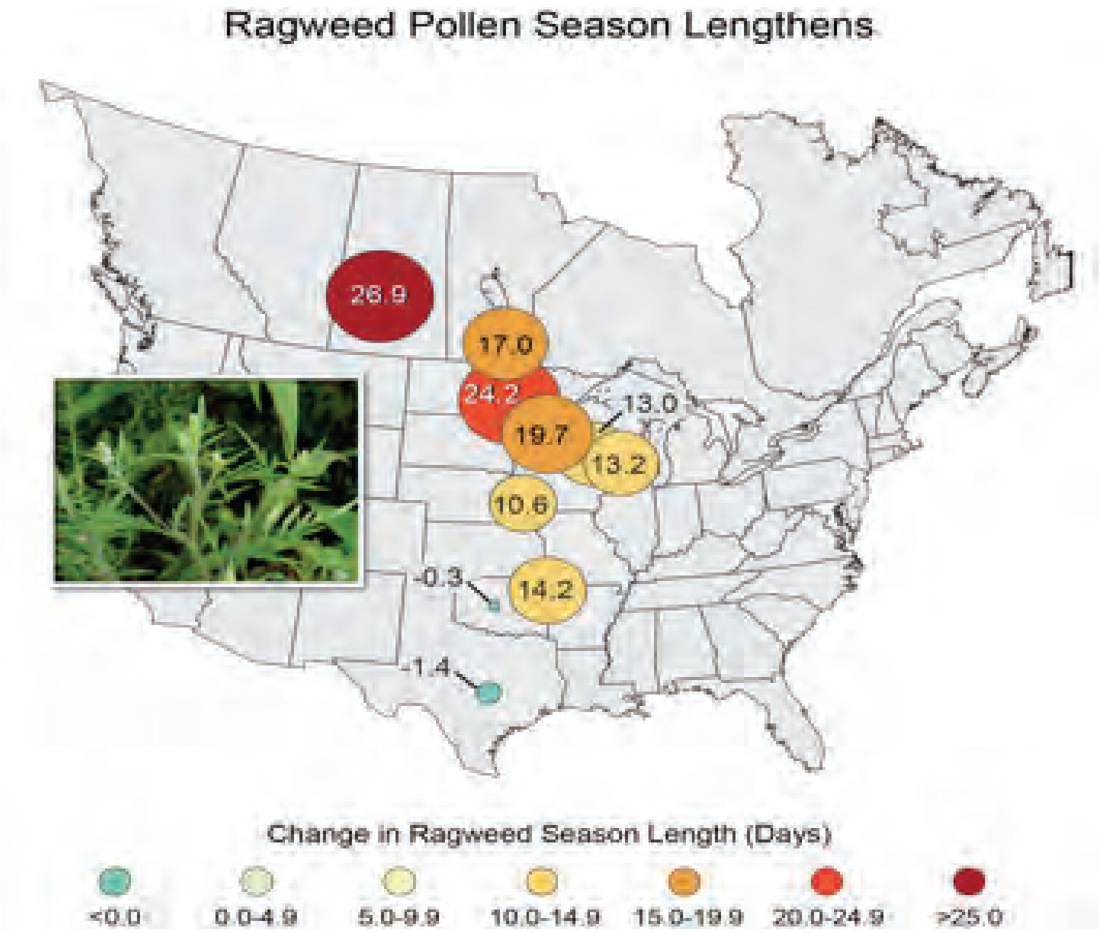
4.5 Allergens

Climate change affects the start, duration, and intensity of global pollen seasons, and causes increases in other air pollutants and respiratory illnesses that exacerbate asthma[1]

Climate Change Increases Allergen Exposures

- Increasing temperatures lead to earlier and longer pollen and allergy seasons, due to more frost-free days and earlier and longer flowering seasons. Since 1995, the season for ragweed pollen—one of the most common outdoor allergens—has lengthened by over 20 days in some parts of the U.S. (See Figure 4.5.1)[2]

Figure 4.5.1: Change in Ragweed Pollen Season, 1995–2015[3]



- Higher carbon dioxide levels and more winter precipitation cause greater plant growth, resulting in increased pollen production and potency.[4] This will increase the allergenicity of trees commonly found across the U.S.
    - Annual birch pollen production and peak values are expected to be 1.3–2.3 times higher from 2020–2100.[5]

- Exposure to allergy-inducing molds—the allergencity of which can also increase with higher CO_2 levels—may increase as more frequent and severe extreme storms lead to more flooding.[6]
- Higher temperatures increase production of ozone, which sensitizes the respiratory tract to allergens.[7]
- Carbon dioxide enhances production of the chemical (urushiol) in poison ivy and poison oak that causes contact dermatitis; carbon dioxide also increases the spread in growth of these allergenic plants.

Health Impacts of Allergens

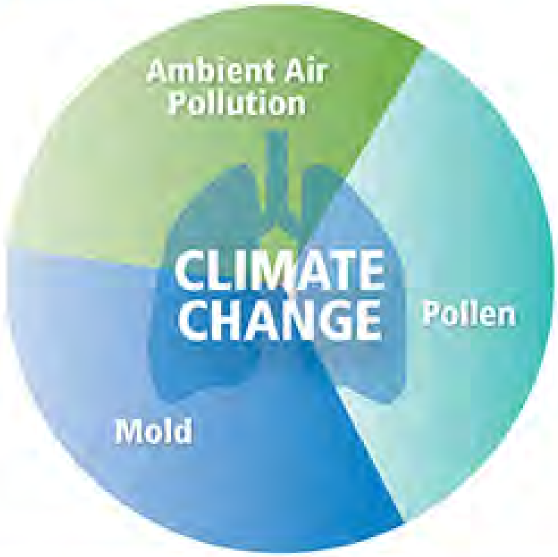
Hay fever, asthma, and eczema are the three major allergic diseases associated with exposure to pollens from trees, weeds, grasses, molds, and other indoor allergens.[8] Nearly 40% of urban populations and close to 25% of rural populations in the U.S. are sensitive to outdoor allergens.[9] The prevalence of hay fever in the U.S. rose from 10% in 1970 to 30% in 2000.[10] Allergies are a significant contributor to work and school absence and the 6th most costly chronic disease in the U.S., with healthcare expenditures of about $21 billion annually.[11]

Allergens and Health Equity

- **Housing:** Poor housing construction and maintenance can increase exposure to pollen or mold.[12]
- **Poverty:** People living in poverty may lack health insurance coverage for allergy management. Low-income communities and households have fewer resources for home rehabilitation to prevent mold growth following flooding.[13]

Climate Change Impacts on Asthma and Allergies

Three main exposures affect asthma and allergies: pollution, pollen, and mold.



Ambient Air Pollution
Climate change increases the amount of airborne pollutants in the environment. Ambient pollutants include particulate matter, carbon monoxide, oxides of nitrogen, and volatile organic compounds. When sunlight combines with oxides of nitrogen and volatile organic compounds, increased ozone levels result. People with asthma are more susceptible to the effects of ozone and also have increased responses to allergens after ozone exposure. In addition to asthma, it is important to note that these exposures are associated with adverse cardiovascular effects.

Pollen
Longer warm seasons result in longer pollen seasons and, therefore, longer allergy seasons. Higher temperatures, changes in precipitation, increased carbon dioxide levels, and changes in plant growth patterns all contribute to a longer and more intense allergy season. For example, higher carbon dioxide levels increase pollen levels and pollen potency. Longer and more intense pollen seasons have negative effects on the respiratory system, especially among those with allergies or asthma. This is particularly true of ragweed season.

Mold
Mold growth is related to increased storms, precipitation, flooding, temperatures, and humidity. Mold is a hazard that can harm our health by decreasing the air quality in home, school, and work environments. Mold can cause respiratory irritation and is a common trigger for asthma and allergies. Reactions to mold exposures are an especially troublesome problem for people with asthma or weakened immune systems.

This document is made possible by memorandum of understanding between the American Public Health Association and ecoAmerica.

- **Race and Ethnicity:** African Americans tend to have higher rates of allergic sensitization compared to Whites.[14]
- **Working Conditions:** Outdoor workers face increased exposure to pollen and to allergenic plants. Low-wage workers without paid sick leave face job and economic loss if required to miss work due to allergies or asthma.[15]
- **Asthma or other Chronic Respiratory Illness:** Exposure to aeroallergens can trigger asthma symptoms.[16]
- **Air Pollution:** Ozone causes airway sensitization, so people living in areas with high ozone levels may be at higher risk.[17]

What Local Health Departments Can Do

See Sections 6—Programs and 7—Functions

Assessment and Surveillance

- Collaborate with other agencies and organizations to improve pollen monitoring in your jurisdiction.[18]
- Prepare an online forum for community scientists in your jurisdiction to report the timing of pollen production in their neighborhood. This data can then be cross-referenced with data on tree cover and air quality to identify vulnerable areas.[19]

Intersectoral Collaboration

Collaborate with public works, parks and recreation, urban forestry, planning, and community based organizations—including local botanic gardens, arboretums, and horticultural societies—to establish policies for preferential planting of less allergenic trees and plants, and for planting a variety of trees so that people are at less risk of an allergic response to a particular pollen.[20] Consult with allergy specialists and work with public works and local tree-planting groups to ensure that allergenicity is a tree-selection consideration.

- Many cities favor planting of male trees to avoid tree-litter on sidewalks, but it is male trees that produce pollen.[21]
- Consider a pollen control ordinance (as in Las Vegas, Albuquerque, Tucson) to prohibit planting or sale of highly allergenic plants.[22]
- Support policies that reduce air pollution, which exacerbates respiratory illnesses and the impacts of allergens. Ozone, the key pollutant associated with climate change, may be the major driver of pollutant/pollen interactions.[23]

Community Engagement and Education

Look for opportunities to integrate mentions of climate change in materials and media messages for the public whenever relevant, to increase public awareness that climate change is a health issue. Opportunities include public health alerts, health advisory announcements, and educational materials and campaigns related to allergens. For example:

Pollen

Original: Ragweed pollen is dominant in the fall and blooms from Mid-July to September.[24]

Modified: Ragweed pollen is dominant in the fall and blooms from Mid-July to September. ***Rising temperatures associated with climate change can lead to longer and more severe ragweed seasons***.

- Educate clients and communities—in multiple languages and via various media—on the rising risks of allergens, and how to minimize exposures, reduce allergy symptoms, and manage asthma.
    - Check pollen levels frequently—individuals can sign up for free alerts at National Allergy BureauTM.
    - For clients with asthma, check ozone levels.
    - For individuals with allergies: The best times to be outdoors are when pollen levels are lower, typically on rainy, cloudy, and windless days. Keep windows closed during allergy season to prevent pollen from drifting inside; drive with car windows closed. Shower after time outdoors, to remove pollen that can collect on your skin, clothes, and hair.
- Provide opportunities for community scientists to participate in pollen and asthma monitoring. For example, Louisville's Asthmapolis project tracks asthma attacks using a mobile network of smart inhalers; city staff are mapping attacks to see correlations with tree cover, air quality, and heat islands.[25]
- Use home visits to educate clients about allergens, mold prevention, and climate change, and to assess housing conditions. Provide referrals to low-income weatherization services (e.g. better sealing of windows).
- Educate local clinicians about climate change and allergies and how they can best protect patient and community health. See *A Physician's Guide on Climate Change, Health and Equity*. Encourage local clinicians to put up posters in their facilities regarding the impact of climate change on allergies.

For More Information

- American Academy of Allergy, Asthma and Immunology
- EPA report on climate change and allergens
- *US Climate and Health Assessment*, Chapter 3: Air Quality Impacts
- *Sneezing and Wheezing*—NRDC report on climate change, allergies, asthma and air quality
- APHA and ecoAmerica's fact sheet on climate change, allergies, and health

4.6 Sea Level Rise

Climate Change Increases the Risk of Sea Level Rise and Related Flooding

- Globally, under moderate emissions scenarios, sea levels are expected to rise 0.3–0.6 feet by 2030, 0.5–1.2ft by 2050, and 1.0–4.3ft by 2100.[1] The rate of sea level rise is now greater than in at least the last 2,800 years.
- Sea level rise in the U.S. will vary along the country's coastlines:[2] Under all scenarios, the Northeast and Gulf of Mexico coastlines are expected to see greater sea level rise than the global averages, while the Pacific Northwest and Alaska are expected to see less under low and moderate sea level rise scenarios.
- Rising sea levels in the U.S. will increase the frequency and extent of coastal flooding with hurricanes, Nor'easters, and other coastal storms.

Health Impacts of Sea Level Rise

Health risks associated with rising sea levels include:

- Increased risk of waterborne illness, vector born disease, and indoor mold growth[3,4] (See Section 4.7—Storms and Flooding).
- Displacement of communities living in coastal areas, increasing their risk of related mental health problems.
- Increased salinity of groundwater basins and well water:
    - Higher salinity in drinking water has been associated with increased blood pressure and kidney disease, and higher risk of preeclampsia.[5,6,7]
    - Reduced crop yields in agricultural areas, impacting food security.[8]
    - Changes in the growth of microorganisms and vectors that use water as breeding grounds, with potential impacts on waterborne and vector borne illness.[9]
- Impacts on hazardous material sites, with risk of community exposure to toxic materials.[10]
- Inundation of coastal wastewater and water treatment facilities in the event of storms and storm surge.[11]
- Ground, surface and drinking water contamination from inundation of septic systems, especially in rural areas.[12]
- Impacts on coastal tourism through damage to beachfront property and beaches, with significant economic and job losses.[13]

Sea Level Rise and Health Equity

- **Geography:** Populations that reside in coastal areas are most impacted by sea level rise.
- **Poverty:** Low-income households are less likely to have disaster insurance, less able to recover from flooding and property loss associated with sea level rise, and have fewer resources to relocate.[14]
    - Residents of areas with failing public waste and water infrastructure, lack of protective barriers (e.g. seawalls), and poor public transit are more vulnerable to flooding and may face evacuation challenges.

    - Low-income communities and households lack funds for adaptation responses, such as elevating roads or costly remodels to elevate homes, which could lessen the risk of displacement and its associated health impacts.[15]
    - Communities with poor housing quality and building ventilation are at increased risk of indoor air pollution from excess moisture and vector borne disease due to lack of window screens.
    - Low-income communities are disproportionately impacted by food and water price increases due to sea level rise impacts on drinking water and crop yield.
- **Gentrification and displacement:** As flooding from sea level rise becomes more common, wealthier homeowners are moving to higher ground, displacing lower income communities that have historically been redlined from beachfront neighborhoods.[16]
- **Tribal Communities:** Indigenous communities that practice subsistence farming and fishing are particularly vulnerable to the impacts of sea level rise—including saline intrusion—on crops and freshwater ecosystems, and of fisheries collapse.[17] Coastal inundation also threatens important indigenous cultural and archaeological resources.[18]
    - 98% of Isle de Jean Charles—the home of a Biloxi-Chitimacha-Choctaw community off the coast of Louisiana—has been lost to sea level rise. Tribal leaders are working with local organizations to create community-based resettlement strategies that emphasize community cohesion and traditions, youth engagement, and sharing experience with other coastal communities facing similar challenges.[19]
- **Chronic Illness:** Individuals with illnesses such as asthma or other respiratory conditions are more vulnerable to indoor air pollution and mold illness from excess moisture or flooding.[20]
- **Individuals with Disabilities:** Cognitive, hearing, physical, and mobility impairments may impede safe evacuation during flooding events.[21]

What Local Health Departments Can Do

See Sections 6—Programs and 7—Functions

Assessment and Surveillance

Collaborate with other agencies to understand projections for sea level rise, saltwater intrusion, and flooding due to groundwater inundation and storm surges. Work with local emergency management, public works, water agencies and coastal conservation agencies and organizations to develop maps of flood-prone coastal areas and at-risk critical infrastructure in your jurisdiction. Visit these websites:

- NOAA's Sea Level Rise Viewer[22]
- FEMA flood maps (Note that many of FEMA's maps underestimate flood risk as they are based on historical flooding and do not incorporate sea level rise projections)[23,24]

Identify at-risk populations: Social vulnerability indicators for sea level rise include poverty, gender, race and ethnicity, age, disabilities, housing, and transit/transportation access.[25] See the sea level rise vulnerability assessment conducted by the Florida Health Innovation Institute.

Flood damage on December 22, 2010 in downtown Laguna Beach, California. Rodenberg Photography / Shutterstock.com

Intersectoral Collaboration

- Coordinate with other agencies to fully understand and be ready to implement the flood emergency response plan.
- Parks, Public Works, Emergency Management, and community groups to implement a green infrastructure plan to reduce storm water runoff and flooding risks and to protect waterways and sewage lines from debris and pollutants (See Section 5.4—Urban Greening)
- community based organizations and planning agencies in most vulnerable neighborhoods to develop long-range planning for sea level rise
- Planning and Public Works to assess road infrastructure and ascertain the need for planning to reroute or elevate critical roads (e.g. those providing access to a hospital, power plant, etc.)
- vector control agencies to plan for enhanced mosquito monitoring following flooding and with rising ground water and sea level rise
- local tribes to ensure Native American communities access shelter and services following flooding and in light of sea level rise, including “managed retreat” and anti-displacement measures to protect people now living on higher ground

Water coming over the streets in Kemah during Hurricane Harvey Cire notrevo / Shutterstock.com

- local water agencies to monitor permit requests for new or deeper wells and limit excessive draws on local groundwater basins that increase vulnerability to salt water intrusion[26]
- local emergency management, public works, planning, fish and wildlife, and coastal conservation agencies, and community based organizations to protect reefs, sand, coastal wetlands restoration, and other natural barriers that reduce erosion and protect coastal areas from storm surges.

Prepare for Storm Surge and Flooding Related to Sea Level Rise

See Section 4.7—Storms and Flooding and Section 6.5—Preparedness

- Prepare and exercise a coastal flooding, storm surge, and sea level rise contingency plan in coordination with agencies that manage critical waste and water infrastructure and with health care facilities at risk of flooding.
- Ensure evacuation and shelter plans address the needs of vulnerable populations.

Community Engagement and Education

Look for opportunities to integrate climate change in materials and media messages for the public to increase public awareness that climate change is a health issue. Opportunities include public health alerts and advisories and educational materials related to sea level rise. For example:

Seawater

Original: Some coastal wells in Washington are now unusable because of seawater intrusion. This is particularly true in coastal areas where high population growth has placed increased demands on groundwater supplies.[27]

Modified: Some coastal wells in Washington are now unusable because of seawater intrusion, ***which is associated with sea level rise due to climate change***. This is particularly true in coastal areas where high population growth has placed increased demands on groundwater supplies.

- Develop and implement a plan for community engagement and participation in sea level rise vulnerability assessments and planning.[28] Folly Beach, South Carolina included community input from vulnerable neighborhoods in preparing the city's Sea Level Rise Adaptation Report.[2]
- Conduct public awareness campaigns—in multiple languages and via various media—and educate clients and communities on risks related to rising sea levels, and how to stay safe and healthy during and after extreme flooding events.
- Engage residents in community science initiatives such as the Urban Tides Community Science Initiative.
- Develop resources to explain how to properly address in-home dampness and flooding, tenant and landlord responsibilities, and how to select a professional contractor. See the Extreme Storms and Flooding section for more details.[30]
- Advise community members to create a personal and family emergency plan in case of evacuation from flooding and connect them with resources to cope with displacement.
- Educate local clinicians on the health impacts of sea level and how they can best protect patient and community health in the face of sea level rise and coastal flooding. For more information see *A Physician's Guide on Climate Change, Health and Equity*.

For More Information

- NOAA's Sea Level Rise Viewer
- APHA and CDC factsheet on flooding, climate change, and health

A Framework for Action: San Francisco Department of Public Health

The San Francisco Department of Public Health (SFDPH) launched its Climate & Health Program in 2010 with funding from the CDC's Climate Ready States and Cities Initiative. The first step in the BRACE framework is to anticipate climate impacts and assess vulnerability. SFDPH completed assessments for extreme heat events (2013) and flooding and extreme storms (2016), a climate and health profile exploring the major health impacts of climate change, preparedness plans for extreme heat and storm/flooding emergencies, and a health co-benefits analysis of the county's climate action plan.

To assess public health preparedness, Climate and Health program (CHP) staff surveyed SFDPH leadership to better understand perceptions of climate impacts and capacity to implement adaptations, reviewed SFDPH strategic planning documents to identify opportunities for departmental action, and assessed climate vulnerability of SFDPH facilities.

From Assessment to Action

In 2017, CHP shifted from assessment to action with the release of its Climate and Health Adaptation Framework. The Framework provides "a starting point to engage San Francisco's diverse City and community stakeholders in designing solutions that reduce health disparities and climate health impacts… a tool to begin conversations about how best to adapt to the health impacts of climate change." It includes the prior vulnerability assessments, indicators of climate risk, an overview of SFDPHs capacity to address climate and health, and proposed strategies and activities to reduce risk and promote health equity in the era of climate change.

The Framework outlines over 70 interventions, including working with other city departments to develop an in-building leak audit program for low-income homes, and evaluating the effectiveness of public information services in extreme weather events. Equity is a guiding principle in the work of SFDPH, and the Framework explicitly addresses the disproportionate burden of climate and health impacts on low-income communities and communities of color.

Future Work and Lessons Learned

SFDPH is developing a Climate and Health Outreach Plan to increase engagement with residents and community based organizations to prioritize adaptation strategies that respond to the concerns of vulnerable communities. Climate and health champions have been identified across SFDPH programs, and SFDPH is bringing their expertise into efforts to improve collaboration with twelve City departments. One proposal is the development of a unified climate and health message for use across multiple City climate initiatives.

Former climate and health program director, Cyndy Comerford shared, "the most successful partnerships have been with organizations and city departments that share our view that climate change is a systems issue, connected to transportation, food, energy, health care systems, and beyond."

Learn More

- San Francisco's Climate and Health Adaptation Framework: 2017
- San Francisco Climate Change & Health Program
- San Francisco Department of Public Health
- San Francisco County CalBRACE Climate and Health Profile

Key Action Steps:

- Conduct a climate and health vulnerability assessment that can form the foundation for a climate and health profile, preparedness plans, community engagement strategies, and recommendations for action.
- Work with LHD program and agency partners to establish a strategic plan to address climate change, health, and equity.
- Use the plan to advance community engagement in prioritizing action on climate, health, and equity.

4.7 Storms and Flooding

Climate Change Increases the Risk of Extreme Storms and Flooding

Extreme precipitation events occur when the air is almost completely saturated, which can occur more quickly at higher temperatures, so extreme evens are likely to increase in intensity by about 6% to 7% for each degree Celsius of temperature increase.[1]

- As the U.S. has many geographic regions, future changes in seasonal average precipitation will be variable depending on season and geography. Overall, high-latitude regions are projected to become wetter, subtropical areas drier, but there is significant uncertainty regarding the U.S. middle latitudes.[2]
- The number of extreme precipitation events is expected to increase by two to three times historical averages in every U.S. region by 2100, with the highest increases expected in the Northeast.[3]
- Due to climate change, global precipitation patterns are likely to become more variable into the future, with extremes becoming more extreme, which can lead to additional vulnerability. [4]

Health Impacts of Extreme Precipitation

- Extreme storms directly cause injury and death due to trauma and drowning.
    - Although the official count due to Hurricane Maria is 64 fatalities in Puerto Rico, some analysts place the actual number at over 4,000.[5]
- Extreme storms and flooding can disrupt medical care, particularly for those with chronic illness. Three days after Hurricane Maria, only 3 hospitals on Puerto Rico were functioning, and 40% were still running on generator power two months after the storm.[6] Two major hospitals were evacuated during Super Storm Sandy, and several were not yet fully operational a year after the storm.
    - A third of deaths after Hurricane Maria were attributed to delayed or interrupted health care, and many residents reported inability to access medications and lack of electricity for respiratory equipment.[7]
- Extreme storms can disrupt critical infrastructure, including electricity, sanitation, water treatment, food refrigeration, communications systems, and transportation.[8] Months after Hurricane Maria, close to 50% of homes on Puerto Rico were still without power, nearly 50% of the island's sewage treatment plants did not have electricity to operate, and over 300,000 Puerto Ricans still lacked access to clean water.[9,10,11,12]
- Mold exposure and related mold illness post-flooding may increase due to excess indoor moisture and is associated with upper respiratory tract symptoms, cough, and wheeze, and can exacerbate asthma.[13]
- Water-borne illness risks increase due to exposure to sewage or water treatment systems overflow, or skin wounds and fungal infections from exposure to flood waters.[14]
- Heavy rainfall is frequently followed by a proliferation of mosquitos, increasing the risk of vector-borne illnesses particularly in warmer climates.[15]
- Flooding from storms can contaminate ground and surface water resources with runoff from hazardous and superfund sites.[16]

- Use of diesel generators during power outages can impact air quality. Improper use of generators in enclosed spaces caused 15 deaths due to carbon monoxide poisoning after Hurricane Sandy.[17]
- Extreme precipitation can lead to erosion and dangerous mudslides, increasing risk of injury and death, as seen in Montecito, CA when heavy precipitation caused destructive mudslides and over 20 fatalities in January 2018, following the largest wildfire in California history that charred much of the area's soil in December 2017.[18]
- Extreme precipitation and flooding cause displacement—which poses risks associated with injury, exposure to contaminated floodwaters, and loss of medications—and property loss.[19] An estimated 1.5 million fled their homes after Hurricane Katrina, and some estimate that hundreds of thousands were never able to return.[20] Damage to the Oroville Dam following severe rains caused the evacuation of over 100,000 people for two days.[21]

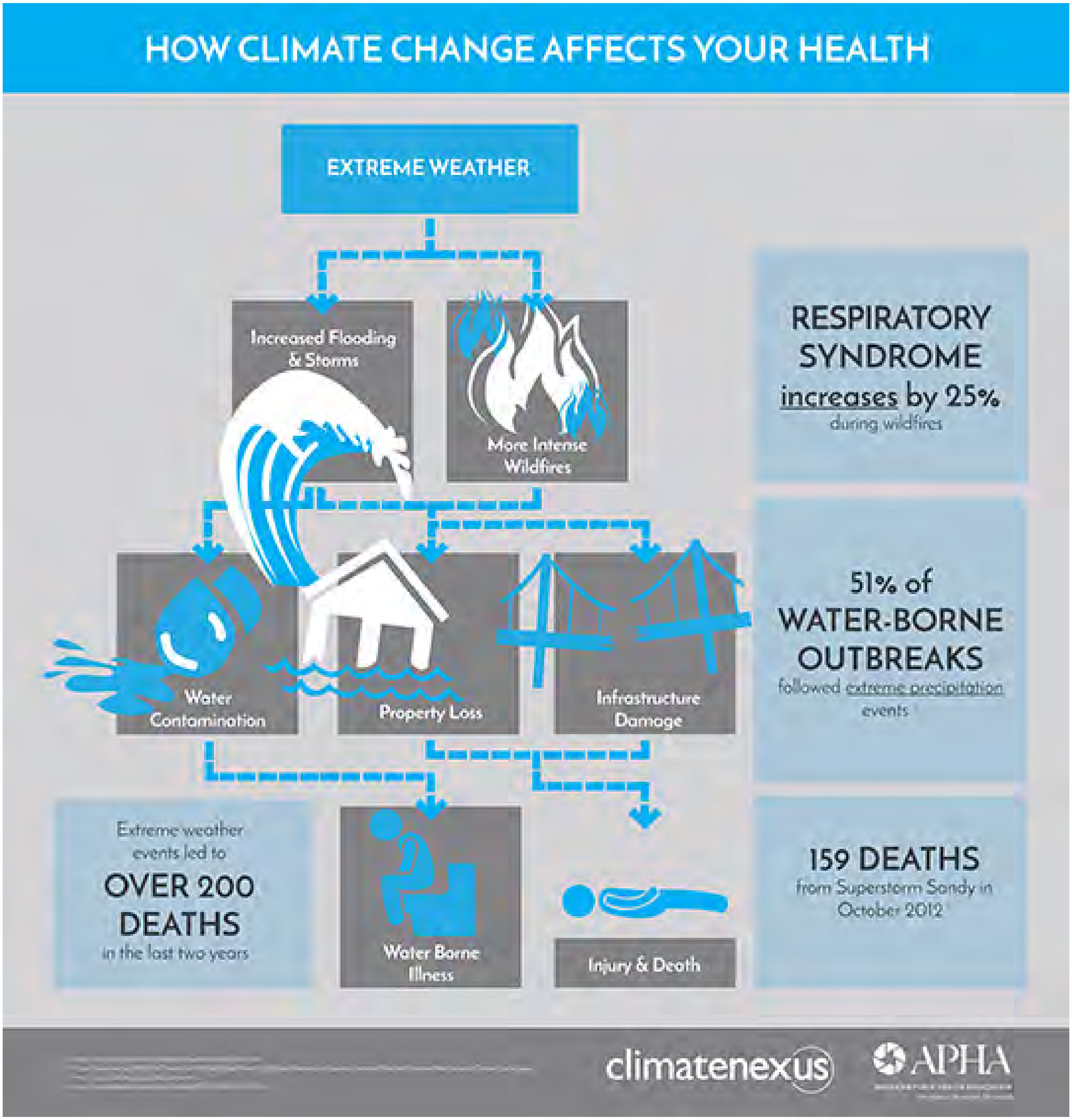
Extreme Precipitation and Health Equity

- **Failing and Aging Public Infrastructure:** Lack of investment in secure transportation or protective barriers leaves residents vulnerable to flooding and poses barriers for evacuation. Inadequate or failing water treatment and sewage systems—especially combined sewer overflow systems—increase the risk of contamination after floods and storms.
- **Poverty:** Low-income communities are disproportionately underinsured for extreme weather events and often lack access to emergency credit to recuperate from property loss. As climate change increases the frequency and severity of extreme weather

Extreme Storms and Mental Health: Hurricane Katrina

Exposure to extreme weather events, such as floods, hurricanes and wildfires, is associated with a range of mental health impacts, including post-traumatic stress disorder (PTSD), depression, anxiety and suicide, increased rates of substance abuse, and interpersonal violence.[22] Mental health impacts persisted long after Hurricane Katrina and its immediate aftermath were over.

- In some impacted areas, prevalence of PTSD rose from 15% a few months after the hurricane to 21% a year later. During the same timeframe, the proportion of people with suicidal thoughts more than doubled: from 2.8% to 6.4%.[23]
- Veterans with preexisting mental illness were 6.8 times more likely to develop additional mental illness after the disaster, as compared to those without a preexisting mental condition.[24]
- Hope abounds: One study found that two-thirds of those who experienced increased rates of PTSD and psychosis one year after the storm no longer displayed symptoms of psychological distress three years afterwards, while some others even reported "post-traumatic growth," or the feeling that surviving the hurricane made them stronger. These findings suggest the importance of long-term support for survivors of climate change-related disasters.[25]



APHA, Climate Nexus 2016

events, insurance prices will rise and continue to move further out of reach for low-income individuals and communities.[26] Four out of 5 homes damaged by Hurricane Harvey lacked flood insurance.[27]

- **Homelessness:** Homeless people often occupy areas near creeks or rivers, making them more vulnerable to storms and floods.[28]
- **Substandard Housing:** Poor housing quality and ventilation increase the risk of indoor air pollution and most from excess moisture.
- **Legal Status:** Undocumented families are not eligible for FEMA assistance and even those who are eligible may fear applying. Immigrants may also have concerns about accessing evacuation shelters and other relief services due to inadequate cultural and linguistic competency of service providers, and undocumented immigrants may fear legal repercussions of seeking services.[29]
- **Chronic illness:** Extreme storms can interrupt treatment for chronic illnesses due to displacement, power outages, stressed health systems, and high-demand for medical supplies.[30,31]
- **Individuals with Disabilities:** People with disabilities have high rates of illness, injuries, or death during extreme events, as cognitive, hearing, physical, and mobility impairments may impede safe evacuation.
  - Emergency information and instructions are not always accessible for those with disabilities that affect communication, and individuals with disabilities can have challenges communicating their needs in an emergency or evacuation situation.[32,33]
  - Power outages can impair electrically powered medical equipment and elevators, preventing some from evacuating or leaving them without necessary treatments.[34]

"When patients with cardiac health issues face evacuation due to flooding, fire or other natural disasters, a spike in stress and anxiety levels may be only the beginning. For sudden, jarring, life-changing events—like that of Hurricane Harvey in Texas and Louisiana this past week—can markedly disrupt months or years of steady treatment and control of heart disease and other conditions."

American Heart Association[35]

- **Race and Ethnicity:** African Americans households faced slower recovery from Hurricane Katrina compared to comparable white households, and recent studies have revealed higher rates of mental illness among Hurricane Katrina survivors who were African American, low-income, and between the ages of 18 and 34, especially single mothers.[36,37]
- **Age:** Almost half of the deaths resulting from Hurricane Katrina were people over the age of 75, and over 10% of total deaths occurred in nursing homes.[38]
- **Women and Children:** Extreme storms, flooding, and related stress can negatively impact pregnancies and disrupt related care, while children are susceptible to severe mental health impacts[39] Globally, women are injured and die more often from extreme events.[40]

LHD Spotlight:
San Francisco Department of Public Health[44]

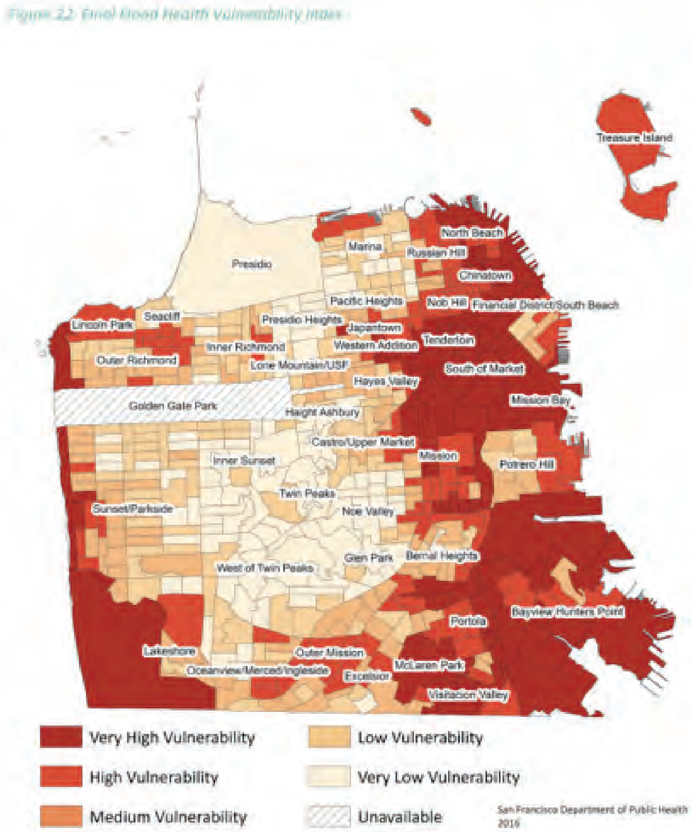
The San Francisco Department of Public Health (SFDPH) conducted a flood health vulnerability assessment in order to focus resources on and design interventions for vulnerable populations. SFDPH included indicators on socioeconomic and demographic, exposure to flooding, pre-existing health conditions, and housing quality (see the table below). To obtain data, the department used results from the American Community Survey and from other local agencies, such as the San Francisco Public Utilities Commission, California Office of Statewide Health Planning and Development, the 2015 San Francisco Homeless Count, the San Francisco Police Department, and the San Francisco Fire Department.

Vulnerability	Indicators[45]
Social and Demographic	Age: Percent of residents who identify as under 18 and over 65
	Percent of residents who do not identify as white
	Percent of residents below 200% of the federal poverty rate
	Percent of residents over 25 with at least a high school degree
	Percent of households with adults who do not speak English
Exposure	Percent of land in 100-year flood plain with 36in of sea level rise
	Percent of land projected to have over 6in of precipitation during a 100-year storm
	Minimum Elevation
Health	Adult hospitalization rate due to diabetes
	Adult hospitalization rate due to asthma
	Adult hospitalization rate due to schizophrenia and other psychotic disorders
	Percent of residents who report a physical disability
Housing	Homeless population, per 1000 residents
	Annual housing violations, per 1000 residents
	Percent of residents who report living alone

continued on next page

LHD Spotlight continued

SFDPH was able to overlay available data creating vulnerability indexes for each indicator set and a combined flood health vulnerability score by block group and neighborhood. The resulting maps defined areas that are most likely to experience flooding and areas that are most likely to experience the health impacts of this flooding.



What Local Health Departments Can Do

See Sections [6—Programs] and [7—Functions]

Assessment and Surveillance

- Collaborate with local emergency management, public works, and other agencies to collect and share data to conduct a flood vulnerability assessment:
    - identify flood-prone areas and areas in need of updated infrastructure to reduce flood risk.
    - identify critical infrastructure vulnerable to floods and storm surges.
    - identify neighborhoods with social vulnerability to floods. Social vulnerability indicators used in one index created specifically for hurricanes included poverty, gender, race and ethnicity, age, and disabilities.[41]
- FEMA offers flood maps searchable by specific addresses, though flooding from Hurricane Harvey demonstrates that many of these maps are out of date.[42,43]

Flooding in Minot, North Dakota
DVIDS, 2011

Intersectoral Collaboration

- Collaborate with other agencies to ensure that your jurisdictions' hazard mitigation and response plans incorporate climate impact projections for storm surge and precipitation and adequately address flooding from extreme storms and/or storm surge.[46] Coordinate with other agencies to fully understand and be ready to implement the flood emergency response plan.
- Collaborate with Parks, Public Works, Emergency Management, and community groups to develop and implement a green infrastructure plan to reduce storm water runoff and flooding risks and to protect waterways and sewage lines from debris and pollutants (See Section 7.5—Greening).
- Collaborate with community-based organizations to inform vulnerable communities about climate impact projections for storm surge, precipitation and flooding, and engage community residents in flood resilience and preparedness.
- Work with local organizations and health care institutions to implement a voluntary registry for those with physical, mental, and sensory disabilities to preauthorize emergency response personnel to enter their homes during search-and-rescue operations.[47]
- Collaborate with vector control agencies to assure availability of increased mosquito monitoring following extreme precipitation and flood events.
- Work with local tribes to ensure Native communities know where shelters are located and how to access services following flooding and extreme storms.

Prepare for Extreme Storms and Flooding

- Develop a flood warning alert system for areas at risk:
  - Prepare boil water orders and other alerts in multiple languages so they are ready to issue to various media outlets and through text alerts and/or social media.
  - If landslides or debris flows have occurred previously in your jurisdiction, prepare messaging and resources for communities to prepare for a potential future event.[48]
  - Evaluate use and effectiveness of public information services during and after extreme weather events.[49]

- Prepare plans for shelters with backup power sources and ensure the needs of vulnerable populations are taken into consideration; disseminate shelter information to at risk groups including older adults, pregnant women, those with chronic illness who require medications, and low income communities.[50]
    - Ensure all shelters and emergency centers are accessible to and comfortable for individuals with physical and mental disabilities.
    - Connect individuals with local shelters that provide safe spaces, especially for LGBTQ individuals who are at higher risk of harassment and assault.
    - Prepare information sheets for families in shelters on the potential for health outcomes from flooding and mental health impacts from stress and displacement, including how to find services.
    - Ensure local wastewater treatment facilities that may be vulnerable to flooding have prepared response plans.
    - Work with social services and mental health agencies to assure access to mental health services.
- Collaborate with health care facilities and systems to increase flood resilience and plan for extreme storm and flooding events.
    - Develop a plan for how medical care will continue if flooding impacts health care facilities. For example, coordinate with pharmacies to allow refill prescriptions for people with chronic illness, even if unable to contact the prescribing physician, during emergencies.[51]
    - Advocate for integration of design features in new health facilities that foster resiliency to flooding, for example:[52]
        - Elevation of first floor above projected flood elevation and placement of critical patient care functions above first floor
        - Placement of all critical mechanical/electrical infrastructure on the roof and/or above flood elevations
        - Use of green roofs to reduce storm water discharge
- Assure that chronically ill patients, their communities, and their providers have contingency plans during and after disasters.[53]
- Make sure evacuation strategies address the needs of all members of the community, including those without access to automobiles, non-English speakers, and people with disabilities.

Community Engagement and Education

Look for opportunities to integrate mentions of climate change in materials and media messages for the public whenever relevant, to increase public awareness that climate change is a health issue. Opportunities include public health alerts, health advisory announcements, and educational materials and campaigns related to storms and flooding. For example:

Flood Advisory

Original: Heavy rain causes floodwaters to rise and pool on streets and throughout neighborhoods. In these situations, be aware of the following…[54]

Modified: Heavy rain causes floodwaters to rise and pool on streets and throughout neighborhoods. ***As climate change increases the potential for more intense storms and related flooding, we need to be even more prepared.*** In these situations, be aware of the following…

- Conduct public awareness campaigns—in multiple languages and via various media—and educate clients and communities on the rising risks of extreme weather due to climate change, health risks, and how to stay safe and healthy during and after extreme events.
- Advise clients to create a personal and family emergency plan in case of evacuation from an extreme storm or flooding. Educate clients about the potential for flooding following wildfires and discuss the potential need for flood insurance.[55]
- Develop resources to explain how to properly address in-home dampness and flooding, tenant and landlord responsibilities, and how to select a professional contractor.[56] Use home visits to provide guidelines for reentering homes after flooding:[57]
    - Remind individuals to NEVER turn power on or off or use an electric tool or appliance while standing in water.
    - Provide information about the risks of sewage contamination and mold for individuals whose homes are flooded,
    - Educate individuals on indoor air quality concerns following flooding. Provide information on mold prevention and treatment options, including preventing mold by washing surfaces with water and detergent and wearing an N95 mask while treating mold.[58]
    - Provide safety guidelines for drying out and cleaning flooded homes
- Educate local clinicians on the health impacts of extreme storm events and how they can best protect patient and community health during storms and flooding. For more information see *A Physician's Guide on Climate Change, Health and Equity*.

Seawater Inundation Following Hurricane Ike on the Bolivar Peninsula, Texas
NOAA, 2008

For More Information

- EPA's Flood Resilience Checklist
- CDC Flood information
    - Cleanup, Mold, Landslides and Mudslides
- FDA Food and Water Safety during floods (English, Spanish)
- EPA Green Infrastructure and Managing Flood Risk information
- *US Climate and Health Assessment*, Chapter 4: Extreme Events
- APHA and CDC factsheet on flooding, climate change, and health
- APHA, American Psychological Association, and ecoAmerica factsheet on climate change and mental health

4.8 Nutrition and Food Security

Food security is "access by all people at all times to enough food for an active, healthy life."[1] It requires that a stable, nutritious food supply is available and accessible to all communities to nourish themselves.

Climate Change Threatens Food Security[2,3]

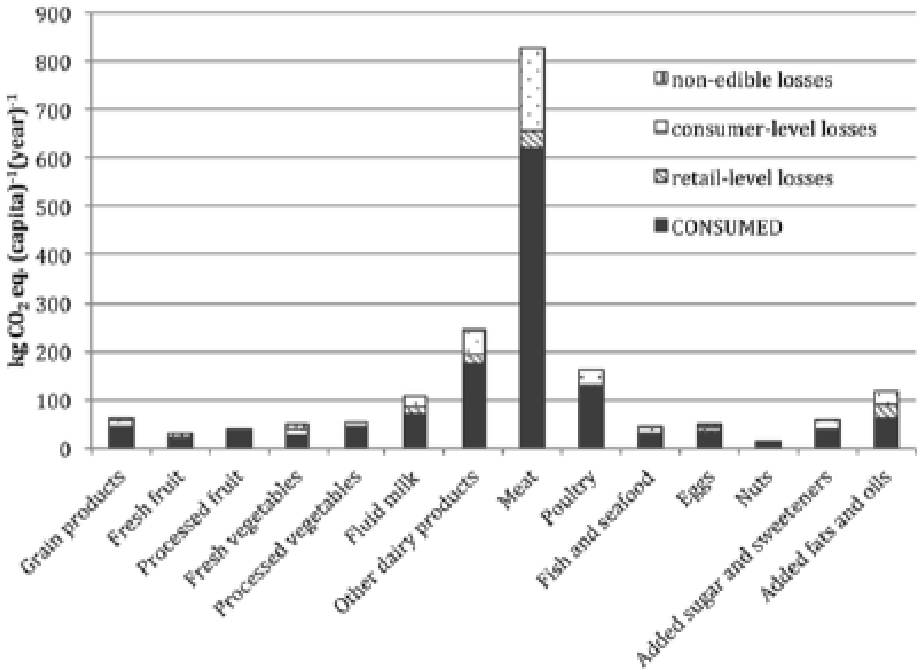
- Crop yields are reduced by extreme heat, drought, and extreme weather events, all of which are increasing in frequency and severity due to climate change.[4] Warmer temperatures also cause higher ground-level ozone concentrations that cause millions of tons of crop losses each year.[5] Warmer temperatures are leading to fewer "chill hours", required for production of avocados, nuts, and tree fruits.[6]
- Higher temperatures and drought associated with climate change can cause heat stress and illness in livestock, reducing milk and egg production.[7]
- Declining fish yields due to overfishing and ocean dead zones are further impacted by ocean acidification from with rising carbon dioxide levels.
- Warmer temperatures increase the growth of *Salmonella, Camphylobacter, Rotavirus*, and various *Vibrio*, and harmful algal blooms, increasing the risk of food contamination.[8]
- Increased atmospheric CO_2 reduces the nutritional value of crops such as barley, sorghum, soy, wheat and rice by reducing their protein and micronutrientscontent.[9]
- Extreme weather events can disrupt transportation of food products, disrupting food supply chains and increasing loss due to spoilage.[10]
- The Intergovernmental Panel on Climate Change (IPCC) estimates that global food production will decrease by 2% per decade, while global food demand increases by 14% per decade.[11] Climate change has increased the number of malnourished children by 7–20% globally.[12]

Agricultural Systems Drive Climate Change

See Section 5.3—Agriculture

- In 2016, agriculture contributed about 9% of the country's total greenhouse gas emissions[13] (See Figure 4.8.1).
- When fertilizer use, refrigeration, transportation, and land use changes are taken into account, our food and agriculture systems account for about a third of all global GHGE.[14] The typical American meal includes ingredients from at least five other countries, contributing to transportation GHGE, especially if food is shipped by air.[15]
- Expansion of agricultural lands can lead to deforestation and soil degradation, removing important carbon sinks.[16]

Figure 4.8.1: Annual Greenhouse Gas Emissions Per Capita Associated with U.S. Food Production in 2010 (kg CO_2-eqis kilograms of carbon dioxide equivalents)[17]



Health Impacts of Food Insecurity[22]

Food insecurity includes under-consumption (of nutrients, fruits, vegetables, and protein in developing nations) and overconsumption of low-cost, high-calorie, low-nutrient foods. Under-consumption negatively impacts development and diminishes physical capacity.[23] Over-consumption is a major contributor to development of chronic diseases such as obesity, cardiovascular disease, and diabetes.

- In 2014, 37.9% of adults and 20.6% of adolescents in the U.S. were obese.[24]
- About 1 in every 4 deaths in the U.S. is the result of heart disease (approximately 610,000 people annually).[25]
- 9.4 percent of the U.S. population (30.3 million people) has diabetes, and 84.1 million have prediabetes.[26]
- Overconsumption of red and processed meat is associated with increased risk of heart disease, stroke, Type 2 diabetes, certain cancers, and premature death.[27]
- Good nutrition is essential to healthy pregnancy, nursing and newborn outcomes.

Food Waste[18]

Forty percent of food produced in the United States goes uneaten. That's 62.5 million tons of food. Households generate 43% of all food waste. Meanwhile, there were 42.2 million people, including 13.1 million children, who did not have enough food in 2015.[19] In landfills, these organic materials are broken down by bacteria to produce methane, a potent greenhouse gas (GHG).[20] Diversion of food waste from the landfill to better uses, including safe food donation, addresses two critical health issues—food insecurity and climate change.[21]

Pigs in a Concentrated Animal Feeding Operation (CAFO)
USGS, 2005

Organic Farm in California
Public Domain

Food Security and Health Equity

- **Poverty:** Low-income people have less ability to absorb rising food prices and may be forced to choose between food and other necessities. Food insecurity is associated with higher risks for diabetes and hypertension.[28]
- **Food Deserts:** According to 2000 data, 13.5 million people in the U.S. have low access to a supermarket, 82 % of whom live in urban areas.[29] In these areas, the impacts of climate change on food security and health are further exacerbated by lack of access to healthy foods.
- **Race and Ethnicity:** Food insecurity is more common in people of color and those living in poverty. According to the USDA, 12.3% of U.S. households were food insecure in 2016: 22.5% of African American households, 18.5% of Hispanic households, 10.7% of other, non-Hispanic households, while only 9.3% of White households.[30] As of the 2014 National Agricultural Workers Survey, 80% of U.S. farmworkers identify as Hispanic and only 53% had work authorization, leaving many members of this community vulnerable to economic impacts of climate change on U.S. agriculture.[31]
- **Tribal Communities:** Many indigenous communities practice hunting, subsistence farming and fishing, and are thus vulnerable to climate change impacts on local game, farming and aquatic habitats. Rising sea levels will also threaten freshwater and saltwater fishing habitats for many indigenous coastal communities.[32]
- **Occupation:** Agricultural workers are often undocumented and poorly paid, and at risk of climate-related illness. Declines in crop yields result in job and economic losses for agricultural workers and farming communities. Warmer temperatures are expanding the territory of certain crop pests, leading to higher use of toxic herbicides and pesticides and associated risks of pesticide-related illness.[33] Farmworkers engage in heavy labor even during extreme heat. Repeated dehydration may be the cause of epidemic chronic kidney disease of unknown etiology in agricultural communities around the world.[34]
- **Pregnant Women:** Nutrition is essential to healthy pregnancy, nursing and newborn outcomes; poor nutrition is associated low birth weight and other adverse outcomes.[35]

What Local Health Departments Can Do

See Sections 6—Programs and 7—Functions

Intersectoral Collaboration

- Collaborate with agencies, schools, and local institutions (e.g. hospitals) to support adoption of food procurement policies that healthy food systems.
- Work with planning, public works, agricultural agencies, regional farmers and land trusts, and community organizations:
    - Promote urban and peri-urban agriculture and agricultural land conservation.
    - Establish farmers markets, including allowance of SNAP EBT, and support other farm-to-fork programs
- Collaborate with planning agencies to ensure the local General Plan includes food access considerations, and promote zoning that supports farmers markets, healthy food retail outlets, and community gardens.[36]
- Partner with schools and school districts:
    - Develop programs to reduce meat served in school meals—e.g. "Meatless Mondays"
    - Support and encourage prevention of food waste and composting of food waste in school cafeterias
    - Establish school gardens
    - Work with local farmers, agricultural commissioners, and community organizations to establish and expand farm to school programs
    - Integrate climate change into lessons about nutrition
- Collaborate with academic agricultural researchers and local agricultural organizations to educate growers and agricultural operations about agriculture-climate change-health connections.
- Provide health data and considerations to support advocacy for subsidies for fruits and vegetable farming and for reduced federal subsidies for commodity crops.
- Collaborate across public health and environmental health programs to reduce food waste and improve safe surplus food donation.
    - Train environmental health specialists on climate change, food waste, and food insecurity using, for example, the Safe Surplus Food Donation Best Management Practices.[37]
    - Disseminate information on food waste reduction—for example the Safe Surplus Food Donation Toolkit—during routine food facilities inspections.[38]
    - Integrate education about date labels and food waste into WIC and NEOP materials and outreach/education programs. See the Save the Food Campaign.[39]
    - Work with local food policy councils, businesses, and Environmental Health to reduce food waste and increase surplus food donation to local nonprofit hunger relief organizations.

Community Engagement and Education

Look for opportunities to integrate climate change in materials and media messages for the public whenever relevant, to increase public awareness that climate change is a health issue. Opportunities include public health alerts and advisories and educational materials related to food and nutrition.

Community Health Needs Assessment

Original: While most report little or no difficulty, 17.4% of Metro Area adults report that it is "very" or "somewhat" difficult for them to access affordable, fresh fruits and vegetables.[40]

Modified: While most report little or no difficulty, 17.4% of Metro Area adults report that it is "very" or "somewhat" difficult for them to access affordable, fresh fruits and vegetables,. ***This is a growing concern as climate change impacts local agriculture and may increase food insecurity.***

- Educate communities, stakeholders, and policy makers about the impact of climate change on food security and nutrition and actions with climate and health benefits.
    - Educate communities on the food-climate change connection, and on the climate and health benefits of reduced meat consumption and sustainable local food systems (urban farms, farmers markets, community gardens, organic food)
    - Encourage clients and community residents to reduce meat consumption and increase consumption of fruits and vegetables; buy locally and sustainably produced food and develop backyard and community gardens, and reduce food waste at home and when eating out.
- Educate food handlers about climate change-related increased risk of food contamination and how to maintain hygiene in food preparation under conditions of extreme heat and water shortages.
- Educate health care providers on the health impacts of climate change and food systems and how to protect patient and community health. See *A Physician's Guide on Climate Change, Health and Equity*.

For More Information

- Re-Fed: Reducing Food Waste
- USDA's Creative Solutions to Ending School Food Waste
- Feeding America's Map the Meal Gap resource
- NRDC's Save the Food Campaign
- Equitable Development Toolkit: Local Food Procurement
- Sample Policy: Los Angeles Good Food Purchasing Policy
- US Climate and Health Assessment, Chapter 7: Food Safety, Nutrition, and Distribution
- Aligning Food System Policies to Advance Public Health

The Health Benefits of Climate Action

Taking action to address climate change can have significant health benefits that present important opportunities for addressing key public health issues. These health benefits are often referred to as "cobenefits." "Cobenefits are the public health (or other) benefits associated with GHGE reductions, independent of reductions to global warming."[1] Cobenefits provide a framework for intersectoral partnerships and increased support for climate mitigation.

5.1 Transportation

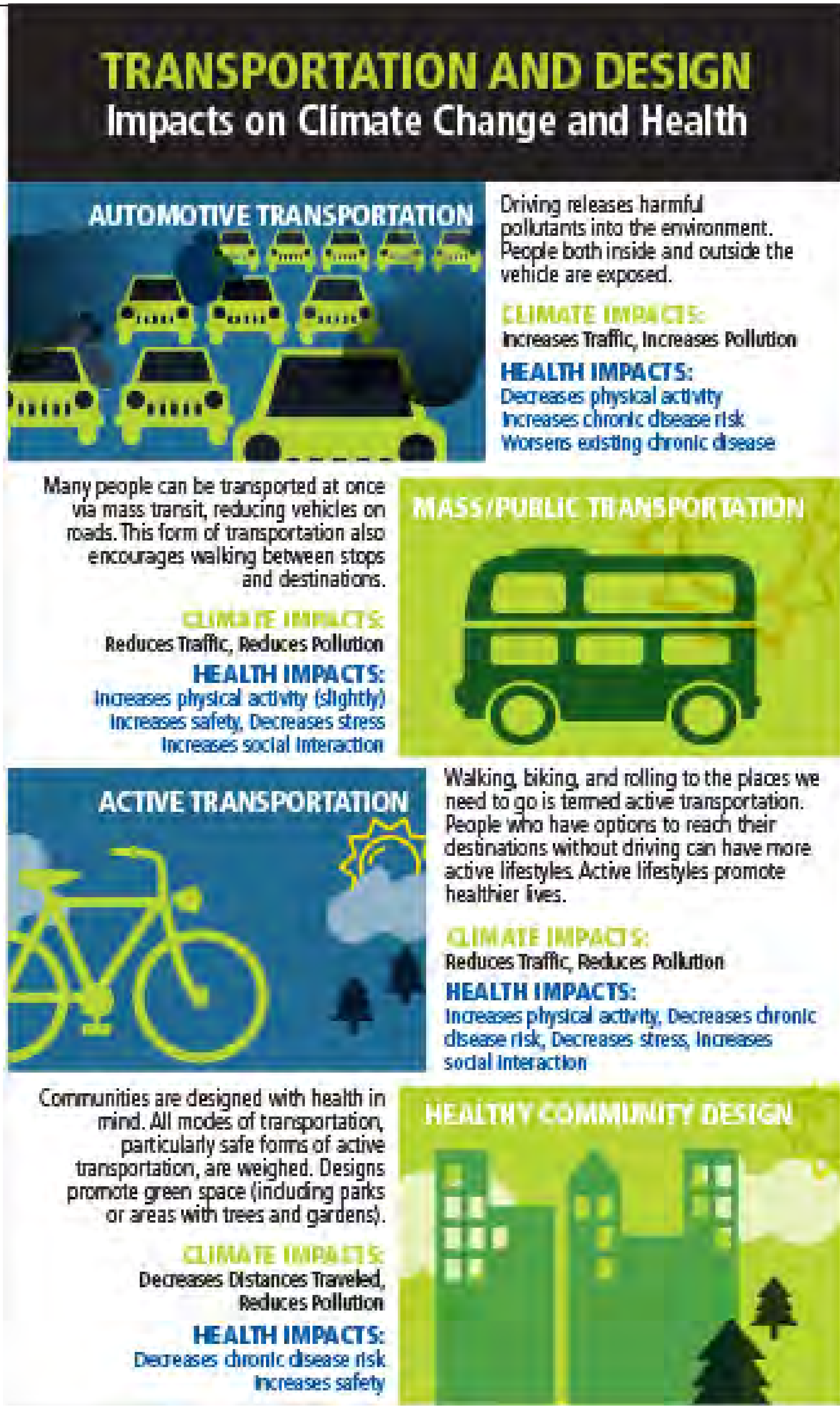
Transportation systems determine how people and goods get from place to place, and impact access to jobs, school, and essential services and resources. Today's transportation system causes injury and illness from air pollution, motor vehicle collisions, sedentary behavior, noise, and stress. Current land use, transportation, and housing patterns have increased our dependence on automobiles. Historical investments in road infrastructure and inadequate investments in public transit and bicycle and pedestrian infrastructure have resulted in a vehicle-centric transportation system that will require investment and behavior change to become a healthy and climate-friendly transportation system.

Key Messages

- Transportation is the largest source of GHGE in the U.S., accounting for 28.5% of emissions.
- Low-income families spend more of their income on transportation, have more exposure to vehicle pollution, and are at higher risk of injury and death due to collisions.
- Car-dependent land use, housing and transportation patterns increase sedentary lifestyles, increasing premature mortality and many chronic disease risks.
- Reduced car use is a priority, yielding significant health and climate benefits, such as increased physical activity and reduced emissions.
- Reduce transportation-related emissions through low and zero emission vehicles, low carbon fuels, and clean freight, also reduces respiratory and cardiovascular disease

Transportation and Climate Change

The transportation sector is now the largest (and fastest growing) source of U.S. GHGs; in 2016, it caused 28.5% of all U.S. GHG emissions.[2] The majority (82.7%) of U.S. transportation-related GHG emissions are attributable to cars, light-duty trucks, and heavy-duty freight vehicles.[3] Other GHGE sources include cement production and roadway impacts on deforestation.[4]



APHA, American College of Sports Medicine, Climate for Health, ecoAmerica 2017

Transportation and Health

Too little physical activity is associated with heart disease, stroke, diabetes, obesity, osteoporosis, depression and all-cause mortality. As of 2017, only one-third of people in the U.S. regularly achieved recommended moderate physical activity levels.[5] Exposure to traffic related air pollutants increases the risk for heart disease, asthma and other respiratory disease, cancer, premature death, adverse birth outcomes, diabetes, and affects lung and brain development in children.[6] Motor vehicles crashes are the top cause of injury, disability, and death in the U.S. for 5–24 year olds.[7] Long commutes and traffic increase stress and isolation from family and community.[8] Pavement contributes to urban heat islands (See Section 5.4—Urban Greening).[9]

Transportation and Health Equity

Low-income individuals and people of color are more likely to live near busy roadways and face disproportionate impacts of motor vehicle pollution.[10,11] Low-income people, people of color and children face greater risk of death and injury due to motor vehicle crashes.[12,13] Low-income families often have few low-cost transportation options, and almost 30% of their income goes to transportation.[14]

Reducing Transport-Related Climate Pollution and Improving Health

One of the best ways to improve our health and reduce climate pollution is to spend less time driving cars and more time using "active transportation"—walking, biking, and using public transit. Modest shifts in travel mode from car travel to active transportation provide big reductions in chronic disease.

- Nearly 28% of all trips in urban areas are less than one mile, easy bicycling distance.[15]
- Walking, biking, and public transit must be safe to ensure that expanding active transportation doesn't lead to more injuries. In 2015, approximately 18% of automobile crash fatalities included pedestrians and bicyclists.[16]
- "Complete Streets" make streets friendly for all users; better road and sidewalk design, segregated bike lanes, lighting, shade, and bike parking make biking and walking safer and more pleasant.[17]
- Programs such as "Safe Routes to School" allow parents to feel that children can safely use active transportation to get to school.[18]

Due to the high cost of driving, low-income people are more frequent users of active transportation. Better service, safety, affordability, and accessibility allows low-income people, youth, seniors and the disabled better access to resources and opportunities. Free or discounted public transit fees for students also increase school attendance and decrease contact with the juvenile justice system.[19]

Zero-emission vehicles and hybrid low carbon vehicles reduce air pollution and climate pollution. Zero-emission vehicles (battery electric and hydrogen fuel cell) produce zero tailpipe smog-forming or greenhouse gas emissions. Using today's average U.S. electricity mix of renewable and non-renewable resources, an electric car will cut harmful carbon pollution by about half compared to the average new vehicle.[20]

Low carbon fuel standards and automobile fuel efficiency standards reduce air pollution and climate pollution. The EPA's Low Carbon Fuel Standards Program 2017–2025 model year light-duty vehicles are projected to save approximately 2 billion metric tons of GHGs over the lifetimes of the vehicles; however, in May 2018, the EPA proposed a roll back on these cleaner car standards.[21,22]

Traffic Jam in NYC
joiseyshowaa, 2011

Active Transportation
Myleen Hollero

What Local Health Departments Can Do

Local health departments can play a critical role in moving toward a healthy, equitable, and climate-friendly transportation system.

Assessment and Surveillance

See Section 7.1—Surveillance

- Implement walkability and bikeability assessments, noting sidewalk width, shared and protected bike lanes, crosswalks and walk signs, aesthetics and shading, and connectivity and accessibility of sidewalks and bike routes.[23] Multiple tools are available to assess streetscape design and walkability, including the Microscale Audit of Pedestrian Streetscapes-Mini Tool.[24]
- Conduct health assessments to identify health benefits and potential health harms of transportation policies and programs proposed during the development of city and county Climate Action Plans, General and Specific Plans, Regional Transportation Plans, Bike and Pedestrian Master Plans, and others.
    - The Clackamas County Public Health Division in Oregon partnered with the county's Department of Transportation and Development to conduct a Health Impact Assessment, which prompted the agencies to recommend that the county build more sidewalks, improve lighting along paths, and enhance safety mechanisms at cross-walks.[25]
- Use available data to show the health impacts of transportation in your community, including the disproportionate impacts on children, low-income communities, and people of color.
- Use the Integrated Transport and Health Impacts Model (ITHIM) to quantify the health benefits and harms of different transportation planning scenarios or mobility goals and vehicle miles traveled reduction targets.[26]
- Assess the health impacts and benefits of shifts in transportation technology and infrastructure, including shifts from gas and diesel motor vehicles and trucks to low or zero emission vehicles and anti-idling ordinances.[27]

Intersectoral Collaboration

See Section 7.3—Collaboration

Collaborate with planners, zoning, transportation agencies, and school districts to support:[28,29]

- Active transportation programs and infrastructure, including Complete Streets, safe routes to school, bike lanes, bike shares, segregated bike lanes, safe pedestrian sidewalks, traffic calming, and signage, lighting and shading on biking and walking paths.
    - In Alexandria, VA, the health department was part of a cross-agency partnership to implement a 58-step action plan to expand Safe Routes to School and eliminate all traffic-related fatalities and serious injuries by 2028.[30]
    - In Helena, Montana, the local public health department collaborated with parks, public transit, and other community stakeholders to improve access to the trail system, creating a free trolley system for youth to access trails, pools, parks, libraries, and other activities.[31]
- Investments in transit infrastructure, maintenance, and access, including reduced transit fares/passes for students and low-income people.
- School siting in walkable, bikeable, transit-friendly locations.

Work with local planning, housing, transportation, and community development agencies and community- based organizations to support policies that encourage density and mixed land use to allow more people to live closer to jobs, schools, services, and parks, including infill and transit-oriented development.

- Anti-displacement measures and affordable housing are critical to ensure that low-income residents are not displaced through gentrification, as "smart growth" and new amenities may increase property values.[32]
- Promote inclusion of trees, parks and green space, and space for community gardens.

Provide health evidence and data to support:

- Lower speed limits.
- Strengthening of low carbon fuel standards and vehicle efficiency standards.
- Strategies to increase the use of electric vehicles such as electrification infrastructure and financial incentives, including mechanisms that allow low-income populations to benefit from electric vehicle ownership, such as enhanced rebates and charging stations in multi-unit housing.[33]

Community Engagement and Education

See Sections 7.2—Engagement and 8—Communications

- Educate communities on the health and climate benefits of active transport and provide resources regarding local bike share programs and bike lanes, walking paths, and public transit.[34]
- Inform local decision makers about the connections among transportation, climate change, health, and equity.
- Promote pedestrian and bicycle safety

- Provide opportunities for community residents—especially youth and seniors—to conduct walkability assessments.
    - In 2007, the Iowa Department of Public Health developed a tool for local health departments across the state to use in assessing the walkability of their communities. Thirteen communities utilized the tool, and many of these communities went on to engage city officials on improving active transport infrastructure.[35]
- Support community based organizations that advocate for active transportation

For More Information:

- Healthy, Equitable Transportation Policy: Recommendations and Research[36]
- Getting Involved in Transportation Planning[37]
- APHA's at the Intersection of Public Health and Transportation[38]
- APHA, American College of Sports Medicine, and ecoAmerica: Changing Climate through Healthy Community Design and Transportation factsheet
- APHA's Transportation and Health Case Studies[39]
- CDC, USDOT, and APHA's Transportation and Health Tool[40]
- Partnering with Metropolitan Planning Organizations to Advance Healthy Communities[41]
- U.S. Climate and Health Alliance's State Policy Initiative, Transportation Resources[42]

Coal Transport in Wyoming
Kimon Berl, 2009

Children Learning About Solar Panels, Reno, Nevada
Jessica Reeder/BlackRockSolar (CC BY 2.0)

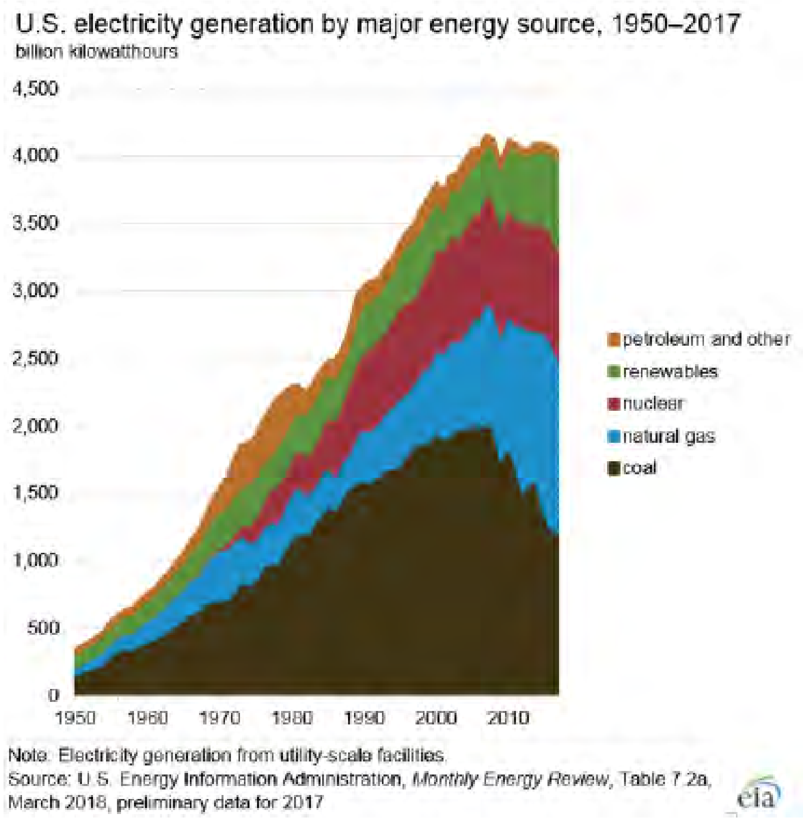
5.2 Energy and Fossil Fuels

Electricity generation is responsible for 28% of U.S. greenhouse gas emissions (GHGE), almost all of which is associated with the burning of dirty fossil fuels (Figure 5.2.1).[1] Fossil fuels—coal, oil, and gas—are fuels that were formed when prehistoric plants and animals died and were gradually buried by layers of rock.[2] As of 2017, coal provides 30.1% of U.S. electricity, although its use is declining due to the cheap cost of natural gas.[3] A significant reduction in our reliance on fossil fuels for transportation, electricity, heating and other uses of energy is vital to make progress in fighting climate change.

Key Messages

- Switching from coal combustion and other fossil fuels to clean, safe, renewable energy—like wind, solar and hydroelectric—is essential for our health and for the climate.
- Energy efficiency and clean renewable energy have substantial benefits for health, including reductions in asthma and other respiratory disease, cardiovascular disease and premature deaths.
- Energy production is the largest source of climate pollution in the U.S., responsible for nearly 1/3 of greenhouse gas emissions.
- Coal-fired power plants release 3.5 million tons of CO_2 per year, the most significant climate pollutant.
- Energy production is a major source of air, water, and soil pollution, and harms our health.
- Air pollution from burning coal causes over 13,000 deaths and 20,000 heart attacks in the U.S. each year.
- Increased energy efficiency (in homes, offices, and industry) allows us to meet our energy needs at lower cost and with less climate and air pollution.

Figure 5.2.1: Types of fuels used in electricity production



Energy and Climate Change

Coal

Coal combustion is a major source of GHGE and of toxic air pollutants.[4] Coal produces more carbon dioxide per unit of energy than any other energy source, producing nearly 68% of CO_2 from U.S. electricity production but only 30% of electricity.[5,6] Coal mining releases methane—a potent short-lived climate pollutant with a global warming potential far higher than that of CO_2—and contaminates land, water, and soil in nearby communities.[7]

Oil

Oil well exploration, offshore oil platform, and oil well production operations and refinery processes result in significant CO_2 and methane emissions.[8,9,10] Transporting oil by truck, rail, or marine vessels also results in significant CO_2 emissions.[11]

Natural Gas

Natural gas has been proposed as a "bridge fuel," producing significantly lower CO_2 emissions than coal.[12] But recent findings suggest that the methane released during the lifecycle of natural gas use may have a climate impact even greater than that of coal. Methane is a potent short-lived climate pollutant with a global warming potential far higher than that of CO_2.[13,14] In 2011, leaks from high pressure natural gas pipelines resulted in emissions equivalent to 33.3 million metric tons of CO_2 (or the CO_2 emissions from 6-7 millions cars.[15]

The Aliso Canyon Gas Leak

In October 2015, the largest methane leak in U.S. history occurred at the Aliso Canyon natural gas storage facility in Los Angeles County, California, releasing over 100,000 metric tons of methane. Thousands of families were evacuated from their homes, and many nearby residents suffered from symptoms such as nausea and headaches that the Los Angeles County Department of Public Health (LADPH) linked to exposure to high levels of mercaptans—odorants used in natural gas.

Researchers at the University of Southern California School of Medicine have raised concern about exposures to contaminants and byproducts such as hydrogen sulfide, benzene, and other volatile organic compounds.

Renewable Energy

Across their life cycles, renewable energy sources produce significantly less greenhouse gases than fossil fuels. A study of new renewable energy resources implemented across the U.S. in 2013 found that these additions resulted in emissions reduced by 59 million metric tons of CO_2 equivalent and $0.7 billion to $6.3 billion in benefits for that year.[17]

Other Considerations

Globally, oil, gas, and mineral extraction account for an estimated 7% of deforestation in the subtropics, which releases stored CO_2 and removes an important global carbon sink.[18,19]

Use of fossil fuel reserves must be limited to stay within 2°C warming

In order to have at least a 50% chance of staying within 2°C of global warming above pre-industrial levels, cumulative carbon emissions between 2011and 2050 need to be limited to 1,100 gigatonnes of carbon dioxide (Gt CO_2,). The emissions embedded in available fossil fuel reserves are around three times that amount. A recent study demonstrates that, "globally, a third of oil reserves, half of gas reserves and over 80% of current coal reserves should remain unused from 2010 to 2050 in order to meet a target of 2°C."

Energy and Health

A switch from dirty fossil fuels to renewable energy will result in significant reductions in illness and deaths.[21] The U.S. Department of Energy's National Renewable Energy Laboratory found that states that reduced fossil fuel energy production through new renewable energy systems saw health benefits and savings.[22] The full life cycles of these fuels includes extraction, processing, storage, transportation and use, each with significant climate, health, and equity impacts.

Coal

- Coal mining can cause significant water contamination and mudslides.[23,24]
- Coal miners suffer from debilitating occupational hazards, such as black lung disease, injuries and fatalities.[25,26]
- Coal is generally uncovered when stored or transported, resulting in significant increases in the concentrations of fine airborne particulates within 25 miles of the storage site or transportation line. Processing coal for export or use also creates coal dust.[27]
- Coal air pollution is also associated with heart disease, asthma, and chronic lung disease, with the greatest impacts on children, the elderly, low-income communities, people of color, and communities downwind of power plants.[28,29,30,31]
- Burning coal to produce electricity releases tons of toxic chemicals into the air, including nitrogen oxides, sulfur oxides and particulate matter (PM).[32] Coal power plants are the largest single source of mercury that pollutes waterways and contaminates the fish we eat. It is a potent neurotoxin that can cause developmental problems and learning disabilities, particularly in fetuses and young children.[33]
- The cumulative health costs of coal-based electricity in the U.S. have been estimated to fall between $62 billion and $523 billion annually.[34]

Hydraulic fracturing—"Fracking"

Fracking Wells, Pipelines, and Roads Deteriorating the Landscape
Simon Frasier University, 2006

As reservoirs of oil and gas continue to deplete, producers have turned to "unconventional" extraction methods such as hydraulic fracturing to tap reserves trapped in deep shale rock formations. Fracking releases significantly more methane than conventional extraction. The process requires huge quantities of water, which may enter surface and groundwater. Improper disposal of fracking water and inadequate treatment of wastewater can contaminate water used for drinking and crop irrigation. Workers at these sites are potentially exposed to chemicals in fracking fluids and high levels of crystalline silica in frack sand. Unconventional extraction processes can destabilize geologic formations causing sinkholes and earthquakes. Sites are often constructed in previously unexploited environments, introducing air quality, toxics, and noise concerns for surrounding communities from industrial activity, construction, and diesel transport emissions.

Drilling and fracking involves over 900 products containing over 600 chemicals, few of which have been fully characterized from a toxicological perspective. Physicians for Social Responsibility and Concerned Health Professionals of New York released a Compendium that summarizes hundreds of studies on the health impacts of unconventional oil and gas extraction, ranging from air and water quality issues to worker health, noise, earthquakes, and radioactive releases.

Other Energy Sources

- Natural gas extraction, storage, and transport emit methane, large concentrations of which may displace oxygen, causing dizziness, weakness, nausea, and vomiting.[35]
    - In the past 30 years there have been approximately 9,000 'significant' pipeline-related incidents across the U.S. with resultant 548 deaths, 2,576 injuries, and approximately $8.5 billion in financial damages[36]
    - Underground storage of natural gas presents risks of explosions, fires, routine toxic air-pollutant emissions, and leaks.[37]
    - Gas extraction, storage, and combustion may also release benzene, which has been associated with leukemia, and other volatile organic compounds, which contribute to the formation ground-level ozone (smog).[38,39]
- Oil production processes release cancer-causing and smog-forming chemicals and particulate matter including diesel exhaust and silica dust.[45]
    - People living in fence-line communities near oil and gas drilling sites have higher risks for cancer, increased asthma attacks and other respiratory problems, and emerging evidence of increased risks of adverse reproductive and neurodevelopmental outcomes.[46,47]
    - In 2010, oil refineries reported approximately 22,000 tons of hazardous air pollution to the Environmental Protection Agency.[48]
- The use of nuclear power poses a very small risk of accidental releases of radiation, though accidental releases could be catastrophic.[49] Nuclear workers face risks from chronic low-level radiation exposure, with attendant cancer risks, and uranium miners have a high risk of lung cancer.[50]

Energy and Health Equity

The greatest impacts of energy-related air pollution affect children, the elderly, low-income communities, people of color and communities downwind of power plants.

- Coal power plants are disproportionately located in low-income communities and communities of color; nearly six million African Americans live within three miles of a coal-fired power plant.[65,66]
- Over 1 million African Americans live in counties that face a cancer risk above EPA's level of concern from toxins emitted by natural gas facilities.[67]
- For many low-income families, "fuel poverty" due to high energy costs means choosing between paying for energy to cook, heat, or cool homes, versus other essential necessities such as food.[68]
- Fuel poverty is associated with increased risk for cold-related illness, and use of unsafe heat sources that can cause carbon monoxide poisoning or fires.[69] Globally, lack of access to energy leads to 3.8 million premature deaths associated with household air pollution from burning solid fuels and kerosene for cooking.[70]
- Concerns about high-energy costs may reduce the use of air conditioning during heat waves, increasing the risk of heat illness and deaths among low-income families. 18% of households below the poverty line do not have air conditioning).[71]

Health and Emerging Electricity Technologies

A transition to clean energy brings significant climate and health benefits because greenhouse gas emissions across the life cycle of renewables are far less than those from fossil fuels.[52,53]

However, the potential health risks of emerging electricity technologies should not be ignored.

- **Solar Photovoltaics**
  - Exposures to toxic dust and chemicals during material extraction and manufacturing stages, much of which occurs outside of the U.S.[54]
  - Disposal of solar photovoltaics (also likely to be offshored) may pose toxics exposure risks; research into safe and sustainable recycling and disposal is needed.[55]
- **Wind**
  - Current data does not support a causal relationship between wind turbine noise, infrasound, and vibration—symptoms common to reports of "wind turbine syndrome."
  - Wind turbine noise exposure has been associated with sleep disruption and annoyance.
- **Biomass**
  - Long-distance transport of biomass feedstocks entails diesel emissions related to goods movement that may be avoided with small, distributed systems.[57]
  - Alternative fates of feedstock—e.g. wildfire, open burning, or landfills—may be associated with health risks such as smoke exposure and displacement.[58]
  - Emissions from the energy conversion process pose health risks that have been inadequately characterized.[59]
- **Geothermal**
  - Occupational exposures to hydrogen sulfide are of concern.[60]
  - Leaks from liquid and solid waste streams may cause water contamination.[61]
- **Storage Technologies**
  - Electrochemical battery storage systems require use of rare and potentially hazardous materials that pose both chemical and fire risks throughout their life cycle.[62]

Emerging electricity generating and storage systems employ a myriad of workers across technology life cycles; more work is needed to ensure that these jobs are healthy and safe, provide career development, and pay living wages.[63]

Utility scale facilities may offer community economic development opportunities, but these should not detract from efforts to reduce related air pollutant emissions, particularly in communities already burdened with poor air quality.[64]

Just Transition

In order to equitably transition to decrease the country's reliance on fossil fuels, there must be policies for a "just transition" for workers currently employed in the fossil fuel industry.

"A just transition brings together workers, communities, employers and government in social dialogue to drive the concrete plans, policies and investments needed for a fast and fair transformation. It focuses on jobs, livelihoods and ensuring that no one is left behind as we race to reduce emissions, protect the climate and advance social and economic justice."[72]

Strategies include investments to retain and create good jobs, modernizing industry, apprenticeship, education, training programs for renewable energy jobs, and providing assistance for any workers and families who may be adversely affected.[73] Chicago IBEW Local 134 is building a renewable energy training facility for IBEW electricians across the U.S. to train for jobs in the new green economy. The site will have wind, photovoltaic, building automation, and smart metering facilities and training programs. [74]

Reducing Reliance on Fossil Fuel Energy

Switching from fossil fuels to clean, renewable energy is a critical path to the reduction of greenhouse gas emissions. Electricity generated from renewables releases about 1/20th the GHGE of coal over the full life cycle.[75] Advances in renewable energy technology have made renewable energy ever more cost-competitive and increased market shares.[76]

- In 2016, renewable electricity accounted for 67% of U.S. electricity capacity additions, growing from 64% in 2015, and coal-fired plants accounts for 80% of facility closures.[77]
    - U.S. wind energy increased by more than 11%, and U.S. solar energy increased by 52% in 2016.[78]

Energy efficiency and energy conservation are important for tackling climate change. They reduce the need for energy production and thus reduce GHGEs and air pollution, helping to reduce the health and climate impacts mentioned above.[79,80,81]

- Energy efficiency also reduces energy costs and saves money, a benefit especially for those on fixed or low incomes.[82,83]
- Programs are available to ensure that energy efficiency upgrades are available to those who need them the most: Low Income Home Energy Efficiency Plan (LIHEAP) and the Weatherization Assistance Program (WAP).[84,85]
- Key strategies for energy efficiency include zero net energy homes and commercial buildings; industry adoption of energy efficiency; deployment of energy-efficient appliances and light bulbs; strengthened energy efficiency standards for buildings and appliances.
    - Energy efficiency measures that tighten the building envelope need to ensure adequate ventilation to maintain healthy indoor air quality.

What Local Health Departments Can Do

Assessment and Surveillance

See Section 7.1—Surveillance

Provide data, mapping, and analysis that layers health and social vulnerability information with information about current or projected air and water pollution related to fossil fuel use and production.

Conduct health impact assessments of proposals for new or expanded fossil fuel extraction, processing, storage, and transportation in your jurisdiction.

- The New York Department of Health conducted a review of high volume hydraulic fracturing that bolstered the Governor's decision to ban fracking throughout the state.[86]
- Green River District Health Department in Kentucky completed an HIA on three proposed coal gasification plants to inform the community and policy makers on how job creation benefits compared to potential health impacts, including on low-income communities and other vulnerable populations.[87,88]

Assess the health and safety risks of oil and gas extraction, processing, storage and transportation in your jurisdiction.

- Assess potential impacts of "beneficial reuse" of oil field produced water for the irrigation of food crops, watering livestock and recharging aquifers.[89]

Analyze the health benefits of local and regional proposals to increase energy efficiency and shift to renewable energy, for example in city or county Climate Action Plans.

- A collaborative HIA by the Massachusetts Department of Public Health and Pioneer Valley Planning Commission assessed health impacts of implementing energy efficiency in municipal buildings.[90]

Interagency Collaboration

See Section 7.3—Collaboration

Provide relevant health data to inform communities and policymakers about the health impacts of local policies and standards that:

- Encourage increased energy efficiency and shift to clean renewable energy
    - Local community choice energy initiatives allow cities and counties the to aggregate energy demand, negotiate with suppliers, purchase more green power, reduce the cost of electricity, and provide power from local sources.[91]
- Reduce climate and air pollutants from electricity production, including methane leakage from natural gas.
- Limit expansion of fossil fuel based energy production.
- Increase access to information about the chemicals used in fracking or the transport of oil and coal.
- Establish a health and safety buffer zone between oil and gas facilities and sensitive "receptors" such as homes, childcare, clinics.

Encourage schools, health care systems, and local governments to purchase or install renewable energy, and connect them with resources on energy efficiency and renewables.[92,93,94,95]

- Health care systems can join Health Care Without Harm's Health Care Climate Challenge.[96]

Partner with housing, code enforcement, and home visiting agencies to improve access to measures that reduce climate vulnerability and increase energy efficiency, such as weatherization and energy assistance.

Work with emergency management agencies and local utilities to ensure no electricity shutoffs during heat waves.

Collaborate with local planners and community-based organizations to expand low-income energy retrofitting and weatherization programs, and to integrate healthy home components into those programs.

- King County, WA increased ventilation, moisture and mold control, carpet replacement, and plumbing repairs in homes visited by community health workers after adding a weatherization component to training.[97]

Partner with schools, community college districts, unions, and local trade organizations and green industries to develop green job apprenticeship and pipeline programs.

- The Oakland, CA Green Jobs Corps provides green jobs training for young adults facing barriers to employment.[98]

Collaborate with OSHA to address occupational health risks across the fossil fuel life cycle.

Community Engagement and Education

See Section 7.2—Engagement

Share information about the health harms of dirty fossil fuel energy from coal, oil, and natural gas and the health benefits of clean energy with colleagues, clients, policymakers, and community.

Support community based organizations seeking a just transition to a low carbon economy, including engagement through HIAs on fossil fuel facilities and projects.

Provide referrals to services for energy efficiency and/or assistance (LIHEAP) and weatherization services and information on funding sources during home visits.

Implement community warning systems if there is a risk of release of toxic substances from oil and gas facilities, such as in Contra Costa County, CA.[99]

For More Information:

- Energy and Human Health[100]
- The National Renewable Energy Laboratory's Retrospective Analysis of Renewable Energy Benefits in the U.S.[101]
- U.S. Department of Energy's Energy Efficiency Resources[102]
- U.S. Climate and Health Alliance's State Policy Initiative, Renewable Energy and Energy Efficiency[103,104]

5.3 Agriculture and Food Systems

Food and agriculture systems have significant impacts on climate change, the environment, and our health. Our food and agriculture systems account for approximately one-third of all U.S. GHG emissions and are driving increased consumption foods associated with chronic illness.[1,2,3]

Key Messages

Shifting to healthy diets and local, sustainable food and agriculture systems offer significant health, climate, and environmental benefits.[4]

- ○ Local food systems increase access to healthy fruits and vegetables.[5]
- ○ Eating less red and processed meat reduces the risk of heart disease and cancer [6] and reduces methane emissions from livestock production.
- ○ Sustainable agricultural practices conserve water, reduce pesticide and fertilizer use, protect topsoil, and sequester (store) carbon.[7]

- Reducing food waste and food waste diversion can reduce food insecurity and climate pollution at the same time.[8]
- Poor nutrition - especially overconsumption of calorie-dense foods and meat - is a leading cause of illness in the U.S., associated with diabetes, obesity, and cardiovascular disease.[9,10]
- Agriculture is a significant source of methane and nitrous oxide, extremely potent climate-warming gases. It is responsible for 8.6% of U.S. greenhouse gas emissions (GHGE) and about a third of global GHGE.[11]
- Industrial agricultural practices are also associated with antibiotic resistance, water contamination, pesticide illness, and topsoil loss.[12,13,14]
- Climate change will reduce worldwide food production through adverse impacts on crop yields and fisheries.[15] This will increase food insecurity and associated risks of chronic illness and under-nutrition.

Agriculture and Climate Change

In 2016, agriculture was responsible for 8.6% of U.S. total GHG emissions, including 36% of the country's methane emissions.[16]

- Factoring in fertilizer use, food refrigeration, food transport, and agriculture-related deforestation and soil depletion, food and agriculture systems account for about one- third of all U.S. GHG emissions.[17]
- Food production and processing account for 17% of U.S. fossil fuel use.[18] In the food industry, food production accounts for 83% of carbon emissions.[19]
- Nitrogen fertilizer accounts for ~80% of U.S. nitrous oxide emissions.[20]

Cows feeding in large cowshed
Official / Shutterstock.com

Urban Farming in San Francisco
VitusKonter, 2010

- 40% of food (valued at $165 billion) is wasted annually, and the 30 million tons of food that goes to landfills releases 23% of U.S. methane emissions.[21]
- Destroying rainforests for cattle feed is eliminating carbon reservoirs and watersheds.[22]
- 1 kg beef equates to roughly the same GHGE emissions as 160 highway miles in a mid-size car.[23,24]

Climate change is adversely impacting agriculture and food production (See Section 4.8—Food Security).

- Extreme heat, drought, and precipitation and higher ozone levels decrease crop yields.[25,26,27]
- Higher temperatures and drought reduce milk and egg production.[28]
- Warmer temperatures increase the risk of food contamination.[29]
- Increased atmospheric CO_2 reduces the protein and micronutrient content of key crops.[30]
- Extreme weather events can disrupt food transportation and supply chains.[31]
- Global food production will decrease by an estimated 2% per decade due to climate change, while global food demand increases by 14% per decade.[32]
    - Climate change has increased the number of malnourished children by 7–20% globally.[33]

Agriculture and Health

Poor diet and nutrition are leading causes of illness and death, increasing diabetes, obesity, cardiovascular disease, and cancer.[34]

- Only 1 in 10 U.S. adults eat the recommended amount of fruit and vegetables per day[35,36]
- Access to healthy affordable food is limited for low-income households and communities, exacerbating health inequities.[37,38]
- U.S. consumption of meat, high-fat, high-salt foods, and sugar has radically increased over several decades, driven by corn and soy subsidies.[39,40]

- Industrial agricultural practices are associated with antibiotic resistance, water contamination, and pesticide-related impacts.[41,42,43]
    - Nitrogen fertilizers and animal waste contaminate groundwater with nitrates, which is associated with "blue baby" syndrome.[44,45,46]
    - Pesticides cause acute illness in farmworkers and their children, increasing cancer, reproductive defects, and neurological and cognitive deficits.[47]
- Environmental and crop degradation from climate change and industrial agriculture increases risk for food insecurity, chronic illness and under-nutrition.[48]

Climate Change, Meat Consumption, and Health

Meat consumption in the U.S. has doubled over the last century. Diets heavy in red and processed meat have been linked to higher rates of heart disease, stroke, Type 2 diabetes, obesity, certain cancers, and earlier death.[49]

Meat production, processing, distribution and retailing accounts for 9% of U.S. and 15% of global GHG.[50] Animal agriculture accounts for 42% of agricultural emissions in the U.S.; worldwide, livestock accounts for between 14.5 percent and 18 percent of human-induced GHGE.[51] A recent study found that there is an 8-fold difference in GHGE associated with vegetarian and meat-based individual diets, 72% of which is due to increased beef intake.[52]

Industrial animal farming practices have devastating environmental impacts. Communities surrounding concentrated animal feeding operations (CAFOs)—frequently low-income communities and communities of color—often have poor air quality with high levels of hydrogen sulfide and ammonia and increased rates of asthma, respiratory illness, depression, and anxiety.[53] These operations are also associated with local water contamination from excessive nutrient runoff, antibiotics, and microbial pathogens.[54] CAFO antibiotic use accounts for 70% of U.S. antibiotics use and is a key contributor to increasing antibiotic resistance.[55,56,57] A third of global arable land is used to grow animal feed, accounting for nearly 70% of the world's deforestation[58] In the U.S., crops such as corn and soybeans receive tens of billions of dollars in subsidies. The vast majority of these crops are used for feed in livestock operations.[59]

Reducing meat consumption and eating a more plant-based diet could:[60]

- Reduce global mortality from chronic disease by 6–10%.
- Reduce food-related greenhouse gas emissions by 29–70%.
- Save $1–31 trillion overall by improving diets.

Agriculture and Health Equity

Climate impacts will exacerbate lack of access to and affordability of safe water and fresh produce for many low-income families and communities of color.[61]

- Food insecurity increases as food prices rise; pushing low-income households to choose cheaper, low-nutrient, processed foods associated with higher risks for diabetes, hypertension and obesity.[62,63]
- Food insecurity is more common in people of color. In 2016, 12.3% of U.S. households were food insecure: 22.5% of Black households and 18.5% of Hispanic households versus 9.3% of White households.[64]

Agricultural workers are at high risk for climate-related health impacts, such as heat illness and vector borne disease.[65]

Declines in food production result in significant job and economic losses in farming communities.

- 80% of U.S. farmworkers identify as Hispanic and just over half are documented, leaving many members of this community especially vulnerable to economic and health impacts of climate change.[66]

Indigenous communities that practice traditional hunting, subsistence farming and fishing are vulnerable to climate change impacts on game, farming and aquatic habitats, particularly in coastal communities where rising sea level threatens fishing habitats.[67]

Reducing Food-Related Climate Pollution and Improving Health

Improvements in food production and distribution, reduced food waste and eating less meat will reduce climate and environmental pollution and improve health.

- The use of available sustainable agricultural practices (e.g. better crop management, reduced fertilizer use, soil and degraded land restoration, improved manure management, increased water efficiency) could reduce agricultural GHGE by 5–14%, while increasing soil productivity and carbon storage and reducing soil erosion and water contamination.[68,69,70,71,72]
- Eating less meat and more fruits and vegetables would decrease greenhouse gas emissions and yield substantial health benefits.[73,74,75,76,77]
- Reductions in the use of pesticides and antibiotics would reduce pesticide related illness and water contamination, improve worker safety, and decrease antibiotic resistance.[78]
- Sustainable local food systems can reduce the use of fossil fuels in food transport, processing, packaging, and storage, increase access to healthy fruits and vegetables; build social capital, and improve mental health.[79] (See Figure 5.3.1)

Figure 5.3.1: Los Angeles Food Policy Council's Good Food for All Agenda[80]

What Local Health Departments Can Do

Public health has a critical role in building healthy, equitable, sustainable, and climate resilient communities.

Assessment and Surveillance

See Section 7.1—Surveillance

Assess and map food insecurity and local/regional food system assets in your community. See: CX3[81], Map the Meal Gap[82], Local Food System Asset Mapping[83], and Healthier Food Retail: Beginning the Assessment Process in Your State or Community.[84]

- Boulder, Larimer, and Weld Counties (CO) collaborated to assess local food systems in their rural regions, including marketing of agricultural products, shopping habits, food distribution, access to food, and nutrition assistance programs, and community gardens.[85]

Intersectoral Collaboration

See Section 7.3—Collaboration

Collaborate with Environmental Health, Planning, agricultural agencies, school districts, businesses, institutions such as hospitals, and community-based organizations to support local and sustainable food systems, including:

- Expansion of community and school gardens, urban and peri-urban agriculture, farmer's markets, mobile fruit and vegetable vending, "farm-to-fork" programs, food hubs, and conservation of regional agricultural lands.
    - Prince George Public Health in Maryland started a farmer's market, collaborating with local parks, businesses, and media outlets to procure space and grants to cover vendors' liability insurance and WIC certification.[86]
- Removal of legal and zoning barriers and promotion of incentives for businesses and organizations growing and selling healthy foods.[87]
- Preservation of agricultural land and natural habitats.
- Sustainable agricultural practices such as water conservation, better management of livestock production, and practices that reduce soil degradation and the use of fossil fuel based inputs such as pesticides and synthetic fertilizers (e.g. a fee on nitrogen fertilizers).[88,89,90,91]
- Reduction of federal subsidies for commodity crops (e.g. corn and soy) and increase in subsidies for production of healthy and sustainably grown foods.

Collaborate across departments and with other agencies and community organizations to increase access to affordable healthy foods.

- Expand the use of SNAP EBT and financial incentives at farmer's market coupons or mobile fruit and vegetable vendors.[92]
    - In Kent County, Michigan, the health department supported the local YMCA in creating a "Veggie Van" to provide urban neighborhoods in Grand Rapids year-round, daily access to fruits and vegetables from local farmers, sold at reduced prices. The Veggie Van accepts EBT, SNAP, WIC, and Senior Project Fresh/Market FRESH benefits.[93]

Encourage local health care providers and pharmacies to establish healthy food prescription programs that refer people to community resources to support healthy eating.[94]

Encourage procurement of healthy and local foods by institutions such as hospitals, schools, businesses, and government agencies.[95] The Kentucky Department of Public Health created the "Better Bites" programs at three state department cafeterias to offer healthy, local meal options and smaller portion sizes, along with related trainings and educational resource.[96]

Reduce food waste and food insecurity by promoting surplus food diversion and gleaning programs in collaboration with community groups.[97]

- Increase donations of healthy and usable food from hospitals, restaurants, and groceries to food banks and pantries.[98]
- Train Environmental Health Specialists on climate change, food waste, and food insecurity. Adapt and disseminate the Safe Surplus Food Donation Best Management Practices and the Safe Surplus Food Donation Toolkit for food facilities during normal routine inspections

Collaborate with Agricultural Extension and local agricultural organizations to educate growers and agricultural operations about agriculture-climate change-health connections.

Community Engagement and Education

See Section 7.2—Engagement

Inform the public and local decision-makers about the connections among food systems, food waste, climate change, health, and equity.

Conduct campaigns and programs with schools, businesses, agencies, and communities to reduce consumption of meat, processed foods, and sugar-sweetened beverages— for example "Meatless Mondays" and "Rethink Your Drink"—and to reduce food waste.[99,100]

Work with community groups and stakeholders to implement and support a Food Policy Council.[101]

- The Cleveland Department of Public Health worked collaboratively with diverse stakeholders to create the Cleveland-Cuyahoga County Food Policy Coalition to build a just, equitable, healthy and sustainable food system through policy change and capacity building.[102]

Train youth and community members to collect neighborhood level data on food quality, availability and affordability in low-income communities, using a tool such as CX3.[103]

- Support use of data to inform policy makers and institutions about opportunities to improve local food system and healthy food access.
- Look for opportunities to integrate climate change into nutrition education, information on food insecurity, and materials that address meat consumption and food waste reduction.
    - San Luis Obisbo, CA integrated climate change education into its OutsideIn SLO nutrition materials.[104]

For More Information:

- Climate Impacts on Food Systems[105]
- Sustainable Agriculture and Healthy Food Systems: A Resource Guide for Planners[106]
- Los Angeles Food Council's Good Food for All Report[107]

5.4 Urban Greening and Green Infrastructure

Urban heat islands are areas in cities with many buildings, lots of dark surfaces such as pavement and asphalt, and fewer trees, parks, and green space.[1] In these "urban heat islands," daytime temperatures are on average 1-6°F higher than in surrounding more suburban and rural areas. Nighttime temperatures can be as much as 22°F higher as the heat is gradually released from buildings and pavement.[2] Climate change is projected to increase average summer temperatures and cause more frequent, more severe, and longer heat waves, worsening the effects of urban heat islands and increasing the risks of heat illness and deaths.[3]

Urban greening refers to strategies that increase trees, parks, gardens, agriculture, forests, and other green and natural space in urban areas, and green infrastructure uses vegetation, soils, and natural processes to manage and create healthier urban environments. Urban greening and green infrastructure can increase resilience to extreme heat and natural disasters while reducing other impacts of climate change, such as flooding, storm surges, and sea level rise.[4]

Key Messages

- The health risks of heat, air pollution and flooding are increasing as climate change brings warmer temperatures, more extreme weather events and sea level rise.
- These risks are greatest in "urban heat islands" and in places with aging infrastructure or where natural protections have been weakened.
- Urban greening reduces the risk of heat illness and flooding, lowers energy costs and improves health.
- Green spaces provide places to be physically active and improve our overall well-being.
- Trees sequester carbon dioxide, improve air quality, capture rainwater and replenish groundwater.

Green Infrastructure and Gray Infrastructure

Gray Infrastructure

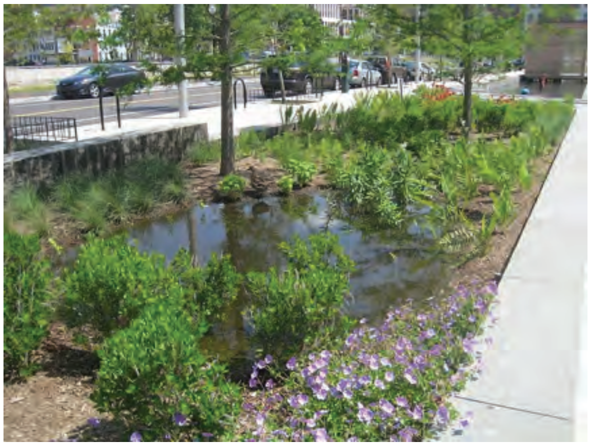
Gray infrastructure refers to man-made structures such as storm sewers, levees, seawalls and detention ponds designed to move water or protect developed areas from flooding.[5] These structures—often made of concrete—may increase water runoff, as surface water is unable to be filtered through soil.[6] Increased runoff contributes to flooding during extreme rain events, and can increase the concentration of pollutants in runoff.[7] Gray infrastructure retains heat from the air, contributing to the urban heat island effect and increasing nighttime air temperatures (Figure 5.4.1).[8]

Green Infrastructure

Green infrastructure includes: tree planting, rain barrels and rain gardens, green street design with permeable pavements and bioswales (sections or sidewalks or curbs with vegetation that allow natural treatment of runoff water), ecosystem restoration and green roofs.[9,10,11] Green infrastructure:

- Provide more green and cool space, and reduce the risk of flooding.
- Increase resilience to extreme heat and natural disasters while reducing other impacts of climate change, such as flooding, storm surges, and sea level rise
- Reduce sewer overflows during storms, recharge groundwater aquifers water by allowing rainwater to soak into the ground, and reduce the energy needed to treat and move wastewater.[12,13,14]

Figure 5.4.1: Green Infrastructure Rain Garden[15] (left) and Grey Infrastructure[16] (right)



Urban Greening, Green Infrastructure, and Climate Change

Urban greening reduces urban heat islands and decreases the risk of heat illness by lowering surface and air temperatures.[17,18,19]

- Shaded surfaces, from trees and other plants, may be 20–45°F cooler than unshaded surfaces;[20] A vegetated "green roof" surface can be cooler than the surrounding air, whereas conventional rooftop surfaces can exceed ambient air temperatures by up to 90°F.[21]
- Warm weather increases in energy demand for air conditioning, increasing the chance of electricity brown-outs.[22] Shade cools buildings and can decrease air conditionings costs by 20%.[23,24,25]
- Plants and vegetative growth can protect fragile coastal areas, mitigate sea level rise, and improve water quality and aquatic habitats.[26]
- Trees sequester carbon dioxide (sequestering an estimated 95.5 million metric tons of carbon dioxide in 2006).[27]

Urban Garden in Detroit
Kate Gardiner, 2012

Farmers Market
John Tornow, 2010

Urban Greening, Green Infrastructure, and Health

People living in urban heat islands are at greater risk of heat-related illness.[28] Green infrastructure could reduce temperatures by 0.5–0.7°C.[29] A 0.5°C reduction in the maximum and minimum temperatures results in a 50% reduction in heat-related mortality.[30]

- Urban areas experience greater air pollution and more negative health impacts during hot summer months.[31] Higher temperatures lead to higher levels of ozone, with increased risks for asthma and heart attacks.[32]
- Trees clean the air by removing harmful pollutants associated with asthma and cardiovascular disease, such as ozone, nitrogen dioxide, and particulate matter.[33]
- Parks provide places for physical activity and social connection, and community gardens increase access to healthy foods (See Section 4.8—Food Security).[34,35]
- Access to green space lowers stress, and even speeds up recovery times in hospitalized patients.[37,38]
- Trees and greenery have been associated with reduction in crime and increases in property value.[39]

Urban Greening, Green Infrastructure, and Health Equity

People of color and low-income families are more likely to live in areas with fewer trees, parks and green spaces and are thus more likely to be exposed to the heat risks of urban heat islands.[40]

- People living in poverty are less able to afford the costs of air conditioning, making other heat adaptation strategies such as greening even more important.
- Accessible parks have been associated with greater physical activity, relaxation, social interaction, and improved quality of life in communities, especially in low-income communities and communities of color.[41,42,43]
- Without intentional strategies to ensure equitable access to greening and green space for all, neighborhood greening may contribute to gentrification and displacement of lower-income residents.[44]

What Can Local Health Departments Do

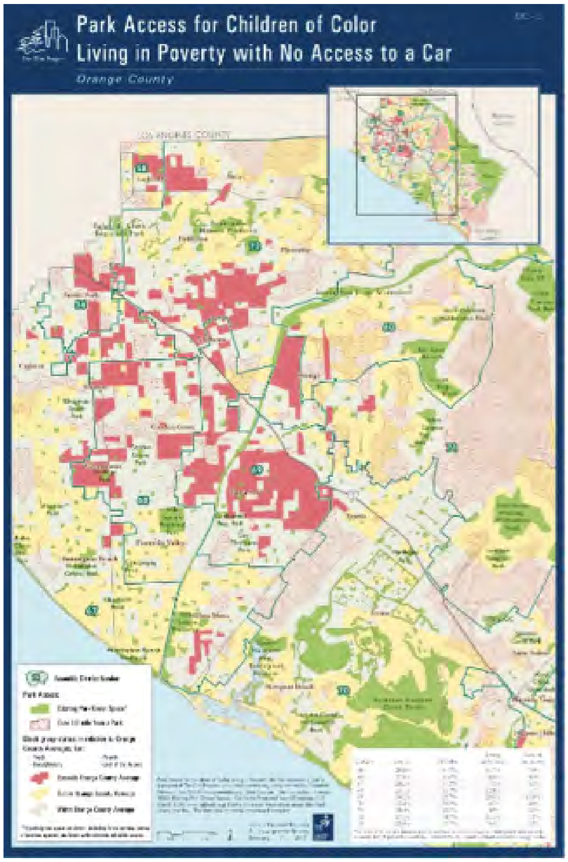
Public health professionals and health agencies have a critical role in building healthy, equitable, sustainable, and climate resilient communities.

Assessment and Surveillance

See Section 7.1—Surveillance

Collaborate with parks and public works agencies and community-based organizations to map park access and to use tools such as i-Tree to assess tree canopy and the benefits of planting more trees. (See Figure 5.4.2)[45,46]

Figure 5.4.2: Map of Park Access for Children of Color Living in Poverty in Orange County[47]



Conduct an assessment of the relationship between access to parks and health.

- The Los Angeles County Department of Public Health assessed park access per capita in relation to premature mortality from various health outcomes. Areas with less park space had higher rates of premature mortality from cardiovascular disease, diabetes, higher prevalence of childhood obesity, and greater economic hardship compared to communities with more park space per capita. African Americans and Latinos were also more likely than Asians and Whites to live in communities with less park access.[48] See the CDC's Parks and Trails Health Impact Assessment Toolkit.[49]

Intersectoral Collaboration

See Section 7.3—Collaboration

Collaborate with planning, parks, transportation, public works agencies and school districts to promote local policies that:

- Increase parks and tree canopy especially in tree-poor and park-poor low-income communities. Consider tree fire resistance, pollen production, and drought resistance.
- Use trees to provide shade for school yards, parking lots, parks, and walking and bike paths
- Restore and surface urban streams and rivers.[50]

Collaborate with parks, school districts, police, and community partners to improve programming in parks—especially those located in neighborhoods with high levels of violence or social isolation.[51]

- The Los Angeles County Department of Public Health documented significant benefits following implementation of the Parks After Dark program, including increased physical activity, improved social cohesion, and decreased violent crime.[52]

Work with public works to promote and develop "green streets", particularly in tandem with development of Complete Streets that promote walking and biking.[53]

- The Miami-Dade Health Department collaborated with the local Parks, Recreation and Open Spaces Department to create an Open Space Master Plan that builds a connected and equitable system of open spaces that encourage exercise, such as parks, natural areas, and cultural amenities linked by greenways, blueways, bike paths, and trails.[54]

Collaborate with local health care providers and parks agencies to start a "Parks Prescription" program.[55,56] The D.C. Department of Health and the D.C. Parks and Recreation Department provided neighborhood-specific resources on park access to primary care physicians for distribution to patients.[57]

Encourage community colleges and job training agencies to create apprenticeship programs that teach skills used to restore and create urban green spaces in low-income communities.[58]

Community Engagement and Education

See Section 7.2—Engagement

- Educate communities on the health and climate benefits of local parks and green space and provide clients with resources regarding local parks and related activities and events.
- Engage residents in mapping park access and tree canopy, and support community initiatives to expand access to trees, parks, and green space.
- Survey community members to assess their experience of local parks to understand their needs and how local park use could be improved.[59]
- Inform the public and local decision makers about the connections among green space, climate change, health, and equity.

For More Information

- Reducing Urban Heat Islands: Compendium of Strategies, Trees and Vegetation[60]
- Quantifying the Greenhouse Gas Benefits of Urban Parks[61]
- The Value of Green Infrastructure for Urban Climate Adaptation[62]
- CDC's Parks, Trails, and Health Workbook: A Tool for Planners, Parks and Recreational Professionals, and Health Practitioners[63]
- ChangeLab Solution's Community Gardens for Public Health[64]

5.5 Unintended Harms of Climate Action

Some climate mitigation and adaptation strategies have potentially adverse consequences on health and/or health equity. For example:

- Market mechanisms such as cap and trade or carbon taxes can, if poorly designed, lead to adverse impacts on low-income communities and communities of color, such as perpetuation of exposure of fence-line communities to stationary air pollution sources.[1,2]
- Large scale production of first-generation biofuels (e.g. corn ethanol) led to increases in the price of corn went up and in land use for commodity crops versus subsistence farming and other agriculture.[3]
- Groundwater withdrawal may increase significantly in response to drought, with consequences that may further limit water options in a prolonged drought, including:
    - increased concentration of drinking water contaminants.[4]
    - saline intrusion into coastal aquifers, increasing treatment costs and limiting usable water reserves.[5]
    - land subsidence, associated with significant damage in parts of California, Texas and Florida in recent decades.[6]
- Gentrification: as neighborhood amenities such as trees, parks, and bike-pedestrian infrastructure are enhanced, home values and rental prices increase, leading to the displacement of people of color and low-income families who may have been in the neighborhood for years.[7]
- Encouraging walking and biking without concomitant enforcement of traffic safety laws and street design protections, can inadvertently place pedestrians and cyclists at greater risk of injury and death.[8]
- Prioritization of clean car strategies to the exclusion of efforts to reduce vehicle miles traveled fails to optimize health and climate benefits.[9] Clean cars provide critically important reductions in GHGE and air pollution, but do little to address the adverse impacts of motor vehicle use on physical activity, injuries, and unsustainable land use.
- Air conditioning is energy and cost intensive, increases street level heat, and with widespread use can cause brownouts.[10]

What Local Health Departments Can Do

Assessment and Surveillance

See Section 7.1—Surveillance

Assess the health and equity impacts of proposed climate policies and programs, and their implementation.[11,12]

Intersectoral Collaboration

See Section 7.3—Collaboration

Collaborate with housing, planning, economic development agencies and CBOs to ensure that anti-displacement measures and affordable housing are integrated into planning for "smart growth" and transit-oriented development where amenities may increase property values, such as bike/pedestrian infrastructure and greening.[13]

Collaborate with local planning and office of sustainability to integrate health and equity into the development of climate action plans to optimize benefits.

Community Engagement and Education

See Section 7.2— Engagement

Support community based organizations to build capacity and ensure strong community voice and participation in the development of climate policies and programs.

- In Richmond, CA, Urban Habitat, a local organization, partnered with other groups to raise awareness of the city's Climate Action Plan, creating climate justice curriculums and trainings for community members and improving mechanisms for their input to be included in the plan and future environmental and sustainability measures.[14]

Public Health Programs and Climate Change

6.1 Maternal, Child, Adolescent, and Family Health

"The social foundations of children's mental and physical health are threatened by the specter of far-reaching effects of unchecked climate change, including community and global instability, mass migrations, and increased conflict. Given this knowledge, failure to take prompt, substantive action would be an act of injustice to all children. A paradigm shift in production and consumption of energy is both a necessity and an opportunity for major innovation, job creation, and significant, immediate associated health benefits."

– American Academy of Pediatrics, 2015[1]

Key Messages

Why Climate Change Matters for Maternal, Child, Adolescent, and Family Health

Climate change impacts on agriculture, built environments, family stability, and economic systems have adverse impacts on nutrition, physical activity, safety and security, financial security, and social cohesion. Thus, climate change makes it more difficult to promote healthy behaviors, healthy development, and healthy families and communities. Many climate solutions, including actions to promote clean air and healthy food and transportation options, offer significant Maternal, Child, Adolescent and Family Health (MCAH) benefits, including actions to promote clean air and healthy food and transportation options. (See Section 5—Health Benefits)

- Infants, children, adolescents and perinatal women are among the most vulnerable to the health impacts of climate change, due to factors such as biological sensitivity, exposure, and adaptive capacity related to perinatal or age-related stages of development. Climate impacts, such as extreme heat and increased ozone levels, directly impact maternal, child, and adolescent health.
- Protecting children against harm and providing all children with opportunities for health are core goals of MCAH. As trusted, credible messengers who are knowledgeable about and committed to the wellbeing of children and families, MCAH professionals are uniquely positioned to enhance public and policymaker understanding about the impacts of climate change on women, children, and families, and to increase motivation for climate action.

Key Messages

What Local Health Departments Can Do

MCAH programs can integrate climate change into existing work and foster consideration of MCAH needs into the climate-related work of other agencies in their jurisdictions. MCAH programs can:

- Assess and map community vulnerabilities for climate-related MCAH impacts and enhance surveillance of climate-related diseases.
- Collaborate with agencies in other sectors such as schools, housing, public works, and parks to support policies and implement programs that reduce the risk of exposure to extreme heat, poor air quality, and infectious agents and vectors, and reduce climate pollution.
- Work with LHD Public Health Emergency Preparedness programs and emergency management agencies to ensure that MCAH populations are protected during extreme weather events.
- Inform the public and policy makers about the connections between MCAH and climate change, and the health and health equity benefits of climate action.
- Inform health care providers and patients about how climate change impacts MCAH and how to promote health in the era of climate change, including through using their voice to support climate solutions.

Climate Vulnerability in Maternal, Child, and Adolescent Populations

Pregnant women, infants, children and youth face greater vulnerability to climate change impacts due to their distinct biologically based sensitivities, exposures, and limited adaptive capacity.[2]

Biological sensitivity and susceptibility[3]

- Physiologic and immunologic changes in pregnancy make pregnant women more susceptible to climate-related health impacts of heat, air pollution and infectious diseases.[4]
- Innate physiological, anatomical, and developmentally based behavioral differences make infants and children more vulnerable to climate impacts.
    - Children take in proportionally larger amounts of air, water and food, relative to their body weight and face higher risks for illness related to heat, ozone, toxic particulate air pollution, and zoonotic, water, and food-borne illnesses.[5,6,7,8,9,10,11,12,13]
    - Children's small size, dependency and cognitive development increase their risk for injury, illness, death, adverse mental health consequences, and separation from caregivers following extreme events.[14,15,16]

Greater exposures due to behaviors and environments

- Children are more likely to be active outdoors, increasing their exposure to climate impacts such as air and water pollution, allergens, vector-borne diseases, and extreme heat.

Limited adaptive capacity

- Children are less able to respond to hazards. They cannot independently evacuate in an extreme weather event or provide cooling on extreme heat days. Climate disasters also disrupt community resources on which children depend, such as schools.[17,18]

How Climate Change Impacts Maternal, Child, and Adolescent Health

Pregnant Women, Fetuses and Infants

- Extreme heat increases the risk of preterm birth, low birth weight, and infant mortality.[19]
- Drought and floods are associated with:
    - Impaired access to safe and reliable water for drinking and sanitation, increasing risk of dehydration, preterm labor, and low birth weight[20]
    - Increased risk for waterborne gastrointestinal illness, which is associated with adverse pregnancy outcomes including spontaneous abortion and preterm birth[21]
    - Exposure to infectious agents, toxic pollutants, and mold. Exposure to mold or dampness during infancy is associated with persistent asthma through adolescence[22]
    - Psychological stress, increasing risk of adverse outcomes, anemia, eclampsia, spontaneous abortion[23]

New Orleans Department of Health Responds to Zika[27,28]

Beginning in May 2015, Brazil experienced a dramatic increase in cases of microcephaly. Investigators concluded that the cause was Zika virus, transmitted by the *Aedes aegypti* mosquito. Prenatal exposure to Zika also causes hearing loss, delayed growth and eye defects.

Climate change contributes to changing mosquito distributions due to changes in precipitation and temperature, and *A. aegypti* is now found in many parts of the U.S., increasing the risks of a Zika outbreak if a traveler returned to the country with Zika. Like many other LHDs, the New Orleans Health Department (NOHD) responded quickly. Mosquito and Termite Control Board and NOHD brought clinicians, environmental specialists, and politicians together to develop a Comprehensive Zika Virus Plan that included a citywide education campaign on Zika and mosquito control, enhanced mosquito surveillance and collection for Zika testing, and case management and response. Pregnant women and clinicians received specific guidance on symptom recognition and screening for Zika, and a phone line provided information and referrals. When a pregnant woman returned to New Orleans with Zika infection, NOHD kicked into high gear. A door-to-door campaign provided neighborhood residents with information about how to protect against mosquito bites. Code enforcement and other city agencies did inspections to find and remove any debris or small water collectors. Plans are in place for additional enhanced mosquito control—such as aerial and ground spraying and more intensive property inspections—should there be any confirmed case of local transmission of Zika.


Children harvest an aubergine in Tainan, Taiwan
Michael Bish (CC BY-NC-ND 2.0)

- Air quality: Rising temperatures cause increased ground-level ozone levels. Exposure to ozone and particulate matter is associated with increased risk for low-birth weight babies and infant mortality.[24]
- Injury and violence: Domestic violence increases during both pregnancy and extreme heat events and with rising temperatures, placing women and fetuses at heightened risk for injury, death and adverse birth outcomes.[25,26]

Children and Adolescents[29]

- Heat: Children are particularly vulnerable to heat stress, especially under age one. Heat illness is the leading cause of death and disability among high school athletes. About 120,000 U.S. children farm laborers are at risk for heat illness.
- Air Quality:
    - Warmer temperatures increase ozone levels; climate change is also increasing stagnation events that create the worst ozone episodes.[30]
    - Children are at greater risk from higher ozone levels due to higher respiratory rates and more time spent outdoors. Ozone has been associated with increased risk of asthma and ED admissions and pediatric ICU stays for asthma.
    - Smoke from wildfires—laden with fine particulate matter ($PM_{2.5}$)—spreads over long distances, and is associated with increased risks of premature deaths, ED visits, and hospitalizations.[31]
    - Warming climates increase the length and intensity of the allergy season.[32]
- Infectious Disease: Climate change is increasing the risk of vector-borne diseases such as West Nile Virus and Lyme disease. Reported cases of Lyme disease are most common in 5–9 year old boys.[33]
- Food Security: Over 13 million children in the U.S. were food insecure in 2016.[34] Climate change threatens crop yields and other food production, food price increases, and higher levels of food insecurity[35] (See Section 4.8—Food Security).
- Extreme weather events:
    - Children are at risk of illness, injury or death, separation from or loss of caregivers, and mental health consequences following extreme weather disasters, which are increasing in frequency and severity due to climate change. Following Hurricanes Katrina and Rita, more than 5000 children were separated from their families.[36]
    - Flooding and extreme precipitation increase the risk for indoor mold exposure and related respiratory disease, and for diarrheal disease due to waterborne pathogens.
    - Children and youth are at higher risk for severe mental health consequences after extreme events, and experience high rates of PTSD symptoms after natural disasters such as hurricanes and floods.[37] When climate change exacerbates poverty and disrupts families and neighborhoods, it heightens impact on teen physical and mental health, behavior, and risky sexual behavior.[38,39]

- Disruption of school and community resources due to climate disasters impacts children's physical, mental and academic development. Children displaced from Hurricane Katrina demonstrated worse academic performance, school attendance, behavioral issues and mental health. Children need an estimated 4–6 months to recover academically following school displacement from severe weather events.[40]

Climate Change and Children: A Global Snapshot

Climate change may cause an additional 25.2 million malnourished children if temperatures increase 3–4°C, primarily due to crop yield reductions.[41,42] Rising CO_2 levels are associated with reductions in micronutrient content of staple crops like rice and wheat.[43]

1.5 million children die from diarrheal disease annually, a number projected to increase significantly due to climate change.[44,45]

Lack of electricity is associated with worse health and educational outcomes.[46] Approximately 3 billion people use solid cooking fuels and kerosene in open fires or inefficient stoves.[47] Exposure to household air pollution approximately doubles the risk for childhood pneumonia and is responsible for 45% of all pneumonia deaths in children under 5.[48] A transition from fossil fuels to clean renewable energy for cooking and lighting will significantly improve health, economic, and educational outcomes, especially in low- and middle-income countries.[49]

Providing women and families with access to reproductive health services is a proven approach to improving the socioeconomic status of women and children, reducing the strain on the environment, and conserving resources. Universal access to contraception and empowerment of women are two of the most cost-effective ways to address both unsustainable population growth and climate change.[50]

"Conclusive evidence has demonstrated that that climate change is having a dramatic impact on the lives of people around the world. Representing physicians dedicated to the whole well-being of women—including their safety, security, and access to quality care—the American College of Obstetricians and Gynecologists recognizes that climate change is an urgent women's health concern as well as a major public health challenge. We call on our national and international leaders to act to curb greenhouse gas emissions and limit further climate destabilization. Without question, climate change has a disproportionate effect on global women's health, as it broadens existing gender-based health disparities. The effects of climate change—such as food and water insecurity, civil conflicts, extreme weather events, spread of disease, and more—put women in affected regions at elevated risk of disease, malnutrition, sexual violence, poor mental health, lack of reproductive control, negative obstetric outcomes, and death. This also has an impact on future generations, with the rate of low-birth weight infants increasing in regions impacted by the effects of climate change, and with the erosion of the health care infrastructure needed to support healthy women and healthy families. Moreover, as the effects of climate change continue to threaten the well-being of women across the globe, we ask that government and public health agencies take steps to ensure the protection of women's health services and human rights."

The American College of Obstetricians and Gynecologists, 2016[51]

MCAH, Climate Change, and Equity

Pregnant women, infants, children and youth face greater vulnerability to climate change impacts as a result of their distinct biologically-based sensitivities, exposures, and limited adaptive capacity.[45,46] Due to the intersection of race, poverty and chronic illness, low-income families and women and babies of color are at yet higher risk of the negative health impacts of climate change.

Women of color are already at higher risk of adverse pregnancy and newborn health outcomes

- The infant mortality rates for African American and Native American women are significantly higher than those for non-Hispanic Whites.[47,48]
- African-American women are more likely to be diagnosed with pre-pregnancy diabetes and hypertension.[49]
- Uninsured, rural, American Indian/Alaska Native, and other women of color are more likely to receive late or no pre-natal care.[50]

Children in low-income households and children of color already face a disproportionate burden of disease and pollution relative to children in wealthier households and White children.[51]

- Black children are two times as likely to be hospitalized for asthma, four times as likely to die from asthma, and two times more likely to die from diabetes relative to White children.[52,53]
- Puerto Rican children are twice as likely to have asthma, as compared to non-Hispanic whites.[54]
- Children in neighborhoods with high levels of poverty visit the emergency room and are hospitalized for asthma at rates four times higher than those in wealthier areas.[55]
- Latino children living in areas with high levels of air pollution have a heightened risk of developing Type 2 diabetes.[56]

Extreme Heat

- Low income and communities of color are more likely to be located in "urban heat islands" where nighttime temperatures may be as much as 22°F higher than surrounding areas. These areas often map onto areas of historical residential segregation.[57]
- Low-income families report that the utility costs of operating and maintaining an air conditioner are a major barrier to staying cool during extreme heat.[58]
- There may be as many as 500,000 employed child agricultural workers under age 18 in the U.S, at particularly high risk of heat illness and dehydration.[59] Eighty percent of U.S. farmworkers identify as Hispanic.[60]

Drought[61]

- Low-income families are more vulnerable to food and water insecurity from rising food and water prices associated with drought and crop loss.[62]
- Agricultural communities are more vulnerable to the adverse economic impacts of drought, and to the mental health impacts.[63]

MCAH, Climate Change, and Equity continued

- Low-income rural communities are disproportionately reliant on small water systems or private drinking water wells, at increased risk of water shortages or exposure to contaminated well water; Native American communities are more likely to lack access to clean, potable drinking water than other groups in the U.S.[64,65]

Flooding and Extreme Weather Events

- Low-income households are less likely to have disaster insurance, less able to recover from property loss associated with extreme events, and have fewer resources to relocate.[66]
- Undocumented families are not eligible for FEMA assistance and even those who are eligible may fear applying. Immigrants may also have concerns about accessing evacuation shelters and other relief services due to inadequate cultural and linguistic competency of service providers, and undocumented immigrants may fear legal repercussions of seeking services.[67]
- Extreme weather can interrupt treatment for asthma and other chronic illnesses due to displacement, power outages, stressed health systems, and high-demand for medical supplies.[68,69]
- People with disabilities have high rates of illness, injuries, or death during extreme events, as cognitive, hearing, physical, and mobility impairments may impede safe evacuation.[70]
- Low-income families are more likely to live in poor housing conditions, which can increase exposure to mold following flooding and extreme weather events.[71]
- Homeless children may occupy areas near creeks or rivers, making them more vulnerable to storms and floods.[72]

Infectious disease[73]

- Low-income families are more likely to live in blighted neighborhoods and sub-standard housing, placing them at increased exposure to vectors and higher risk of vector-borne disease due to lack of A/C conditioning and poor screening in houses or apartment buildings.[74]
- Native American and Alaska Native communities more frequently lack access to clean, potable drinking water.[75] Warmer water temperatures may exacerbate already-high rates of diarrhea-associated hospitalizations for Native American and Alaskan Native children.[76]

Air Quality[77,78]

- Low-income households, people of color, and non-English speaking and foreign-born persons are more likely to live near busy roadways, and therefore face worse air quality.
- Nearly 1 in 2 Latinos live in counties frequently violating clean air and ozone standards, exacerbating air quality issues, and Latino children are twice as likely to die from asthma as non-Latino Whites.[79]

continued on next page

MCAH, Climate Change, and Equity continued

- Thirty-nine percent of the people living near coal-fired power plants are people of color; seventy-eight percent of African Americans live within 30 miles of a coal-fired power plant and a million African Americans live within half a mile of oil and gas operations.[80,81]

Wildfire

- Communities and households at the wildland-urban interface where human-built environments are adjacent to areas of wildland vegetation are at greater risk of wildfires.[82]
- Native American and Alaska Native populations living near forested regions are at increased risk of displacement, smoke-exposure, injury, and property loss, especially if more populated areas are prioritized for fire management response.[83]
- Children with asthma are at risk of disease exacerbations due to wildfire smoke and the emergency conditions created by wildfires disrupt ability to adequately manage asthma.

Food insecurity[84,85]

- People of color and those living in poverty face higher rates of food insecurity.
    - 22.5% of African American households and 18.5% of Hispanic households are food insecure, compared to 9.3% of White households.[86]
- Women and children in indigenous communities that rely more on subsistence farming and fishing are more vulnerable to climate change impacts on game, farming, and aquatic habitats.[87]

Mental health[88]

- African Americans suffered higher rates of adverse mental health outcomes following Hurricane Katrina, with low-income individuals and people between the ages of 18 and 34—especially single mothers—at particularly high risk.[89,90]

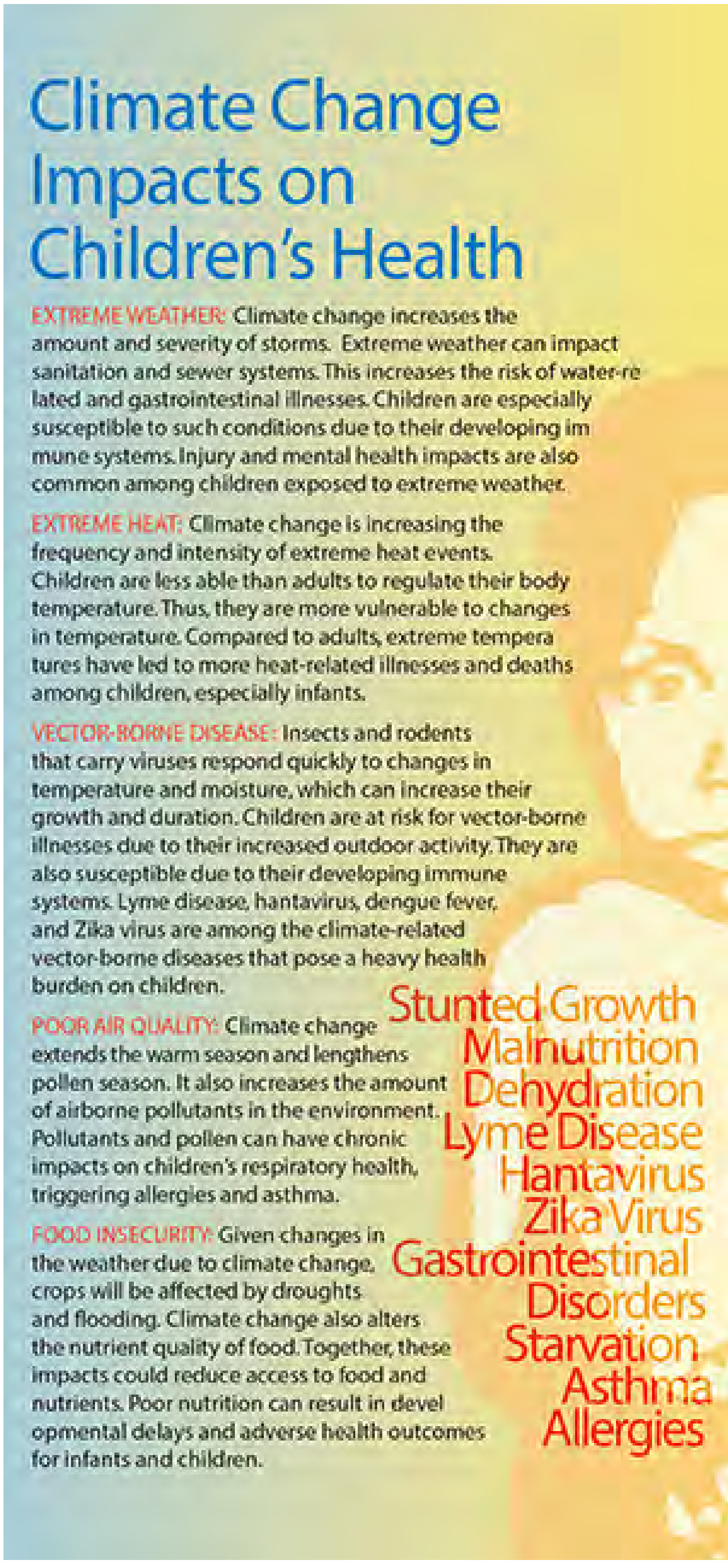
What Local Health Departments Can Do

Assessment and Surveillance

See Section 7.1—Surveillance

Integrate climate and health risks into MCAH assessments:

- Identify and map areas with large populations of children ages 0–5.
- Map prevalence of tree canopy, parks and green space and impervious surfaces near schools and childcare facilities to assess heat risk.
- Map busy roadways and stationary pollution sources and assess proximity to schools and childcare facilities to evaluate air pollution exposure.
- Identify neighborhoods at risk for vector-borne disease related to poor housing conditions and blight.



APHA, American Academy of Pediatrics, Climate for Health, ecoAmerica 2017

Intersectoral Collaboration

- Work with housing, planning, building, home-visiting, sanitation and code enforcement agencies to identify and address climate-related risks. For example remove standing water in vacant properties, and encourage addition of window screens in rental properties and apartment buildings.
- Collaborate with agricultural agencies, local food policy councils, schools, and local businesses and community-based organizations (CBOs) to build healthier, more sustainable and resilient local food systems (See Section 5.3—Agriculture).
    - Support community and school gardens, urban agriculture, and acceptance of SNAP EBT and WIC at farmer's markets.
    - Promote food waste reduction (See Section 6.3—Environmental Health).
- Collaborate with transportation, planning, parks and recreation agencies and schools to increase opportunities for safe active transportation, especially for children and youth, including Safe Routes to School, walking school buses, Complete Streets, traffic calming and speed reduction, and lighting and shading on sidewalks and bike paths. Support reduced transit fares or free bus passes for students and youth (See Sections 5.1—Transportation and 5.4—Urban Greening.).
- Collaborate with parks, planning, and community-based organizations to expand tree canopy, urban greening, and park access and programming, especially for youth and children.

LHD Spotlight: School Health

Schools, school districts, and school health programs are uniquely positioned to reduce the health impacts of climate change and to reduce greenhouse gas emissions through policies and programs to promote active transportation, energy efficiency, and local food procurement. LHDs—in providing information and advice on student and schools health issues, and as school health providers—can encourage climate-friendly school practices and promote and protect student health in the era of climate change.

- Provide information to schools, community colleges and PTAs about the climate-child health connection.
    - Encourage integration of climate change into school curricula.[54]
    - Provide opportunities for students and families to participate in "community science" initiatives, such as temperature monitoring through iSeeChange.[55]
    - Integrate green jobs planning and preparation into youth career development and training, such as retrofitting buildings to increase energy efficiency or installing renewable energy infrastructure.[56]
- Work with schools, districts, PTAs, and school health and athletic programs to protect students from climate-related impacts
    - Ensure that training and protocols are in place to prevent heat-related illness.
        - A 2018 Indiana law requires school coaches to undergo training for heat-related medical issues.[57]
    - Connect school districts with emergency management agencies to ensure schools personnel participate in emergency management planning including for family support and academic continuity post-disaster.
- Encourage schools and school districts to implement policies and practices that promote health and address climate change, including:
    - Active transportation for school children, youth and school staff (e.g. Safe Routes to School; bicycle safety and maintenance classes; and incentives for school employees to use active transportation (See Section 5.1 – Transportation).[58,59,60]
    - Clean energy procurement and school energy efficiency measures[61]
    - Healthy and sustainable food for school meals, including farm to school programs, school gardens, and reduction in meat consumption (See Section 5.3 – Agriculture).[62,63]
        - Many schools have implemented Meatless Monday programs, see the Meatless Monday Implementation Guide[64]
    - Food waste reduction through programs such as StopWaste[65] or SavetheFood[66]

Additional Resources

- Green Schools Alliance[67] and Green Schools Initiative[68]
- Sustainable Jersey for Schools[69]—model online initiative for health, climate, and sustainability

Indigenous Day Native March to Transition to 100% Renewable Energy.
Backbone Campaign, 2016

School Gardening Program
Amanda Lucidon, 2016

  - The Minneapolis Department of Health and Family Support partnered with the city's Park and Recreation Board to create and implement programming in parks located in neighborhoods with high levels of violence, with staff going door-to-door in the surrounding neighborhoods to discuss the resident's experiences and needs.[52]

- Work with schools to integrate climate change into curricula, and encourage schools and childcare providers to provide information and resources to parents and students about climate change and the health benefits of climate solutions, for example on local food systems, food waste reduction, and active transportation.
- Work with schools, camps, and childcare providers to ensure plans are in place related to heat, air quality, waterborne and vector-borne disease and wildfire risks to children and adolescents.
- Work with home-visiting agencies and other health care providers to refer clients for energy assistance (LIHEAP), weatherization, tree planting, and healthy home interventions to address mold remediation and safety violations.[53]
- Collaborate with healthcare providers and systems to (See Section 6.6—Clinical Services):
  - Inform patients about climate risks.
  - Incorporate knowledge of climate impacts into patient care.
  - Make referrals for climate-related services.
  - Serve as "climate and health champions" to educate community residents and decision makers about climate health impacts and support climate actions with health benefits.
  - Work to reduce the carbon footprint of health care facilities.
  - Ensure that health care systems are able to function during and after climate disasters.

Preparing and Planning for Extreme Weather Events and Population Displacement

Work with Public Health Emergency Preparedness programs to ensure that protocols are in place to provide shelter and assistance for MCAH populations in the event of climate-related disasters (See Section 6.5—Preparedness).

- Ensure safe and welcoming places for all types of families and for children and youth in evacuation centers.
- Prepare for and respond to the needs of pregnant and postpartum women, including post-disaster reproductive health assessments.[70,71]
- Integrate family reunification and educational continuity strategies into disaster planning.
- Encourage pediatric and women's health care providers and pediatric mental health specialists to participate in Medical Reserve Corps and emergency response.
- Advise healthcare providers to monitor vaccine cold chain management during extreme heat events.
- Engage in recovery planning to promote rebuilding that supports families and child health and development, e.g. active transportation, parks, and complete neighborhoods.

Adolescent Health and Positive Youth Development

Positive Youth Development involves social, emotional, and skills training to promote pro-social norms and develop youth capacity for improved decision-making, communication, self-sufficiency, and self-determination, and fosters bonding with peers and responsible adults.[85,86] PYD often involves community services—an opportunity for youth to engage on climate change that will impact them throughout their lives. Collaborate with youth community services programs to engage youth on climate and health issues, including through peer education and participation in climate action campaigns. See for example:

- SustainUS[87]
- Youth Action on Climate Change[88]
- iMatter[89]
- Our Children's Trust.[90]

Community Engagement and Education

Work with community organizations to engage families and youth in public campaigns, school and community initiatives.

- Make information accessible to all
    - Provide information in all languages relevant in your community.
    - Make the information culturally appropriate.
    - Use multiple formats (print, radio, television, social media) and outlets (community events and meetings, worship services, and other venues).
    - Use low-literacy formats.
    - Address the needs of those with communication impairments.

- Support families and youth organizations to get involved through community science initiatives and actions with health and climate benefits, for example:
  - Energy conservation campaigns such as "Turn It Off"[72] or "Switch Off"[73] or campaigns to reduce meat consumption "Meatless Mondays"[74] or "Rethink Your Drink"[75] for reduction of sugar-sweetened beverages.
  - Local community science projects that engage and educate community members, such as the Chicago Botanic Garden BudBurst project that "brings together researchers, educators, gardeners, and citizen scientists" to learn how plants are affected by climate change.[76]
- Provide information to parents, youth, and caregivers, about how to protect against climate-related health impacts:
  - Check the Air Quality Index (AQI) for unsafe ozone and particulate levels during hot days and if wildfire smoke is present.[77]
  - Prepare an emergency response plan for any extreme event.
    - CDC—Emergency Preparedness for Expectant and New Parents[78]
    - American Academy of Pediatrics—Children and Disasters[79]
    - Ready.gov—English[80] and Spanish[81]
  - Advise parents and childbearing age women on climate-related infectious disease risks and appropriate precautions.
  - Take special care when preparing food in hot weather, and when eating outdoors without proper refrigeration for food.[82]
  - Wear long sleeves and pants and insect repellent when outdoors near mosquito and tick habitats. Check for ticks after visits to grassy or forested areas. Use screens on windows and door at home to keep insects out.
  - Recognize the symptoms of Lyme disease, Zika, and other infectious or vector-borne diseases.[83]
  - Check with your provider before traveling to areas that may pose a Zika risk if pregnant or considering pregnancy.[84]
  - Make the climate-health connection in education materials for patients, trainings for staff, and media messages whenever relevant, to increase public awareness that climate change is a health issue (See Section 8—Communications).
  - Include climate and health information and messages in patient education and clinic materials on topics including Zika and other VBD, nutrition, water quality, air quality and heat.
    - Use Climate and Health posters[91]
  - Include climate and health information in various program educational and training activities and in home visits.[92]

  - Convene a public workshop or symposium on the issue, or partner with the PTA or school district to organize a workshop for parents focused on climate change and children's health.
  - Organize grand rounds for MCAH health care providers on the connections between climate change and the health of women, children, and adolescents.
- Integrate climate change messaging in routine program messaging, including health advisories, educational materials, and social media messages.

Nutrition

Original: Local food is fresher and tastes better than food shipped long distances from other states or countries. Fresher food is more nutritious.[93]

Modified: Local food is fresher, tastes better, and ***causes less climate pollution*** than food shipped long distances from other states or countries. Fresher food is more nutritious and ***better for the environment***.

Original: Community gardens are a great way to learn about life and stay healthy too. Not only does gardening provide tasty, healthy foods, it teaches responsibility and patience.[94]

Modified: Community gardens are a great way to learn about life and stay healthy too. Not only does local gardening provide tasty, healthy foods, ***it teaches responsibility and it reduces climate pollution***.

Emergency Preparedness

Original: Houston, Hurricane Season starts in 9 days. Now is time to prepare: Make a Plan, Build a Kit, Stay Informed, Know Your Neighbors.[95]

Modified: Houston, Hurricane Season starts in 9 days. ***Climate change is increasing the frequency and severity of extreme storms.*** Now is time to prepare: Make a Plan, Build a Kit, Stay Informed, Know Your Neighbors.

Heat and Children

Original: It is easy to get distracted. Look before you lock.[96]

Modified: ***It is never safe to leave a baby in the car when it's warm outside, and climate change is making hot days more common.*** It is easy to get distracted. ***Never leave a baby alone in a hot car.*** Look before you lock.

Original: Babies and young children can become ill during very hot weather. Their health can be seriously affected by dehydration and need to drink plenty of fluids to avoid becoming dehydrated.[97]

Modified: Babies and young children can become ill during very hot weather, ***which is becoming more frequent due to climate change.*** Their health can be seriously affected by dehydration and need to drink plenty of fluids to avoid becoming dehydrated.

Physical Activity

Original: Keep the kids active and safe this summer! Pima County's Natural Resources, Parks and Recreation Department is offering online registration for its summer swim lessons.[98]

Modified: ***Our summers are getting hotter due to climate change.*** Keep the kids active and safe this summer! Pima County's Natural Resources, Parks and Recreation Department is offering online registration for summer swim lessons.

Original: Walking, biking, and skateboarding are good for our physical and mental health.

Modified: Walking, biking, and skateboarding are good for our physical and mental health and ***create less air and climate pollution.***

Raising Awareness About Climate Change: San Luis Obispo Department of Public Health

The San Luis Obispo County Department of Public Health (SLO-PHD) launched their climate change and health communication campaign—***OutsideIn SLO: We Take Health and Climate Change Personally***—in 2014, in collaboration with the California Department of Public Health (CDPH).

Integrating climate change into other LHD programs

First, staff from health department programs (Public Health Nursing, Emergency Preparedness, and Environmental Health) were trained about the health impacts of climate change. Because women and children are particularly vulnerable to climate change, the SLO-PHD Health Promotion Division partnered with the Program for Women, Infants, and Children (WIC) to produce a climate change curriculum that could be integrated into WIC classes. The 20-minute class, taught in English and Spanish by a dietician or public health educator, reached about 1400 families in 2014–2015 and over 1000 families in 2016. Although SLO-PHD attempted to evaluate whether the class impacted behavior, the response rate was too low to reach a firm conclusion.

"We asked if the WIC clients thought climate change was an issue. They weren't surprised about it and they were very accepting of the information. We found that Latinos were more aware and more knowledgeable going into it than the White population—most likely because of the drought. Many of the Latino families here have relatives in the Central Valley so they were dealing with layoffs, with drought, with no water in their homes, with food prices going up, and so it wasn't like, 'Oh, now we are going to talk about some random topic in our nutrition class.'"

Kathleen Karle, Division Manager—Health Promotion,
San Luis Obispo County Department of Public Health

SLO-PHD also worked with a marketing firm to develop fact sheets on energy efficiency, climate-friendly travel, and eating locally grown fruits and vegetables. Distribution channels included farmer's markets, community meetings, social media, and radio advertisements. In Summer 2017, SLO-PHD partnered with CDPH to host webinars on communicating climate change as a public health issue. The webinar series explored climate change and health storytelling, adaptation planning, health equity, and developing curricula.

SLO-PHD is now integrating climate change into its reviews of the potential health impacts of projects under review by the county Planning department. The Healthy Communities Work Group, addresses the health and climate benefits (or risks) of the projects.

"We talked to a lot of staff who saw climate change as an issue but at first had a harder time connecting it to health. Once we started the conversation, they were totally on board with looking at the health co-benefits and integrated messaging."

Morgan Feld, Community Wellness Health Education Specialist

Lessons and Next Steps

While senior management is very supportive of the OutsideIn SLO campaign, limited funding and no dedicated staff person make it difficult to expand this work. But a core group of committed staff continue to view their work through a climate and health lens, and now plan to incorporate climate and health education into school health classes. SLO-PHD found that staff training and messages that focus on health benefits of climate action make it both feasible and fruitful to integrate climate change into existing public health work.

Learn More

CDPH's SLO case story and NACCHO Stories from the Field

San Luis Obispo OutsideIn SLO

San Luis Obispo "Communicating Climate Change as a Public Health Issue" webinar

San Luis Obispo CalBRACE Climate and Health Profile

Key Action Steps:

- Develop climate change, health, and equity training curriculum for LHD staff.
- Develop climate and health educational materials, including fact sheets, for the general public.
- Integrate climate change impacts and actions into established public health curricula and programs.
- Incorporate climate and health considerations in intersectoral collaboration.

6.2 Infectious and Communicable Disease Control

Controlling the spread of infectious disease is one of the most basic functions of public health, and a core mandate of local health departments. Climate change increases infectious disease risks and impacts population immunity and susceptibility to illness. Understanding climate impacts, their implications for the occurrence of infectious diseases, and population vulnerabilities will help LHD Communicable Disease Control programs prepare for climate-related infectious disease threats.

"…the incidence of most infectious diseases varies by season and geography—and that's related to climate. So it makes sense to consider climate change as a possible contributor to many changes in the regional incidence of many communicable diseases. We need to be alert to that possibility, and prepared for it."

Matt Willis, MD, MPH, Health Officer, Marin County, California

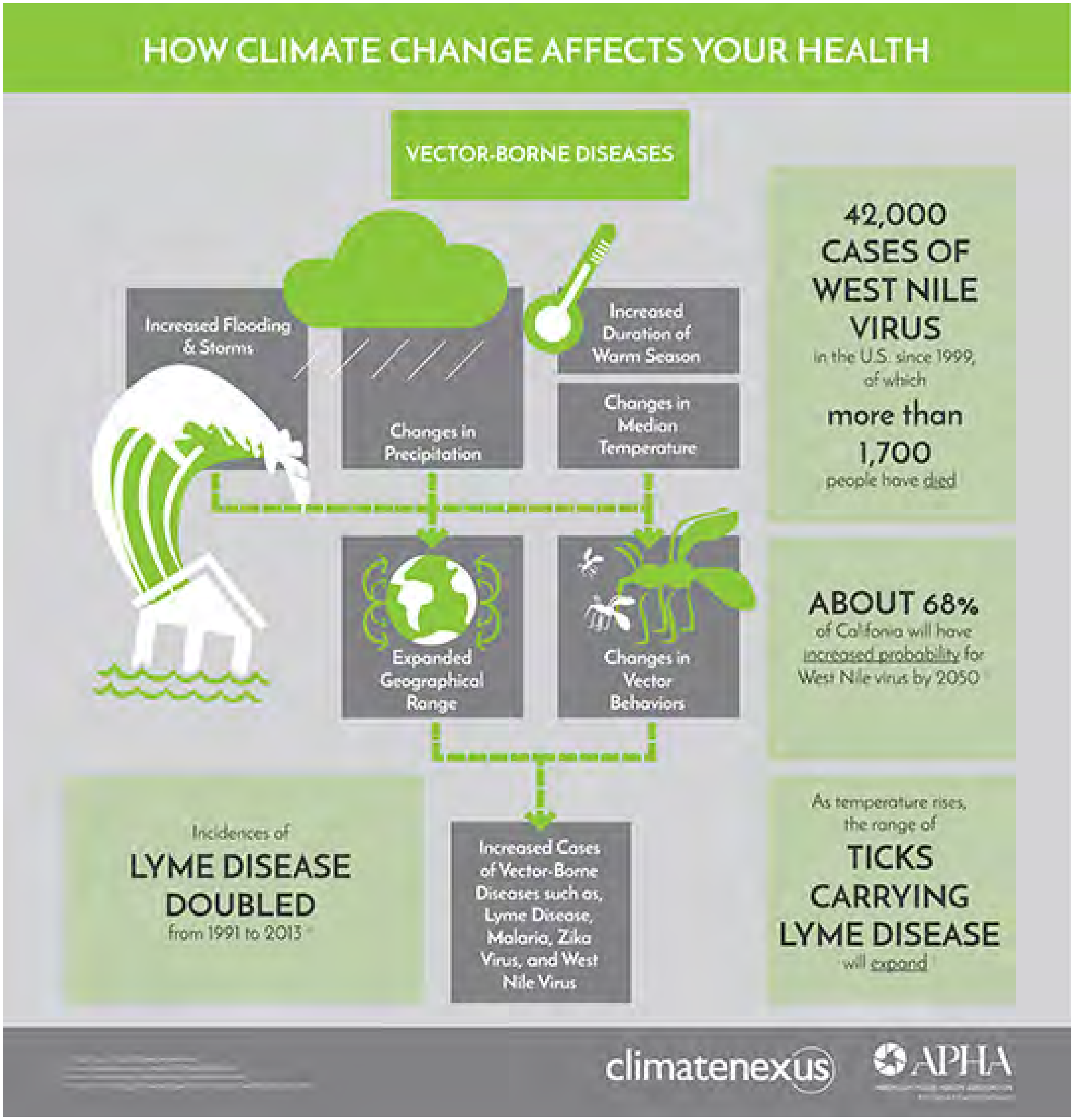
Key Messages

Why Infectious and Communicable Disease Control Should Care

- Vector, food, water, and air-borne infectious disease risks are all impacted by climate change through multiple pathways, including increases in air and water temperature, the occurrence of extreme weather events, and human responses to climate change, such as migration.
- Climate change also impacts immunity and susceptibility to illness, as populations become more vulnerable to food insecurity, chronic illness, and health system disruptions due to extreme weather events.[1] Individual characteristics and social and economic inequities place some individuals and communities at greater risk than others for infectious disease. Outdoor work, substandard and crowded housing, neighborhood blight, and outdated and failing infrastructure increase vulnerability. Indigenous communities reliant on aquatic food harvesting and homeless and displaced populations are also at higher risk.

What Infectious and Communicable Disease Control Can Do

- Enhance vector-borne and infectious disease surveillance systems—through adjustment of location, frequency, and methodologies—to address changes in infectious disease risk levels and characteristics.
- Develop infectious disease prevention and rapid response plans to reduce the risk of epidemics associated with extreme weather events or in response to case reports, for example of Zika.
- Collaborate with agencies in other sectors such as housing and public works to reduce the risks of exposure to infectious agents and vectors.
- Provide information to health care providers, community residents, and decision makers about the increasing risks of climate-sensitive infectious diseases and measures to protect against them.



APHA, Climate Nexus 2016

How Climate Change Impacts Infectious and Communicable Disease Control

Climate change is increasing the risk of infectious disease, including vector, food, water, and airborne diseases.

Vector-borne Disease and Climate Change

Climate change is causing warmer temperatures, changes in precipitation, and sea level rise that impact the habitat distribution, seasonality, mating and reproduction cycles, and competence of disease-carrying mosquitos, ticks, and mice, increasing the risks of exposure to disease in some areas.[2]

- Drought can bring mosquitos in closer contact with humans by forcing them to move toward domestic water sources due to water scarcity and reducing rain-fed "wash out" of their underground habitats.
- From 2004 to 2016 there was a 300% increase in reportable vector-borne disease in the U.S., including a 2-fold increase in reported tick-borne diseases.[3]
- Sea level rise causes shifts in population densities, agricultural practices, water use, housing conditions, and vector reservoirs, which could increase vector-borne disease (VBD) in impacted areas.[4]
- Climate-driven human behaviors can augment VBD spread and exposure, e.g. inadequate window screening, water storage in open outdoor containers, and poor swimming pool maintenance.
- Climate change may alter Hantavirus (HPS) transmission risk; deer mice—the main vector—proliferate when vegetation grows after high precipitation, but come into proximity with humans as they seek water during drought.[5]

Foodborne Disease and Climate Change

There are an estimated 48 million cases of foodborne illness in the U.S. each year, with over 120,000 hospitalizations and nearly 3,000 deaths.[6]

- Higher ambient temperatures increase the replication cycle of foodborne pathogens such as salmonella, campylobacter, or E.coli, increasing disease risk.[7] Warm weather encourages outdoor eating and picnics, with risk of leaving food unrefrigerated for too long.[8]
- Onsite container refrigeration, truck-trailer refrigeration, cold storage, and food retail display cases are all susceptible to heat stress and power outages; a breach in temperature control can increase contamination.[9]
- Increasing drought can also increase the risk for foodborne illness, as water for basic sanitation becomes scarcer.[10]
- Higher temperatures and water-logged pastures following extreme storms may lead to increased indoor housing of livestock, which could increase zoonotic exposures for workers, proliferation of antibiotic resistant bacteria, and food and water contamination.[11,12]
- Heavy rainfall may increase risk of contamination of irrigation water or produce.[13]

Waterborne Disease and Climate Change

- There are an estimated 12 to 19 million endemic cases of waterborne illness in the U.S. each year, 50% of which are associated with extreme rainfall (See Section 4.7—Storms and Flooding).[14]
- Flooding of water and sewage treatment facilities increases the risk of waterborne disease.[15]

Colorful anti Zika poster decorates the sidewalk during a campaign in Ipanema. lazyllama / Shutterstock.com

Mosquito Spray
Fairfax County/flickr.com

- Heavy rainfall can overwhelm "combined" sewer systems (collecting both sewage and storm water runoff) with release of untreated waste into surrounding water bodies.[16]
- Warmer water temperatures, in both ocean and freshwater sources:
    - Allow for greater proliferation of microorganisms that can cause serious gastrointestinal illness.[17]
    - Foster the growth of harmful algal blooms (HAB), associated with exposure to dangerous, potentially fatal, toxins. Algal growth also increases with higher CO_2 levels.[18,19]
        - In summer of 2015, an unprecedented HAB stretched from Alaska to the California coast, leading to extensive fisheries shutdowns to prevent exposure to algae-produced domoic acid, which can cause life-threatening Amnesic Shellfish Poisoning if consumed.[20]
        - Recent studies have found that harmful algal blooms contribute significantly to methane emissions, further contributing to global climate change.[21]

Airborne Illness and Climate Change

Wind, especially in conjunction with dust, can increase concentrations of airborne bacteria, viruses, and fungi.[22,23] High temperatures and drought increase soil dry-out and dust, which in arid areas like U.S. Southwest can carry *Coccidioides immitis* fungal spores that can cause Valley Fever when inhaled.[24]

- California experienced a fivefold increase in Valley Fever cases between 2000–2011, and in Arizona in 2018, the total number of recorded cases as of March was 2,461, compared to 1,360 over the same period in 2017.[25,26]

Climate Change, Infectious Disease, and Health Equity

- **Occupation:** Farm workers and other outdoor laborers are at greater risk for exposure to vector- and air-borne illness.[27]
- **Housing and Neighborhood Conditions:** Lack of window and door screens can increase exposure to vector-borne disease. Poor neighborhoods have more mosquitos because they have more abandoned properties and more trash that pools water to harbor mosquito larvae.[28]
- **Poor Infrastructure:** People living in neighborhoods with aging water and sewer infrastructure may be at greater risk of sewer overflows and water-borne disease after flooding.[29]
- **Race and Ethnicity:** African Americans and Filipinos are at higher risk of illness following exposure to Coccidioidomycosis.[30]
- **Indigenous Communities:** Communities with greater reliance on traditional food resources, such as shellfish, are at higher risk due to the increase in pathogens associated with rising ocean temperatures.[31]
- **Insurance Status:** Those without insurance are at greater risk of delaying care or receiving insufficient health care.[32]
- **Chronic Illness:** Those with compromised immune systems are more susceptible to infectious diseases.[33]
- **Displaced Populations:** People displaced by climate change and extreme weather events are at higher risk due to crowded and poor quality living conditions, and limited healthcare access.[34]

What Local Health Departments Can Do

Local health departments' infectious disease control strategies need to evolve to address the shifts in disease dynamics associated with climate change.[35] This will require: 1) assessment and surveillance, 2) preparedness and planning for extreme events and related displacement, 3) collaboration with other departments and agencies, and 4) increased outreach and education for the public and health professionals. Recommendations for specific infectious disease categories follow the general recommendations below.

Across Programs

Assessment and Surveillance

Surveillance is critical for the identification and control of climate-sensitive infectious diseases and the factors contributing to their spread.[36] Current vector-borne and infectious disease surveillance systems may be enhanced to ensure adequacy in the era of climate change. For example, vector monitoring may change as habitats and distribution of tick, mosquito and rodent species shift in seasonality, geographic range, and concentration due to climate change (See Section 7.1—Surveillance).

Assessment

Work with your LHD epidemiology and surveillance staff, local climate scientists, vector control agencies, and others to identify populations vulnerable to climate-sensitive infectious disease, including:

- Baseline demographic and socioeconomic data
- Baseline incidence of climate-sensitive infectious diseases
- Baseline prevalence of vectors and reservoirs
- Nature and magnitude of travel and immigration patterns
- Climate risks for your jurisdiction
- Neighborhoods at higher risk for flooding, sea level rise, heat
- Neighborhoods at risk due to housing conditions, blight, sewage and storm water overflow
- Risks associated with land use and land cover (e.g. grazing near recreational waters, wetlands)
- Households using private or very small system wells
- Indigenous populations at risk due to reliance on local food sources (e.g. shellfish harvest)

Surveillance

- Modify surveillance, enhance data analysis, and prepare for case response and investigation based on anticipated changes in infectious disease risk.
- Enhance syndromic surveillance in hospital emergency departments to include febrile illness.
- Forecast disease outbreaks: Combine environmental data, meteorological forecasts, and information on disease incidence to develop models that can forecast high risk of disease and information for early warning systems.[37,38]

Intersectoral Collaboration

Look for opportunities to work across departments to address the impacts of climate change on infectious diseases and to ensure that actions prioritize low-income communities and vulnerable populations. For example, housing, sanitation, and public works agencies can implement strategies to reduce standing water that provides breeding habitat for mosquitos; environmental health agencies can educate food retail workers on strategies to reduce food-borne illness risks with rising temperatures; housing, building, and zoning agencies, can address factors in the built environment that impact vector habitat, such as rain water harvest systems, abandoned swimming pools, outdoor tire sales, or window screens.

Work with health care providers and facilities to ensure recognition and reporting of climate-related infectious diseases:

- Educate providers on anticipated climate impacts, the connection to infectious disease, screening, diagnosis, and treatment of climate-sensitive diseases.
- Emphasize the importance of reporting new cases of climate-sensitive infectious illness or any unusual occurrences or patterns of illness to the LHD.
- Provide patient education materials for distribution through provider offices.

Preparing for Extreme Weather Events and Population Displacement

Climate change will increase the risk of extreme events throughout the country, whether through extended periods of extreme heat, prolonged droughts, or the intensification of storms and flooding. Communicable disease risk after natural disasters is associated most closely with the extent of population displacement and the characteristics of the communities displaced.[39] Access to safe drinking water, food, and healthcare will impact potential transmission following displacement, as will interrupted waste management services, limited shelter for displaced populations, the underlying health status of the population affected, and underlying rates of disease transmission.[40,41]

- Public outreach: Proactively plan for potential challenges pertaining to outreach, language and cultural barriers, legal status (immigration status, age, guardianship/vulnerable adults), and risky occupational situations.
  - Prepare working drafts of public education/alerts/communications for distribution during extreme events (e.g. boil water orders, flood water precautions).
  - Establish an accessible information hotline for residents with multiple language options.
  - Ensure messaging regarding infectious disease prevention following a disaster is broadcast on local TV and radio stations in multiple languages and is accessible for people with disabilities.
- Educate providers about infectious disease risks associated with climate change and with climate-related extreme weather events. For example, inform providers about increased risk of infection in people with direct contact with floodwaters.[42]
- Work with Public Health Emergency Preparedness (PHEP) to ensure availability of sanitation facilities, hand washing facilities with soap and water, operation procedures and operator training, community outreach and education in case of extreme weather events that disrupt water supplies and sanitation systems. See CDC's Potential Sanitation Solutions during an Emergency Response.[43]
- Work with your PHEP program to ensure that plans are in place for immunizations for evacuees and displaced persons following a climate-related disaster.
  - See the CDC's recommendations on immunizations following natural disasters and extreme weather.[44]
  - Inform Medical Reserve Corps of recommendations for tetanus and HepB vaccines for disaster responders.[45]
  - Develop protocols for onsite tuberculosis screening, immunization and/or treatment following extreme events (e.g. in evacuation shelters).
  - Prepare for enhanced medication and vaccine cold chain monitoring and protection as extreme events and heat will potentially disrupt electricity production for proper refrigeration.
  - Ensure providers safely store vaccines (and other medications) in the case of a power outage.[46]
- Keep policies and permissions up-to-date (e.g. with regards to quarantine, triaging and housing of displaced populations).

Community Engagement and Education

- Engage communities through participation in "community science" programs that address climate-related infectious disease risks. For example, researchers in Texas established a citizen science program to monitor distribution and infection prevalence of the "kissing bugs" that transmit the parasite that causes Chagas disease.[47] In Southeast Alaska, the Sitka Tribe's Southeast Alaska Tribal Ocean Research (SEATOR) program monitors for harmful algal species whose toxins can accumulate in shellfish.[48]
- Work with community organizations throughout the development and distribution of outreach and educational materials to ensure that all residents receive information about infectious disease risks:
    - Use multiple formats (e.g. print, radio, television, social media) and outlets (e.g. community events and meetings, worship services, and other venues) See Climate Change and Lyme Disease.[49]
    - Provide information in all languages relevant in your community, use low-literacy formats, and address the needs of those with communication impairments. See HealthReach for materials in many languages.[50]

Vector-Borne Illness

Assessment and Surveillance

Consider changes in the frequency or location of surveillance to detect changes in the presence of disease-carrying vectors and vector-borne disease in animal hosts.[51] Surveillance for different mosquito species may require changes in trapping location, time of day, and trap type.

- Notify vector control or your state health department of identification of mosquitoes tentatively identified as *Aedes aegypti* or *Aedes albopictus*; send specimens to confirm identification.[52]
- Work with housing and code enforcement agencies to acquire data on vacant and blighted properties to identify and map vulnerable neighborhoods for targeted education and vector habitat control.[53]
- Assess projected burden of vector-borne disease using current surveillance data and climate projections, using VBD models and decision support tools.[54]
- Prepare a plan for follow-up of suspected and confirmed cases of dengue, chikungunya, or Zika infection:
    - Rapid notification to the local vector control agency to launch targeted mosquito surveillance and control activities.[55]
    - Case follow-up and management protocols.
    - Protocols and responsibilities for sharing information about human cases of dengue, chikungunya, and Zika.

Intersectoral Collaboration

Collaborate with public works, housing, zoning, and building agencies to upgrade codes and enforcement

- Require screens on home doors and windows, including rental properties and multi-family housing.
- Ensure that rain water collection systems include adequate screening.

Train building inspectors, sanitation workers, code enforcement workers and others to look for even small amounts of standing water to prevent vector reproduction.

- In August 2016, following the announcement of several locally transmitted Zika cases, Miami-Dade County Department of Health collaborated with city sanitation workers who flushed standing water, sprayed streets with 250-degree water, and removed trash to eliminate potential breeding sites.[56]

Work with parks and recreation and water departments to implement strategies (e.g. tree planting) to reduce water temperature and standing water in parks and recreation areas to reduce vectors.[57]

Work with vector and animal control agencies:

- Prepare for the introduction and spread of mosquito species that may be new to your jurisdiction (e.g. *Aedes Aegypti*).[58]
- Conduct enhanced monitoring of *Aedes* and *Culex* mosquitoes, dead birds and sentinel chickens after extreme precipitation and flooding and during drought.[59]
- Collaborate on an outreach plan that can be implemented at the first detection of invasive *Aedes* mosquitoes.[60]

For LHD home visit programs, support Public Health Nursing and Maternal Child Health to integrate patient education and assessment of vector-borne disease risks into home visits (e.g. window and door screens, standing water), along with referrals for code enforcement and weatherization services.

LHD Spotlight: Tulsa City-County Health Department

With increasing temperatures and changing precipitation patterns in the region, the Tulsa City-County Health Department in Oklahoma was concerned about the spread of *Aedes aegypti* mosquitos, known to transmit Dengue, Chikungunya, Zika, and Yellow Fever viruses. The department's Environmental Health Services (EHS) team wanted to enhance its program to proactively monitor for local *Aedes aegypti* and to educate the community about vector control and VBD.

Adam Austin, Environmental Specialist for the Tulsa City-County Health Department, commented: "We didn't realize when we started how steep the learning curve would be—not only did we have to learn how to use new traps, but it took some time to learn when and where to place the traps to yield the best information. This mosquito just does not behave the same way as the mosquitos we've mainly been concerned about in the past."[61]

Once the department developed a monitoring protocol, they created maps of the distribution of *Aedes aegypti* in the region, measuring against variables like locations of standing water, soil type, seasonal flooding, and economic hardship quartiles. They worked with the city to consider new standards for screens on windows/doors and enforce existing screen requirements and prohibition of the sale of tires (notorious mosquito breeding receptacles) within 300 feet of residential properties, as well as consideration of a new requirement that tires stored outdoors be covered.

Community Engagement and Education

Integrate climate change into routine informational materials.

Zika
Original: Residents of the Rio Grande Valley should remain on alert for Zika and take precautions even during winter months because it often stays warm enough for mosquito activity to continue through the winter.[62]
Modified: Residents of the Rio Grande Valley should remain on alert for Zika and take precautions even during winter months. As ***climate change is causing milder winters***, mosquito activity is more likely to continue through the winter.

Foodborne Illness

Assessment and Surveillance

Consider implementation of syndromic surveillance for food-borne illness during heat waves or following significant power outages.

Intersectoral Collaboration

Environmental Health

- Work with food facility inspectors to ensure that food handlers and preparers are informed about climate-related risks of food-borne illness.
- Increase frequency of retail food inspections (and incorporate education addressing heightened risk of food-borne illness with higher temperatures).
- Monitor water temperature in areas of seafood and shellfish harvest.
- Monitor seafood and shellfish for *Vibrio* bacteria with high water and ambient air temperatures.

Community Engagement and Education

Integrate climate change into public information.

Foodborne Illness
Original: Due to factors including warmer temperatures, foodborne illness increases in summer. Stay healthy and safe during warmer months by following these food safety recommendations.[63]
Modified: Foodborne illness increases in summer due to factors including warmer temperatures, ***and climate change is making temperatures even warmer***. Stay healthy and safe during warmer months by following these food safety recommendations.

Waterborne Illness

Assessment and Surveillance

Assess the need for increased frequency and more locations for monitoring of water quality.

- Consider implementation of syndromic surveillance for water-borne disease following extreme precipitation and flooding.

Map outlet sites for combined sewer and storm water systems to identify neighborhoods at risk due to extreme precipitation and flooding events.

Intersectoral Collaboration

Advocate for building codes that encourage the use of gray water, and work with Environmental Health and building inspectors to ensure prevention of cross-contamination in water sources used for drinking or vegetable garden irrigation.

Support parks and public works to build swales and rain gardens, and plant more trees near waterways to prevent flooding and runoff and reduce water temperature (See Section 5.4—Urban Greening).[64]

Work with local and regional water quality control districts, water utilities, and watershed managers:[65]

- Assess water quality monitoring protocols and potential need for enhancement.
- Strengthen regulations and enforcement to prevent water contamination.

Encourage planning, public works and building permit agencies to require the use of permeable material in new paved areas to prevent flooding and runoff.[66]

Preparing for Extreme Weather Events and Population Displacement

Support the regional Water Board and Environmental Health to plan for alternative water sources for drinking and hygiene following flooding or extreme precipitation.

Community Engagement and Education

Engage residents in community science programs, for example to increase monitoring for harmful algal bloom through collection of cyanobacteria and toxin data. See the Eel River Recovery Project[68]

Integrate climate change into educational messages about waterborne illness.

Harmful Algal Blooms

Original: When conditions are favorable (such as an increase in water temperature and available nutrients) algae can produce algal blooms[67]

Modified: When conditions are favorable (such as an increase in water temperature and available nutrients) algae can produce algal blooms. ***Warming temperatures and waters due to climate change are increasing the likelihood of these favorable conditions for blooms***.

Airborne Illness

Assessment and Surveillance

Partner with health care providers in endemic areas to report all Valley Fever cases, especially during and following periods of drought.

Intersectoral Collaboration

Collaborate with County Agricultural Commissioners and local growers and construction businesses to implement safety training in multiple languages and low literacy formats for agricultural and construction workers to prevent Cocci exposure and Valley Fever infections.

Work with local air quality control districts and occupational safety and health agencies to increase outreach on measures to reduce dust.

In Valley Fever endemic areas, collaborate with local fire agencies to inform wildland firefighters about prevention of coccidiodomycosis.[69]

Provide employers in Valley Fever endemic areas with information about reducing risk, and employer requirements to reduce dust exposure and report Valley Fever cases.[70] See Preventing Work-Related Coccidioidomycosis (Valley Fever).[71]

Community Engagement and Education

Conduct outreach and provide linguistically and culturally appropriate information about Valley Fever to outdoor workers in endemic areas. See this Valley Fever handout in Spanish.[72]

For More Information

CDC Infectious Disease Sites:

- Valley Fever[73]
- West Nile Virus[74]
- Dengue Fever[75]
- Lyme Disease[76]
- Zika[77]

6.3 Environmental Health Services

Public Environmental Health (PEH) agencies are responsible for addressing food, water, recreational health, hazardous materials, solid waste and waste management, indoor and outdoor air quality, housing, noise, body art, medical waste, and emergency preparedness. Environmental Health Specialists may be licensed to inspect and enforce laws at restaurants and markets, temporary food facilities, food warehouses, licensed housing and swimming pools at apartments and condominiums, pet food stores, theaters, and self-service laundries. PEH agencies handle sanitation complaints and educate the public about protecting against environmental health risks. Local PEH programs often work closely with agencies that address air quality and vector control.

Key Messages

Why Public Environmental Health Should Care

- Virtually every area in which local public environmental health programs (PEH) are involved is impacted by climate change, including water, air, food, housing, and waste infrastructure.
- Climate change exacerbates many of the environmental risks that PEH endeavors to reduce and control. PEH agencies are uniquely positioned to help minimize the risks associated with climate change, and in several areas, your PEH routine activities and emerging responsibilities can help mitigate climate change by reducing greenhouse gas emissions from various sources.

What Public Environmental Health Can Do

- Enhance surveillance and laboratory capacity to address changes in food and waterborne illness risk.
- Collaborate with agencies in other sectors such as parks, public works, and local air quality management districts to manage climate-related risks and impacts.
- Augment regulatory practices in order to reduce greenhouse gas emissions and climate related risks.
- Work with Public Health Emergency Preparedness to include environmental health concerns in emergency response and recovery planning.
- Inform the regulated community, partner agencies, and community residents about the increasing risks of climate-related food and waterborne illness and measures to protect against them.

Environmental Justice

"Environmental justice is the right of all people and communities to live, work, and play in a clean and safe environment"

– Environmental Health Coalition

Environmental justice calls for:[1]

- recognition of and a halt to imposition of disproportionate environmental harm on low income communities and communities of color
- opportunity for full inclusion of community residents in decisions that affect their communities
- striving to achieve, environmentally healthy and economically sustainable communities.

Communities of color and low-income communities are disproportionately impacted by environmental hazards, including air pollution and other toxics exposures, living with a cumulative environmental burden that stems from a legacy of land use, planning, and infrastructure investment decisions that have placed them in harm's way due to proximity to transportation infrastructure, industrial facilities, hazardous waste sites, and industrialized agricultural operations. Historical disenfranchisement, lack of social and economic power, environmental racism, and the policies and activities of governments, corporations, and other institutions contributed to this burden.[2]

These risks are exacerbated by climate change, leading to the "Climate Gap"—"disproportionate and unequal implications of climate change and climate change mitigation" for "people of color and the poor."[3] For example, people of color and low income people often live in neighborhoods with higher levels of air pollution, have higher asthma rates and are more impacted by rising ozone levels due to warmer temperatures.[4,5]

Through proactive engagement with disadvantaged communities, PEH can better integrate equity considerations into PEH practice and help to both redress environmental injustice and build climate resilience.

How Climate Change Impacts Public Environmental Health

Food Safety and Climate Change

See Section 4.8—Food Security

- Higher ambient temperatures increase the replication cycle of food-borne pathogens such as salmonella, campylobacter, or *E. coli*, increasing disease risk.
- Extreme weather events can prevent transportation of food products, disrupt food supply chains, increase loss due to spoilage, and increase risk of breaches at any stage of the food cold chain, with resultant food contamination.
- Reduced access to water for basic sanitation during drought may increase the risk of food-borne illness.[6]

Vector Control and Climate Change

See Section 6.3—Infectious Disease

Climate change is causing warmer temperatures and precipitation changes that

- impact the habitat, geographical range, and mating cycles of disease-carrying mosquitoes and ticks;[7,8]
- foster earlier seasonal onset and longer seasons for vector borne disease transmission;[9,10]
- accelerate pathogens and mosquito reproduction, shorten disease incubation time in mosquitoes; and[11]
- increase droughts that may create stagnant water (e.g. poorly flushed sewers) that breeds mosquitos.[12,13]

Water Access and Quality and Climate Change

Rising sea levels (especially coupled with drought) can result in significant salt-water intrusion, rendering fresh water undrinkable without significant treatment and reducing access to safe drinking water.[14]

Severe drought may reduce water access and limit water for sanitation and hygiene.

Drought increases the concentration of harmful contaminants in ground and surface waters, such as industrial chemicals, heavy metals, and nitrates from fertilizers.

- Increased reliance on groundwater during drought may increase toxics exposure.
- Land subsidence puts infrastructure like roads and levees at risk of permanent damage.[15]

Climate change increases the risk of illness related to recreational water use.

- Increased sea and freshwater temperatures increase frequency and severity of toxic Harmful Algal Blooms (HAB) associated with respiratory, gastrointestinal and neurological problems.[16]
- Increased water temperatures are associated with more growth of virulent strains of *Vibrio* bacteria (e.g. V. cholerae).[17]

In many poor, rural communities access to clean, safe drinking water is already tenuous, further threatened by drought.

- Every year from 1982 to 2018, 3–10% of water systems in the U.S. were in violation of federal Safe Drinking Water Act health standards.[18]
    - In 2015, 21 million Americans were likely drinking from unsafe water sources.[19]
    - The most U.S. violations clustered in Oklahoma and West Texas.[20]
- For communities reliant on groundwater for drinking water, contamination has far-reaching health impacts.[21]

Solid Waste and Climate Change

Extreme weather events associated with climate change may damage solid waste infrastructure and disrupt road and rail waste transport. Coastal flooding and erosion due to sea level rise threaten low-lying coastal waste facilities.

Housing and Climate Change

Flooding increases mold associated with asthma and allergies. Increased average temperatures and extreme weather events may drive rodents closer to people, increasing risk of rodent-borne pathogens.[22]

Hazardous Waste and Climate Change

- Extreme precipitation, storms, and flooding increase the risk of hazardous waste leakages from storage sites and associated exposure to hazardous materials.[23]
  - Flooding after Hurricane Harvey caused spills at one of Houston's dirtiest Superfund toxic waste sites, a former petroleum industry waste processing plant.[24]
- Extreme storms and flooding may cause the emergency shutdown of refineries and chemical manufacturing facilities, often associated with flaring and toxic emissions.[25]
  - During Hurricane Harvey, ExxonMobil reported damages to two of its refineries, causing the release of hazardous materials.[26]
- Wildfires can result in release of toxics when materials are burned, resulting in soil and water contamination.

Air Quality and Climate Change

See Section 4.4—Air Quality

Many regions in the U.S. have a serious problem with particulate matter and ozone pollution; climate change makes it more difficult to attain clean air standards.[27,28]

- Higher temperatures increase ozone and stagnation events create the worst ozone episodes.[29]
- Greater frequency and intensity of wildfires increases exposure to smoke laden with fine particulate matter ($PM_{2.5}$). Wildfire smoke spreads over long distances and is associated with increased risks for respiratory and cardiovascular disease.[30]
- Drought is increasing in frequency and severity and causes higher dust levels, causing respiratory irritation and exposure to dust-borne fungal spores.

What Local Health Departments Can Do

Across Programs

Assessment and Surveillance

Surveillance is critical for the identification and control of climate-sensitive environmental health outcomes. Even states and jurisdiction with sophisticated vector-borne and infectious disease surveillance systems need to consider enhancement to ensure adequacy in the era of climate change.

- Monitoring for vectors must be adapted as vector habitats and distribution of tick, mosquito and rodent species shift in seasonality, geographic range, and concentration due to climate change.
  - Work with Communicable Disease programs and Vector Control agencies to assess whether enhanced surveillance is required.
  - Train PEH staff to identify and report sources of standing water that breeds mosquitos.

Intersectoral Collaboration

PEH often review new development permitting and associated Environmental Impact Reports (EIR). Providing a health lens in land use, transportation, and housing planning and in climate action planning brings significant community health benefits. Reach out to enhance PEH collaboration with city and county planning, public works, Regional Water Boards, Vector Control Agencies, and Air Districts.

Regulatory Activities

The role of PEH agencies in permitting and inspecting facilities provides a prime opportunity to integrate climate and health education and surveillance across facilities and with diverse populations.

Preparing for Extreme Weather Events and Population Displacement

Strategies to ensure PEH health and safety during climate-related disasters include:

- Work with your Public Health Emergency Preparedness program to ensure that plans are in place to minimize impacts on food, water, and waste systems during a climate-related disaster.
- Develop communication channels and materials to ensure the public is informed about how to protect people from illness during climate-related extreme weather events. Make sure all materials are available in languages used in the community.

Community Engagement and Education

Work with community partners to develop plans for disseminating information about PEH risks and responses that use communication channels and language that will reach all community members.

Coordinate with "community science" programs to provide opportunities for residents to monitor climate-related risks and impacts using new, accessible and portable monitoring technologies. Examples of projects include:

- NASA Harmful Algal Bloom tracking program[31]
- Texas A&M Chagas disease monitoring[32]
- Unmask My City air monitoring project and campaign[33]

Look for opportunities to integrate mentions of climate change in materials and media messages for the public whenever relevant, to increase public awareness that climate change is a health issue. Opportunities include public health alerts, health advisory announcements, and educational materials and campaigns related to public environmental health.

Make information accessible to all

- Provide information in all languages relevant in your community.
- Make the information culturally appropriate.
- Use multiple formats (print, radio, television, social media) and outlets (community events and meetings, worship services, and other venues).
- Use low-literacy formats.
- Address the needs of those with communication impairments.


An urban farm in Chicago
Linda from Chicago, USA - New crops, CC BY 2.0

Food Safety

See Sections 4.8—Food Security and 5.3—Agriculture

Assessment and Surveillance

Increase the frequency of retail food inspections, incorporating education about temperature and food safety.

Conduct active surveillance of food-borne illnesses. See for example the CDC FoodNet program.[34]

Intersectoral Collaboration

Collaborate with local agencies to support sustainable, local food systems.

- Increase permitting of urban farms and community gardens.
- Support zoning changes that facilitate urban farms, community gardens, and mobile vending of fruits and vegetables.
- Engage with local educational agencies, hospitals, universities, and large food facilities to increase local food procurement programs to support sustainable local food systems.
- Collaborate with local agricultural organizations and extension programs to educate growers and agricultural operations about agriculture-climate change-health connections.
- Advocate for subsidies for fruits and vegetable farming.
- Collaborate broadly to reduce food waste and improve safe surplus food donation.
    - Train all Environmental Health Specialists on climate change, food waste, and safe food recovery and food insecurity. Adapt and disseminate the Safe Surplus Food Donation Best Management Practices and Toolkit.[35,36]
- Encourage local electeds to set food waste and recovery goals.

Regulatory Activities

Increase frequency of retail food inspections and provide materials about liability protections and benefits of diverting surplus wholesome food from the waste stream to local nonprofit hunger relief agencies.

Update temporary food facility permitting to include a requirement for arrangements with a nonprofit hunger relief agency to recover surplus edible food following events.

Preparing for Extreme Weather Events and Population Displacement

Establish protocols for minimizing risks associated with disruptions in food cold chains due to extreme events, power outages, or transportation problems.

Plan for disruptions in food supply chains.

LHD Spotlight: Partnerships to Reduce Food Waste

In 2016 the California Conference of Directors of Environmental Health, the Public Health Institute, and local PEH programs developed a Climate Resilience, Equity, and Food Waste Reduction training curriculum for Environmental Health Specialists (EHS). The curriculum covered the nexus of climate change, food systems and food waste, food insecurity and health equity, and the role of EHS in educating the public and ultimately reducing GHGE associated with food and organic waste breaking down in the landfill. The collaborative team also developed these documents: Safe Surplus Food Donation Best Management Practices: Guidance for Environmental Health Departments and Safe Surplus Food Donation Toolkit: Guidance for Food Facilities.

- Over 850 EHS were trained across 52 of the 62 state jurisdictions in 30 trainings.
- Many departments adopted the recommended best management programs outlined in the training sessions, including;
    - Appointing a Safe Surplus Food Donation liaison in Food Program to answer questions and provide guidance regarding surplus food donation
    - Posting informational materials on PEH website.
    - Collaborating with local CBO and other agencies to establish a food recovery workgroup.

Community Engagement and Education

Support community-based organizations that are working to build healthy and sustainable local food systems.

- See for examples: Models and Best Practices-Urban Agriculture[37]

Collaborate to inform residents about the climate-food-health connection.

- Ask businesses and community organizations to share and display educational materials about food safety and food waste, such as USDA's Be Food Safe Campaign, information on food safety following a power outage, or resources from the Save the Food Campaign.[38,39]
- Encourage programs such as Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) and Nutrition Education and Obesity Prevention (NEOP) programs to integrate education about date labels and food waste into materials and education.

Look for opportunities to integrate mentions of climate change in materials and media messages for the public whenever relevant, to increase public awareness that climate change is a health issue. Opportunities include public health alerts, health advisory announcements, and educational materials and campaigns related to food safety.

Vector Control

See Section 6.2—Infectious Disease

Assessment and Surveillance

Change the frequency or location of monitoring and surveillance programs to detect changes in the geographic range or incidence of vectors and vector-borne diseases.[40]

- Plan enhanced surveillance during droughts and after flooding and storm surge events.
- Target communities at risk due to housing conditions, lack of access to water, or other infrastructure considerations.

Share disease and vector surveillance data with other LHDs to detect patterns larger than a single jurisdiction.

Develop early warning systems to alert residents of forecast increases in tick or mosquito activity.

Combine data of environmental change, social and demographic determinants, and health system capacity to create a predictive model for disease outbreaks for early warning systems.[41]

Intersectoral Collaboration

Collaborate with preparedness, communicable disease, and vector control to ensure plans to adequately monitor for the introduction and spread of mosquito species new to your jurisdiction (e.g. *Aedes Aegypti*).

- Prepare an outreach plan for implementation at the first detection of invasive Aedes mosquitoes.

Ask animal control agencies to report unusual disease patterns or increased incidence of wildlife/human contact.

Work with housing, zoning, building, and public works agencies to reduce vector-borne disease risk:

- Require screens on windows throughout mosquito season to prevent transmission (including for renters).
- Require businesses that sell tires and other mosquito breeding receptacles keep them inside or covered (e.g. with awning).
- Increase code enforcement to reduce vector habitat on abandoned or blighted properties.

Work with Communicable Disease and vector control to prepare a plan for suspected and confirmed cases of Dengue, Chikungunya, or Zika infection, including:

- rapid notification to the local vector control agency.[42]
- case follow-up and management protocols.
- protocols and responsibilities for sharing information about human cases of Dengue, Chikungunya, and Zika.

Regulatory Activities

Develop protocols to inspect for and address vector breeding habitat during routine inspections.

- Ensure proper installation of screening on rainwater harvest/catchment systems.

Preparing for Extreme Weather Events and Population Displacement

Establish (and exercise) plans to respond to detection of invasive mosquito species and/or cases of mosquito-related illness such as Dengue or Zika, e.g. house-to-house education, inspection for standing water.

Community Engagement and Education

Engage residents in identifying and mapping vacant and abandoned buildings to target inspections and improve code enforcement to remediate vector habitat.

- The Detroit Blight Removal Task Force partnered with several community-based organizations to collaborate with city residents to use a mobile application, "Blexting," to survey and map all of the abandoned and blighted properties across the city. Community scientists took photos of the properties and answered a series of standardized questions about each property.[43]

Partner with parks and vector control agencies and community-based organizations in community science projects that enhance tick and mosquito surveillance.

- The San Mateo County Mosquito and Vector Control District and county Parks department conducts events that engage community residents in tick collection and mosquito surveillance. During one event, community scientists were provided basic training for tick collection and tick bite prevention, and then participated in tick collection along 12 miles of trails in the area.[44]

Increase public outreach based on changing vector patterns, including education during on-site inspection of housing and other facilities.

Look for opportunities to integrate mentions of climate change in materials and media messages for the public whenever relevant, to increase public awareness that climate change is a health issue. Opportunities include public health alerts, health advisory announcements, and educational materials and campaigns related to vector control. For example:

Mosquitos

Original: Reduce the number of mosquitoes inside your home by patching, repairing or replacing screens with holes or screens that don't fit tightly to the door or window frame. If your outside doors are ever propped open, make sure there is a screen door and that it remains closed.[45]

Modified: Reduce the number of mosquitoes inside your home by patching, repairing or replacing screens with holes or screens that don't fit tightly to the door or window frame. ***Climate change is altering mosquito habitat ranges and breeding patterns, which may bring them closer to your home…***

Algal Bloom Warning, Marion Lake, KS, US
Dr. Jennifer L. Graham, U.S. Geological Survey

Water Access and Quality

Assessment and Surveillance

Ensure monitoring of water temperature and prompt cessation of seafood and shellfish harvesting when temperatures are high, to prevent Vibrio-related illness.[46]

Establish protocols for increased monitoring of water quality after flooding and during prolonged drought conditions.

Increase frequency of monitoring for harmful algal blooms/toxins with warmer temperatures in beach waters and recreational water bodies.

Assess water security (e.g. likelihood of drought, projected impact on drinking water, water for agriculture/livestock, inventory of wells); map populations vulnerable to water insecurity.

Intersectoral Collaboration

Coordinate with planning, housing, building and public works agencies to increase use of permeable pavements and safe rainwater harvesting systems,

Collaborate with regional water agencies to plan for alternative water sources for drinking and hygiene following flooding and drought.

Collaborate with water districts and water utilities to increase public support and plan for "indirect potable reuse" projects that replenish groundwater with recycled wastewater.

- Orange County, CA expects to process and pump 130 million gallons of wastewater into groundwater basins per day. Orange County Water District has projected that the wastewater treatment project will eventually supply water to 2.4 million people, meeting approximately 40% of the county's water needs.[47]

Work with parks and public works agencies to implement strategies (e.g. planting trees, permeable surfaces) to reduce water temperature and standing water in public areas.

Coordinate with parks and water agencies to inform the public and policy makers on climate change and water quality issues.

Regulatory Activities

Increase permitting of water conservation methods such as rainwater harvesting/catchment systems, on-site grey water reuse.

During routine inspections of pools and spas educate owners about the risk of mosquito breeding in poorly maintained swimming pools, spas, or backyard ponds.

Preparing for Extreme Weather Events and Population Displacement

Prepare and translate materials in advance to inform the public about how to protect from contaminated water or obtain adequate water supplies, including ***Boil Water*** and ***Do Not Drink*** orders.

During flooding events or prolonged drought encourage well users to use alternative drinking water (i.e. bottled water) while testing the water for bacteria, nitrates, arsenic, and other contaminants and treating as needed.

- Following the wildfires in Sonoma County in 2017, a Do Not Boil, Do Not Drink order was issued due to benzene contamination in the water.[48]

Develop strategies to provide emergency or supplemental water sources (e.g. agreements for purchase/provision of bottled water, locations to store and distribute it, agreements with water suppliers and haulers).

Identify, support, and implement long-term water conservation strategies, in partnership with regional water districts and community partners.

Community Engagement and Education

Engage community residents in community science projects.

- Support projects to monitor water bodies for harmful algal blooms. See CyanoTracker for an example of HAB monitoring.[49]
- Partner with CBOs to conduct community-based projects to revitalize streams and waterways.
    - The Morrison Creek Revitalization Project in South Sacramento, CA is a "collaborative community-based urban stream revitalization project," which aims to transform a stretch of local creek into a naturalized and attractive waterway, improving active transportation and neighborhood connectivity.[50]

Support community based organizations that are educating about and advocating for clean water. See, for example, the network of Waterkeepers.[51]

- The Environmental Justice Coalition of Water worked to secure passage of California AB 685 - Human Right to Water.[52]
- Black Mesa Water Coalition works to stop overuse of and prevent coal contamination of the Navajo Aquifer.[53]

Look for opportunities to integrate mentions of climate change in materials and media messages for the public whenever relevant, to increase public awareness that climate change is a health issue. Opportunities include public health alerts, health advisory announcements, and educational materials and campaigns related to water safety. For example:

Harmful Algal Blooms

Original: ***Public advised to avoid water contact:*** High levels of toxic algae have been found in X water body. A harmful algal bloom of Microcystis aeruginosa is occurring in the water body. This type of blue-green algae produces a toxin that can cause rashes and other illness. The Virginia Department of Health is warning citizens to stay out of the water and to keep their pets and children out as well. Due to low body weight, children and pets are at greater risk of severe illness if the water is ingested. Harmful algal blooms occur when warm water and nutrients combine to make conditions favorable for blue-green algae growth.[54]

Modified: Harmful algal blooms occur when warm water and nutrients combine to make conditions favorable for blue-green algae growth. ***These conditions are occurring more frequently because climate change is causing warmer water temperatures."***

Solid Waste

Assessment and Surveillance

Assess local landfill and waste management sites' vulnerability to projected climate impacts (flooding, sea level rise).

Assess potential public health risks associated with compromised solid waste management facilities, including water and refuse management in the case of extreme weather events.

Conduct health impact assessments (HIA) - in collaboration with community stakeholders - to assess the potential health benefits and adverse impacts of proposed biogas, anaerobic digesters, and other waste-to-energy (WTE) projects.

- Portland Metro conducted a rapid HIA on a proposed waste–to-energy project that would divert waste from the local landfill to an alternate facility. The rapid HIA illustrated that while there were negligible differences in the potential health impacts of either type of facility, the WTE project would generate 10 times the energy than the methane-to-energy production from the landfill. It was recommended that more in-depth research be conducted to assess the longer-term environmental and equity impacts of WTE.[55]

Intersectoral Collaboration

Collaborate with local waste and recycling agencies, public works, waste haulers and community organizations to support and facilitate organic waste diversion efforts, for example through community composting workshops.

- In partnership with Denver Recycles, Denver Urban Gardens hosts free public composting workshops regularly throughout the spring and summer.[56]

Regulatory Activities

In alignment with state organic waste diversion mandates, support diversion of organic waste and food waste to other recycling facilities, such as composting facilities or anaerobic digesters.

- In California in 2014, Governor Brown signed AB 1826, which aims to reduce the amount of organic waste being sent to the landfill. The mandate outlines that business or multi-family dwellings that generate a certain amount of waste must recycle organic waste.[57]

- In the City of Seattle in 2014, the city passed a council bill that all commercial establishments must divert food and paper waste to organics recycling facilities.[58]

Work with water, planning, and building agencies to explore expanded permitting of "eco-toilets"—composting and urine-diverting toilets. Massachusetts's law, for example, explicitly allows the use of composting toilets.[59]

Decrease barriers associated with organic waste diversion.

- Promote siting of community gardens, community composting operations, and large-scale composting facilities and anaerobic digesters.

Educate and collaborate with other agencies and sectors to increase safe and appropriate distribution of biosolids on open land, including consideration of odors and proximity to homes and communities.

Preparing for Extreme Weather Events and Population Displacement

Establish solid waste disposal and management protocols for extreme weather events, for example in evacuation sites or in the event of compromise of solid waste disposal sites and transport

Integrate projected climate impacts and climate preparedness into:

- current solid waste management protocols (e.g. assess risks of combined sewer overflow)
- siting and approval of solid waste facilities

Community Engagement and Education

Increase public education regarding the benefits of organic waste diversion.

Look for opportunities to integrate mentions of climate change in materials and media messages for the public whenever relevant, to increase public awareness that climate change is a health issue. Opportunities include public health alerts, health advisory announcements, and educational materials and campaigns related to solid waste.

Housing

Intersectoral Collaboration

Coordinate with public health nursing, maternal and child health, communicable disease to integrate assessments and referrals to address mosquito protection (e.g. screening, standing water) and rodent control.

Regulatory Activities

Integrate inspection for window screening and vector habitat into routine multi-unit housing inspections.

During inspections of farmworker housing, assess ventilation, air conditioning, screening, and access to safe drinking water.

During inspections of organized homeless encampments assess sanitation, and potential risks associated with climate-related events (e.g. extreme heat, flooding, storms).

Preparing for Extreme Weather Events and Population Displacement

Work with PHEP and emergency management agencies to ensure adequate sanitation, drinking water, and vector and rodent control in evacuation shelters.

Connect with community-based organizations and social service agencies to ensure inhabitants of organized homeless encampments are aware of resources in the event of a climate-related emergency.

Community Engagement and Education

Support community organizations that are endeavoring to improve housing conditions that will increase resilience to climate change impacts and improve health and social cohesion.

- Learn more about Community-Based Housing Strategies.[60]

Look for opportunities to integrate mentions of climate change in materials and media messages for the public whenever relevant, to increase public awareness that climate change is a health issue. Opportunities include public health alerts, health advisory announcements, and educational materials and campaigns related to housing. For example:

Flooding and Mold
Original: Mold can create serious health problems for residents recovering from the severe storms and flooding…[61]
Modified: ***Climate change is increasing the frequency of severe storms and flooding.*** Mold can create serious health problems for residents recovering from the severe storms and flooding…

Hazardous Waste

Assessment and Surveillance

Map hazardous waste sites and establish protocols for monitoring for release of toxics following extreme weather events, floods, and wildfires.

Intersectoral Collaboration

Collaborate with environmental protection agencies and facility operators to assure that climate projections and related risks are being assessed and planned for.

Regulatory Activities

Consider projected climate impacts when reviewing permitting applications for hazardous waste sites and facilities that store hazardous materials.

Preparing for Extreme Weather Events and Population Displacement

Work with PHEP and emergency management agencies to include considerations for exposure to hazardous materials in emergency response and recovery plans.

Community Engagement and Education

Draft emergency notices (including in multiple language) about toxics contamination in advance of an emergency.

Collaborate with community-based organizations to inform residents near facilities that store hazardous materials or waste about potential risks of contamination following an extreme weather event and appropriate protective measures.

Look for opportunities to integrate mentions of climate change in materials and media messages for the public whenever relevant, to increase public awareness that climate change is a health issue. Opportunities include public health alerts, health advisory announcements, and educational materials and campaigns related to hazardous materials and waste.

Air Quality

See Section 4.4—Air Quality

Assessment and Surveillance

Work with local air quality management agencies to increase monitoring of air quality with rising temperatures and during wildfires, and encourage use of community science to enhance air quality monitoring.

Intersectoral Collaboration

Collaborate with housing, maternal and child health, public health nursing, and fire agencies to integrate climate-related indoor air quality concerns such as mold into home visits and inspections.

Preparing for Extreme Weather Events and Population Displacement

Collaborate with Public Health Emergency Preparedness to establish a plan for "cleaner air" shelters in case of wildfires and smoke. Include:

- Identification of facilities with tight-sealing windows and doors, and public access (newer public schools, fire stations), with a ventilation system that can significantly reduce intake of outdoor air; newer buildings tend to be more desirable.
- Ensure filters are upgraded prior to fire season.
- See the sample cleaner air shelter checklist from Oregon Health Authority.[62]

Community Engagement and Education

Work with the local air quality management district or air quality control agencies to raise awareness about the connections between climate change, air quality, and health.

Look for opportunities to integrate mentions of climate change in materials and media messages for the public whenever relevant, to increase public awareness that climate change is a health issue. Opportunities include public health alerts, health advisory announcements, and educational materials and campaigns related to air quality.

6.4 Chronic Disease and Injury Prevention and Control

Chronic disease and injury prevention and control programs (CDIP) address a diverse array of health outcomes, behavioral risk factors, and social and environmental determinants of health, all of which are connected to climate change.

Key Messages

Why Chronic Disease and Injury Prevention Programs Should Care

- Climate change and chronic disease have shared systemic causes and shared solutions. Our transportation and land use, energy, food and agriculture, building and housing, and economic systems are major contributors to climate change and to the living conditions that drive chronic disease, injuries, and health inequities. Many upstream interventions to reduce chronic disease and injuries are the same as those required to reduce greenhouse gas emissions. See below and Section 5—Health Benefits.
- Climate change impacts temperature, air quality, food production, pollen production, and water access, which in turn makes it harder to prevent and control chronic illness. Rising temperatures increase the formation of ozone, making it more difficult to meet air quality standards that protect against cardiovascular and respiratory disease. Rising temperatures make outdoor exercise and active transportation more difficult, leading to lower levels of physical activity and greater dependence on GHGE emitting-vehicles. Climate impacts—such as drought and extreme storms—increase crop loss and drive up food prices that spur increased consumption of cheaper, energy intensive meat and processed food. Extreme weather events cause injuries and fatalities, and warming temperatures are associated with increased violence.
- Climate change exacerbates existing inequities in populations living with chronic illness. Low income communities and communities of color have a higher prevalence of chronic illness and disabilities because of the cumulative burden of toxics and air pollution exposure and lesser access to affordable healthy foods and physical activity opportunities. People with pre-existing chronic illness and disabilities are more susceptible to the health impacts of climate change.

What Chronic Disease and Injury Prevention Programs Can Do

- Enhance surveillance and mapping of demographic changes, chronic disease prevalence, and built environment to address changes in chronic diseases and injury risks and burdens associated with climate change.
- Collaborate with agencies in other sectors to promote GHGE reduction strategies with health benefits and to reduce risk of adverse health outcomes associated with climate change impacts for those with pre-existing chronic diseases.
- Work with Emergency Preparedness to include considerations for those with chronic illness and disabilities in emergency response and recovery plans for climate-related emergencies.
- Support community engagement and inform the public and policy makers about the connections between chronic disease and injury, climate change, and the benefits of climate action.
- Inform health care providers and patients about climate change impacts on chronic disease, how to protect against them, and the climate benefits of healthy eating and active transportation.

Shared Causes and Solutions: Climate Change and Chronic Disease

Transportation and Chronic Disease

See Section [5.1—Transportation](#)

Transportation impacts on climate change, chronic disease and injury

- The transportation sector accounts for almost 30% of the U.S. GHGE.[1]
- Climate-related extreme weather events disrupt transportation systems.
- Transportation allows access to jobs, education, and essential services.
- Our current transportation system fosters physical ***in***activity associated with obesity, diabetes, heart disease, stroke, osteoporosis, depression, and some cancers.
- Motor vehicle crashes are the leading cause of injury, disability, and death in the U.S. for 5–24-year-olds.[2,3]
- Motor vehicles emit air pollutants that increase risk for heart disease, asthma and other respiratory disease, cancer, premature death, and affect lung and brain development of children.[4]
- Road infrastructure contributes to loss of farmland, diminishing the ease of creating local/regional sustainable food systems that enhance healthy eating.[5]

Transportation and health equity

- Low-income individuals and people of color are more likely to live near busy roadways and face disproportionate impact by pollutants from motor vehicles.[6,7]
- Low-income people, people of color and children face greater risk of death and injury due to motor vehicle crashes. Pedestrians are killed at higher rates in poorer neighborhoods.[8,9]
- Transportation is the second largest expense for American households, costing more than food, clothing, and health care.[10]
- Low-income families often have few low-cost transportation options, with the result that almost 30% of their income goes to transportation alone.[11]

What can CDIP do?

Support transportation policies and programs with health and climate benefits.

- Active transportation increases physical activity. Modest shifts in travel mode from car to biking, walking, and public transit yield big reductions in chronic disease, cut GHGE, and improve health equity.
  - Implement Safe Routes to School, Complete Streets, and complete neighborhoods
  - Increase funding for transit and bicycle/pedestrian infrastructure
- Zero emission vehicles and hybrid low carbon vehicles reduce air pollution and climate pollution; ZEV policies need to include equitable access to ZEV for low-income communities, such as:
  - ZEV financial incentive programs for consumers
  - Increased infrastructure (e.g. charging stations)
- Low carbon fuel standards and fuel efficiency standards reduce air pollution and climate pollution.

Assess the health benefits of strategies to reduce transportation GHGE and inform the public and policy makers of those benefits.

- The Integrated Transport and Health Impacts Model (ITHIM) quantifies the health benefits and harms of regional transportation plans[12] (See Section [7.1—Surveillance](#)).

Energy and Chronic Disease

See Section 5.2—Energy

Energy impacts on climate change, chronic disease and injury

- In 2016, electricity production contributed 28% of U.S. CO_2 emissions.[13]
- Energy systems provide for heating, lighting, and cooking.
- Natural gas extraction, storage, and transport are associated with methane emissions.
- Burning fossil fuels—especially coal—produces significant air pollution associated with heart disease, asthma, and chronic lung disease.
- Fossil fuel extraction, transportation, processing and storage are associated with significant health impacts.

Energy and health equity

- Coal power plants are disproportionately located in low-income and communities of color.[14]
- The greatest impacts of coal air pollution affect children, the elderly, low- income communities, people of color and communities downwind of power plants.
- For many low-income families, "fuel poverty" due to high energy costs means choosing between paying for energy to cook, heat, or cool homes, and buying food or medicine.[15]
- High energy costs may impede use of air conditioning during heat waves, increasing the risk of heat illness and deaths.[16]

What can CDIP do?

Support energy policies and programs with health and climate benefits.

- Energy efficiency reduces the need for energy production, decreases indoor air pollution, and reduces energy costs.[17,18]
  - Strengthen building and appliance standards for energy efficiency.
  - Expand low-income energy retrofitting and weatherization programs.
- Renewable energy (from sun, wind, geothermal) generation releases about 1/20th the GHGE of coal over the full life-cycle.[19]
  - Strengthen targets and provide incentives for renewable energy use.
  - Establish goals to phase out new fossil fuel extraction and infrastructure and shift investments from fossil fuels to clean energy.
  - Regulate methane leakage from natural gas extraction, production, and distribution.
  - Provide for access to solar energy for low-income households and multi-unit housing.

Food and Agriculture and Chronic Disease

See Section 5.3—Agriculture

Food and Agriculture systems impacts on climate change, chronic disease and injury

- In 2016, agriculture was responsible for 8.6% of total U.S. GHGE.[20] When fertilizer use, refrigeration, transportation, and land use changes, such as deforestation and soil depletion, are taken into account, food and agriculture systems account for about a third of all U.S. GHGE.[21]
  - o Agriculture—primarily livestock production—accounts for 52% and 84% of U.S. methane and nitrous oxide emissions respectively.[22]
- Agriculture and food systems impact the cost and availability of nutritious and unhealthy foods, and contribute to antibiotic resistance, water contamination, and pesticide illness.
- Poor nutrition contributes to diabetes, cardiovascular disease, obesity, and cancer.[23]
- Americans eat far more meat than is recommended, contributing to cardiovascular disease and cancer.[24]

Food and Agriculture systems and health equity

- Climate impacts will further decrease the access and affordability of safe water and fresh produce for low-income families.[25]
- Indigenous communities practice traditional hunting, subsistence farming and fishing, and are thus vulnerable to climate change impacts on local game, farming and aquatic habitats. Rising sea levels threaten fishing habitats for many indigenous coastal communities.[26]
- Food insecurity is more common in people of color and those living in poverty. According to the USDA, 12.3% of U.S. households were food insecure in 2016: 22.5% of Black households, 18.5% of Hispanic households, 10.7% of other, non-Hispanic households, only 9.3% of White households.[27]
- According to 2000 data, 13.5 million people in the U.S. have low access to a supermarket, 82% of whom live in urban areas.[28] In these areas, the impacts of climate change on food security and health are exacerbated by lack of access to healthy foods.

What can CDIP do?

Support food and agriculture policies and programs with climate and health benefits:

- Localized, sustainable and resilient food systems reduce the use of fossil fuels in food transport, processing, packaging, and storage, increase access to healthy foods, build social capital, neighborhood support systems, and improve mental health.[29]
  - o Support urban and peri-urban agriculture, school and community gardens, farmer's markets, mobile produce vendors, and food hubs.[30]
- Sustainable and agroecological agricultural practices conserve soil and water, sequester carbon, and reduce use of toxic chemicals.[31,32,33,34,35,36]
- Strategies such as SNAP EBT at farmer's markets and zoning to allow mobile produce vendors make local, healthy food more available and affordable.[37,38]
- Collaborate with Environmental Health, hospitals and food businesses to minimize food waste and increase surplus food donation to reduce methane emissions from landfills, conserve resources, and reduce food insecurity.[39]
- Campaigns to reduce meat consumption support heart health, and reduce methane emissions and pollution from commercial animal feeding operations.[40]

How Climate Change Impacts Chronic Disease and Injury

Climate Change Impacts on Asthma and Respiratory Disease

Worsening air quality exacerbates asthma, allergies, and other respiratory illnesses.

- Ozone: Ground level ozone formation increases with rising temperatures, leading to thousands of excess illnesses and deaths per year in coming decades, due to asthma exacerbation and greater sensitivity to allergens.[41,42,43]
- Particulate matter (PM) and wildfire smoke: Climate change increases the frequency and intensity of wildfires. Wildfire smoke is laden with fine particulate matter ($PM_{2.5}$), spreads over long distances, and increases risk of premature deaths, ED visits, and hospitalizations, especially for cardiovascular and respiratory diseases, including asthma and bronchitis.[44,45]
- Drought, increasing in frequency and severity due to climate change—dries out the soil and increases dust levels, causing respiratory irritation.
- Indoor mold growth after extreme precipitation and flood events may trigger asthma and infectious diseases such as Legionnaire's disease.[46]

Population Spotlight: People with disabilities are at increased risk[123]

People with disabilities have high rates of illness, injuries, or death during extreme weather and heat events. Cognitive, hearing, physical, and mobility impairments may impede safe evacuation during extreme storms, flooding and heat waves.

- 14% of the people who remained in New Orleans during Hurricane Katrina had a physical disability.[124]
- Emergency information and instructions are not always made accessible for those with disabilities that affect communication.[125]
- Limited mobility can increase the risk of isolation, a risk factor for heat illness,[13]
- Cognitive impairment may limit the ability to recognize risk or seek assistance during an extreme heat event.
- Power outages can impair electrically powered medical equipment and elevators, preventing some people with disabilities from evacuating or leaving them stranded without necessary treatments.[126]

Allergies are intensified as:

- Increasing temperatures and precipitation changes lead to earlier and longer pollen and allergy seasons.
- Ozone sensitizes the respiratory tract to allergens.[47]
- Higher carbon dioxide levels increase pollen production and potency.[48]

Thunderstorms are occurring more often during high pollen season, causing severe asthma epidemics.[49]

Extreme heat increases death rates and acute morbidity in people with pre-existing respiratory disease.[50]

Displacement and disruption in health care services due to climate-related disasters impedes asthma and COPD management.[51]

Climate Change, Asthma, and Equity

Due to the intersection of race, poverty and preexisting chronic illness, low-income individuals and people of color are disproportionately affected by health impacts of climate change.[52]

- U.S. cities with the worst air quality have high densities of low-income communities and communities of color and are projected to have the greatest climate change-related ozone increases.[53,54]
- People living in very low income neighborhoods are four times more likely to visit the emergency room or be hospitalized for asthma, relative to higher income areas.[55]
- Asthma prevalence in African-Americans is 11.2% compared to 7.7% for Whites and African-Americans are three times more likely to visit the emergency room for asthma.[56]

Climate Change Impacts on Diabetes

People with diabetes are at increased risk of heat illness.[57,58]

- Diabetes complications such as damage to blood vessels and nerves can affect the ability of sweat glands to cool the body effectively.
- People with diabetes are more susceptible to dehydration; commonly used medications such as diuretics can also increase dehydration risks, which are exacerbated by heat exposure.
- Exposure to heat reduces the efficacy of insulin, and may require adjustments in insulin dosing.

Extreme weather events disrupt dietary management and access to medications; power outages cause loss of refrigeration for insulin.

Climate Change, Diabetes, and Equity

Due to the intersection of race, poverty and chronic illness, people of color and those with lower educational attainment are at higher risk of negative health impacts of climate change on diabetes.[59]

- Diabetes prevalence is higher among American Indians/Alaska Natives (15.1%), non-Hispanic blacks (12.7%), and people of Hispanic ethnicity (12.1%) than among non-Hispanic whites (7.4%) and Asians (8.0%).[60]

Population Spotlight: Homelessness and Heat Illness

"… the homeless population in the U.S. suffers from disproportionate levels of chronic disease, particularly cardiovascular disease, respiratory conditions, and mental illness, as well as alcohol and drug use that can make them even more vulnerable. Many also lack access to the facilities that are most helpful during heat waves, like water, food, shelter, and health care and other social services. More homeless people are likely to sleep outside when it's hot out, which can leave them more vulnerable to harassment, abuse, or theft of their belongings. And while the majority of the homeless population is under the age of 50, the dangers are even greater for elderly homeless individuals, who may be less mobile and particularly prone to pre-existing conditions."[74]

– Deepa Sivarajan
Earth Institute- Columbia University

- 12.6% of adults with less than a high school education had diagnosed diabetes versus 9.5% of those with a high school education and 7.2% of those with more than a high school education.[61]

Climate Change Impacts on Cardiovascular Disease (CVD)

People with CVD have increased risks associated with climate impacts:

- As core body temperature increases, the cardiovascular system is "over-loaded," increasing the risk of direct heat mortality.[62]
- Higher ground-level ozone exposures due to heat and particulate matter and dust exposure, from wildfires and drought increase risk for heart attack and uncontrolled hypertension in people with CVD.[63]
- Extreme weather events disrupt medication management and health care access, and cause significant acute stress.

People with CVD may be less able to regulate core body temperature in response to heat.[64]

- Diminished heart function and arterial narrowing reduce capacity to increase skin blood flow
- Some medications (e.g. beta blockers, diuretics, anti-depressants, antihistamines) interfere with heat regulation. See Medication and Heat- Pima County.[65,66]

Climate Change, CVD, and Equity

Due to the intersection of race, poverty and chronic illness, low-income individuals and people of color are at higher risk of negative health impacts of climate change on cardiovascular disease.[67]

- African Americans have a higher prevalence of unrecognized CVD risk factors and a greater burden of myocardial infarction, heart failure, and stroke.[68]

Climate Impacts on Mental Illness

Extreme weather events such as wildfires, drought, and floods disrupt medication management and increase the risk of post-traumatic stress disorder, depression, suicide, anxiety, substance abuse, and interpersonal violence.[69]

Drought and extreme weather events not only impose physical damage but also damage the social fabric of communities. Even people who are not directly impacted may experience stress, anxiety, and fear about climate change and its impacts, based on news reports and through the experiences of family and friends.

Impact Spotlight: Climate Change and Violence

Psychological studies have shown that exposing individuals to high, uncomfortable temperatures increases aggressive thinking, perceived aggression in others, hostile feelings, and violent behavior.[81] Violence can often be triggered or exacerbated by underlying poverty and resource shortages, making certain communities more vulnerable than others. In the U.S., studies have shown association between periods of extreme heat and increased rates of violent crimes.[82] With rising temperatures due to climate change, there is an increased risk of extreme heat days and periods in many regions, increasing the likelihood of interpersonal violence.[83] One analysis found that a single standard-deviation increase in temperature elevates the risk of person-to-person violence by 2.4% and the risk of group-to-group violence by about 11%.[84]

Economic burden associated with climate related disasters may increase the likelihood of stress-related mental health problems.

Heat is associated with an increased incidence of violence, aggression, suicide and higher rates of admission for those with a psychiatric condition.[70]

Interactions between some psychotropic medications and heat increase the risk of adverse medication effects and/or heat illness.[71,72]

Persons with mental illness may have triple the risk of death during a heat wave and. individuals with mental illness admitted to emergency departments for heat-related illness have a higher risk of death.[73]

Climate Impacts on Injuries

Extreme weather events increase the risk of injury and death due to trauma or drowning.

- During the 2017–2018 Northern and Southern California wildfires and subsequent mudslides, thousands of home and businesses were destroyed or damaged and 44 people were killed.[75,76,77]
- Risks for falls, car crashes, and electrocutions are increased during recovery and clean up.[78]

Extreme heat may decrease mental performance, increasing occupational injury risk for those working at heights or operating heavy machinery.[79]

APHA, Climate for Health, ecoAmerica, American Psychological Association 2017

Climate Change, Injuries, and Equity

- Utility workers, emergency workers and first responders, including healthcare and public safety workers, are at increased risk for injury during and after extreme weather. Workers may be out during a severe weather event, which increases risk for death or injury from lightning strikes, flooding, high winds or other conditions.[80]
- Individuals with limited mobility and/or social connections are at increased risk of injury, illness and death related to extreme weather events.

Climate Change Impacts on Physical Activity and Nutrition

Climate change impacts the opportunity for people and communities to engage in activities and behaviors that reduce chronic disease risk.

Physical Activity: Climate impacts may limit opportunities for safe physical activity.

- Heat: Increasing frequency and severity of extreme heat events may limit outdoor physical activity. Rising average temperatures increase harmful algal blooms (HAB) in recreational waters.
- Air Quality: In the world's most polluted cities, people with respiratory and CVD are at higher risk and are advised to limit outdoor activity when air pollution levels are high.[85]

Climate change threatens to increase food insecurity and access to affordable healthy foods, essential for prevention and management of chronic disease[86,87] (See Section 4.8—Food Security).

- About 12% of U.S. households (15.6 million) were food insecure in 2016.[88]
- Extreme heat, drought, and extreme weather events reduce crop yields and production of tree fruit and nuts, milk, and eggs; ocean acidification and drought exacerbate decline of fisheries.[89,90]

What Local Health Departments Can Do

Across Programs

Assessment and Surveillance

See Section 7.1—Surveillance

Include chronic disease, physical disability, and mental disability prevalence indicators in Climate, Health, and Equity Vulnerability Assessments.

Plan and implement syndromic surveillance to identify respiratory and CVD impacts associated with heat, wildfires and other extreme events.[91,92]

Conduct a Community Assessment for Public Health Emergency Response (CASPER) to assess mental health and other impacts of drought and extreme events.[93,94]

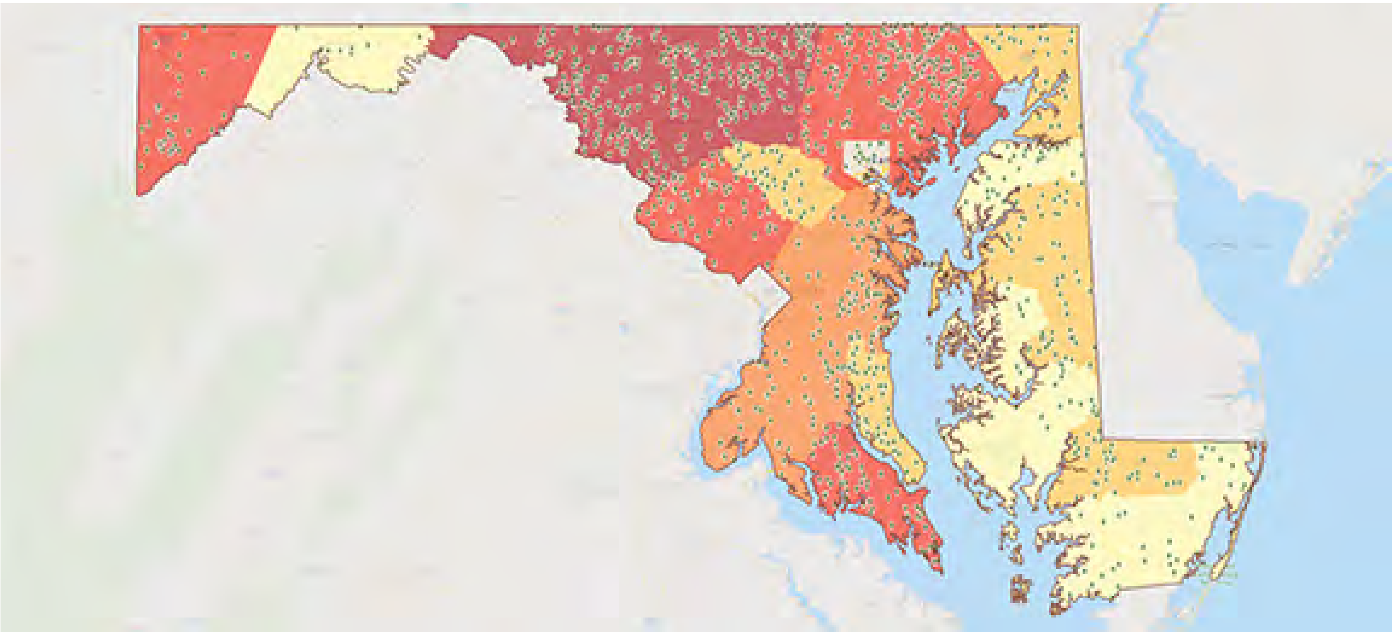
Use data to support healthy transportation access, active transportation, and outdoor recreation.

- Map parks, open space, trails, bike routes, bike paths, and pedestrian routes.
    - OpenDataPhilly provides access to datasets related to active transportation, green space and tree canopy.[95]
    - Map bicycle and pedestrian crashes to support design change for safe biking and walking. See California's Transportation Injury Mapping System[96] and Hawaii State Health Department interactive map of bike and pedestrian crashes.[97]
    - Houghton, MI: The Western Upper Peninsula Health Department worked with the local Bike Task Force to complete the League of American Bicyclists' Bicycle Friendly Community Survey which informs the city's Complete Streets policy and Bicycle Friendly City resolution.[98]
    - Maricopa County, AZ used BioSense to identify nearly 600 cases of heat-related illness in near real-time, and plans to use this data to inform interventions for heat-related illness prevention.[99]

- Analyze health impacts of various transportation planning scenarios using tools such as ITHIM.[100]
    - The ITHIM-Sacramento equity analysis tool uses health, injury, and physical activity information to evaluate expected health outcomes for subpopulations (by race/ethnicity, income, and county) for various scenarios versus the adopted plan.[101]

Use data to support policies and zoning laws for healthy food access.

- Map local/regional food systems, assets, and food insecurity
    - Johns Hopkins Center for a Livable Future's Maryland Food System Map, Feeding America's Map the Meal Gap, Local Food System Asset Mapping, CDC's Healthier Food Retail: Beginning the Assessment Process in Your State or Community.[102,103,104,105]



Maryland Food System Map
mdfoodsystemmap.org

Intersectoral Collaboration

Collaborate with other agencies to increase opportunities for physical activity and healthy living.

- Inform agency partners about the magnitude and causes of chronic illness, and the significance of the health benefits that can be attained through GHGE reduction strategies that promote healthy eating and active living.[106]
- Support funding, policies, and programs to reduce vehicle miles travelled, such as ambitious VMT reduction goals and supporting metrics, investments in pedestrian and bicycle infrastructure and transit, speed reduction, Safe Routes to School, reduced transit fares for youth, transit-oriented development and "Complete Communities" linked with anti-displacement measures[107] (See Section 5.1—Transportation).

- Support funding, policies and programs for parks, green and open space, urban greening and tree canopy, and shading for transit stops, school grounds, and bike/walking paths (See Section 5.4—Urban Greening).
    - The Washington DC Departments of Health and Parks and Recreation "Parks Prescription Program" provided local providers with resources for patients about neighborhood parks.[108]
- Work with camps, schools and childcare centers to establish policies and protocols for safe outdoor activity during extreme heat and bad air days (See Section 6.1—Maternal Health).
- Work with indoor, air-conditioned recreational facilities to provide access and reduced fees to low-income individuals.

Collaborate to increase access to healthy and affordable food and reduce meat consumption (See Section 5.3—Agriculture).

- Support localized, sustainable and resilient food systems that reduce the use of fossil fuels in food transport, processing, packaging, and storage, increase access to healthy foods, build social capital, neighborhood support systems, and improve mental health.[109,110]
    - Work with local food policy councils and planning and agricultural agencies and school districts to reduce zoning and legal barriers and promote urban and peri-urban agriculture, farm to school, school and community gardens, mobile produce vendors, and food hubs.[111]
    - Support food procurement policies that preferentially source local and regionally grown foods in schools, hospitals, government agencies and businesses.[112]
- Support sustainable and agroecological agricultural practices that conserve soil and water, sequester carbon, and reduce use of toxic chemicals.[113]
- Support policies that make local, healthy food available to all, such as SNAP EBT at farmers markets, nutrition subscription programs, or mobile food vending in residential areas.[114,115]
- Conduct campaigns in partnership with schools, businesses, agencies and communities to reduce consumption of meat ("Meatless Mondays") and other processed foods.[116]
    - Promote clean water access including investments in water stations for schools and communities.
- Work with Environmental Health, local food policy councils, businesses, schools, and hospitals to reduce food waste and enhance surplus food donation to nonprofit hunger relief organizations.
    - See this guidance on share tables in schools from Washington state.[117]

Collaborate with Air Quality Management Districts and Transportation to reduce air pollution, especially near vulnerable sites (schools, childcare centers) and in communities with high rates of asthma and CVD.

Engage in recovery planning with a rebuilding vision that favors active transportation, parks and green infrastructure, renewable energy, and planning public space for social cohesion.

Preparing for Extreme Weather Events and Population Displacement

Work with Public Health Emergency Preparedness to ensure plans for extreme heat and climate-related disasters include considerations for those with chronic diseases, including medication access during and post disaster.

- Work with PHEP and law enforcement to provide information about the risks of heat-related illness and mental health exacerbations among the homeless population during an extreme heat event

Community Engagement and Education

Collaborate with CBOs to train community youth and residents to assess healthy food and transportation access, and neighborhood green space to provide data in support of strategies that benefit climate and health.

- CX3 provides the data on healthy food availability and affordability that communities need to pursue healthy eating options.[118]
- Healthy Eating Active Living (HEAL) New Hampshire collaborated with Partnerships for Healthy Communities to develop a Guide to Conducting Walkability and Bikeability Assessments in New Hampshire Communities.[119]

Inform clients and encourage health care providers to advise patients about air quality, heat, and climate change, and strategies to reduce and manage asthma and CVD risk. Inform clients and providers about:

- The impact of heat on CVD medications, including adverse effects, effectiveness and risk for heat illness.[120]
- Information on nearby cooling shelters in the event of extreme heat.
- The impacts of ozone and wildfire smoke on asthma and cardiovascular health.
    - Check the Air Quality Index for unsafe ozone and PM levels and adjust outdoor activity on bad air days for unsafe ozone and particulate levels.[121]
    - During wildfires, advise them to keep windows and doors closed, set air conditioners to recirculate and use HEPA air to decrease indoor air pollution.
    - Keep home and car windows closed on days with bad air related to wildfires, high pollen counts, and dusty drought conditions.

Integrate climate change into nutrition education and campaigns. See San Luis Obispo OutsideIn SLO Curriculum.[122]

Ensure that all residents receive information by working with community organizations and cultural leaders throughout the development and distribution of outreach and education materials. Make the information culturally appropriate and provide information in all languages relevant in your community. In addition:

- Use low-literacy formats, multiples formats/channels/outlets such as radio, TV, social media, bus posters, community events, worship services.
- Address the needs of those with communication impairments.

For More Information

- PolicyLink - Equitable Development Toolkit: Local Food Procurement[127]
- Reconnecting America - Are We There Yet? Creating Complete Communities for 21st Century America[128]
- Active Living Research - Moving Toward Active Transportation: How Policies Can Encourage Walking and Bicycling[129]
- U.S. EPA - Reducing Urban Heat Islands: Compendium of Strategies, Cool Pavements[130]

Asthma and Respiratory Disease

Assessment and Surveillance

Implement asthma surveillance and monitor environmental contributors to asthma. See CDC's National Environmental Public Health Tracking tool and CSTE's climate change indicators.[131,132]

Implement syndromic surveillance when wildfire smoke exposures are high.

Work with air quality agencies and community organizations to implement expanded air quality monitoring including through use of low-cost air sensors.[133]

Intersectoral Collaboration

Support air quality management agencies' actions to reduce air pollution from on and off-road motor vehicles, freight, and stationary sources (See Section 4.4—Air Quality and 5—Health Benefits).

Work with planning, housing, public works, transportation, and building agencies to implement strategies to reduce near-roadway air pollution exposure, such as siting, speed reduction, vegetation, and filtration.[134]

Work with home visiting programs to screen and refer clients for assistance with indoor air quality risks related to wildfires, drought, or extreme precipitation (leaky pipes, windows and doors, indoor mold) such as air conditioning or air filters.

Advise schools, camps, and childcare providers to adjust outdoor activities when air quality is bad and to be aware that ozone levels increase on hot days.

Preparing for Extreme Weather Events and Population Displacement

Work with PHEP and emergency management agencies to ensure that plans are in place for provision of asthma medications in any evacuation shelters, and for clean air shelters and distribution of N-95 respirators for serious wildfire smoke exposure; consider distribution of HEPA filters to households and facilities at highest risk.

Community Engagement and Education

Inform communities about the climate-asthma connection and strategies to reduce air and climate co-pollutants.

Support community science projects that use low-cost air quality monitors to broaden assessment and awareness of air quality.

- Utah Physicians for a Healthy Environment joined the global Unmask My City initiative that uses portable $PM_{2.5}$ monitors equipped with LED lights that turn red when levels are high.[135]

Integrate climate change in messages for the public in health advisories and educational materials. For example:

Allergens and Asthma

Original: Pollen comes from trees, flowers, grass, and weeds and can trigger asthma. High pollen counts in the spring and fall seasons are known to be asthma triggers for some children.[136]

Modified: Pollen comes from trees, flowers, grass, and weeds and can trigger asthma. High pollen counts in the spring and fall seasons ***are increasing due to climate change*** and are known to be asthma triggers for some children.

Diabetes

Intersectoral Collaboration

Inform home visiting programs, schools, parent groups, camps, and childcare centers about the impacts of extreme heat on insulin and on heat illness risk in people with diabetes.

Prepare for Extreme Heat Events

Work with Emergency Preparedness and emergency management agencies to ensure proper storage capacity for insulin and protocols for providing insulin to people with diabetes in cooling centers and evacuation centers,

Community Engagement and Education

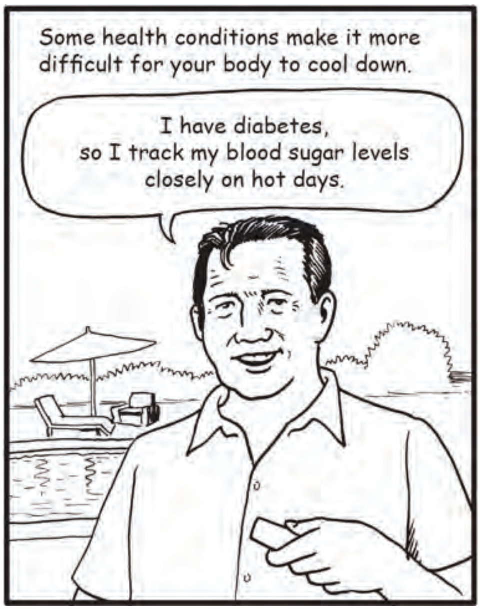
Inform clients and encourage health care providers to advise patients with diabetes on the increased risk of heat illness; how to adjust insulin dosage, hydration, and nutrition in response to extreme heat; and impact of heat on insulin during extreme heat.

Integrate climate change in routine messages and materials, for example:

Extreme Heat and Diabetes

Original: We often look forward to changes of season, but if you have diabetes, you need to be extra careful when temperatures climb dramatically. Extreme heat can affect your blood sugar control.[137]

Modified: We often look forward to changes of season, but if you have diabetes, you need to be extra careful when temperatures climb dramatically. ***Climate change is causing more frequent and severe extreme heat events***, which can affect your blood sugar control.



Source: Public Health- Seattle King County

Cardiovascular Disease

Intersectoral Collaboration

Collaborate across departments and with other agencies and community organizations to increase access to affordable healthy foods and decrease meat consumption.

- In Kent County, Michigan, the health department supported the local YMCA in creating a "Veggie Van" to provide urban neighborhoods in Grand Rapids with year-round, daily access to fruits and vegetables from local farmers, sold at reduced prices. The Veggie Van accepts EBT, SNAP, WIC, and Senior Project Fresh/Market FRESH benefits.[138]

Encourage local health care providers and pharmacies to establish healthy food prescription programs that refer people to community resources to support healthy eating, including reduced meat consumption.[139]

Encourage institutions such as hospitals, schools, businesses, and government agencies to offer "Less Meat, Better Meat". Provide resources such as the Health Care Without Harm procurement recommendations.[140,141]

Community Engagement and Education

Inform providers, clients, and communities about the increased cardiovascular risks associated with heat, wildfires, and air quality. Also, inform them about the cardiovascular health and climate benefits of reduced meat consumption.

Integrate climate change in messages in health alerts and educational materials. For example:

Air Quality and CVD
Original: It's National Air Quality Week. AQ is impacted by $PM_{2.5}$, which can impact the cardiovascular system. Visit nmtracking.org for data.[142]
Modified: It's National Air Quality Week. AQ is impacted by $PM_{2.5}$ and ***higher ground-level ozone, which is increasing due to climate change***. Poor AQ can impact the cardiovascular system. Visit nmtracking.org for data.

Spotlight:
Meat Consumption, Health, and Climate Change

Meat consumption in the U.S. has doubled over the last century, especially red meats. Diets heavy in red and processed meat have been linked to higher rates of heart disease, stroke, Type 2 diabetes, obesity, certain cancers, and earlier death.[143]

Meat production, processing, distribution and retailing accounts for 9% of U.S. and 15% of global GHG.[144] Livestock—especially cattle—accounted for 30% of U.S. emissions related to agricultural production in 2016.[145] The process of raising livestock for meat production in the U.S. also has devastating environmental impacts. Communities surrounding concentrated animal feeding operations (CAFOs)—frequently low-income communities and communities of color—often have poor air quality with high levels of hydrogen sulfide and ammonia. Studies have shown increased rates of asthma, respiratory illness, depression, and anxiety in these communities.[146]

A 2016 study found that reducing meat consumption and eating a more plant-based diet could:[147]

- Reduce global mortality from chronic disease by 6–10%.
- Reduce food-related greenhouse gas emissions by 29–70%.
- Save 1–31 trillion U.S. dollars by improving diets.

Mental Illness

Intersectoral Collaboration

Coordinate with local mental health agencies and providers to ensure adequate mental health screening, referrals and services during and after climate-related extreme events, including droughts.

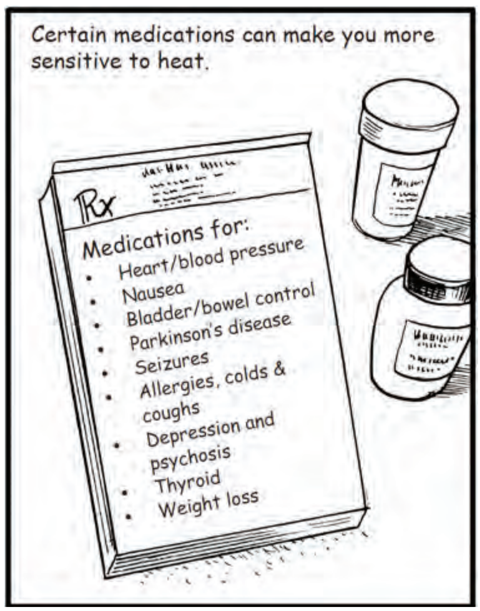
Preparing for Extreme Weather Events and Population Displacement

Collaborate with Emergency Preparedness to ensure availability of mental health services in assistance centers and evacuation shelters, including access to psychotropic medications.

Community Engagement and Education

Inform clients about the impacts of extreme heat on some psychotropic medications: [Handout on Medications and Heat.][148]

Work with community-based organizations and other partners to support social cohesion. Social resources, social cohesion, and community trust are critical to response and recovery after disasters. Following Superstorm Sandy, poorer neighborhoods with abundant social resources proved to be more resilient than wealthy neighborhoods with low social resources.[149]



Source: Public Health- Seattle King County

Injuries

Intersectoral Collaboration

Work with other agencies, employers, and labor unions to support policies and standards that protect workers in the face of a changing climate.

- Inform outdoor workers about the risks of heat illness and protective measures (water, shade, rest) to prevent it.[150,151]

Work with planning and public Works to implement safe active transportation infrastructure and other programs to decrease the risk of bike and pedestrian injuries (e.g. reduced speed zones).

Preparing for Extreme Weather Events and Population Displacement

Collaborate with emergency responders, public safety workers, utility workers and others to reduce the risks of injury related to extreme weather events.

Community Engagement and Education

Integrate climate change in materials and messages including health alerts public health alerts, health advisory announcements, and educational materials and campaigns related to air quality.

Flooding

Original: Winter weather and flooding can cause power outages. Call your local power company to report outages.[152]

Modified: Winter weather and flooding, ***which are become more severe and frequent due to climate change***, can cause power outages. Call your local power company to report outages. If you use a generator, make sure to place it outside the home.

From Collaboration to Action: Philadelphia Department of Public Health

Philadelphia is a sprawling city with a diverse population (42% African American) of over 1.5 million people. Philadelphia city government developed its first climate action plan in 2007. The Philadelphia Department of Public Health (PDPH) participated in the greenhouse gas inventory, but only more recently has it addressed more explicitly the human health impacts of climate change climate change.

In early 2016, PDPH convened its first Climate Change and Health Advisory Group (CCHAG) with over 34 representatives from a diverse array of community-based organizations, health care systems, local and regional government agencies, and academic partners. CCHAG established a unique space for diverse stakeholders to learn from one another and prioritize collaborative action to address climate, health, and equity. Participants identified several priorities, including asthma, extreme heat, and flooding, and an overarching concern about climate impacts on Philadelphia's most vulnerable communities.

A CCHAG Asthma subcommittee compiled data and maps to identify zip codes with high asthma emergency room use. PDPH and CCHAG member Asociacion de Puertorriquenos en Marcha developed culturally competent materials for patients and service providers about the impact of climate change on asthma, and strategies to reduce asthma risks in a changing climate. Materials were disseminated by Drexel University, the Clean Air Council, St. Christopher's Hospital for Children, the National Nurse-Led Care Consortium, Temple's Health Homes program, the Philadelphia School District, and others. The CCHAG Asthma Subcommittee met with the Pennsylvania Horticultural Society and U.S. Forest Service to explore how urban greening programs could integrate considerations of the rising risks of allergy due to the impacts of climate change on pollen levels.

PHPP also launched an Extreme Heat Workgroup with the Office of Emergency Management to review the City's Excessive Heat Plan. In partnership with graduate students at a local university, PDPH developed a heat vulnerability index and maps of vulnerable neighborhoods. An update of the City's Excessive Heat Plan—informed by projected increases in summer temperatures and more intense heat events of longer duration—addresses the disproportionate impacts of heat on vulnerable residents with strategies such as activating cooling centers and spraygrounds that are accessible to neighborhoods where risk for adverse health outcomes is higher. Agencies agreed to redesign heat warnings so that all city agencies use the same language—"heat health warning" and "heat health emergency"—so that residents more clearly understand the level of risk. During heat health emergencies, the City requires that residential utility shutoffs are stopped, and may dispatch mobile heat health teams to high-risk neighborhoods.

The PHPP team also collaborated with the Franklin Institute to integrate discussions of heat health risks and vulnerabilities into an innovative demonstration of how typical climate effects and mitigation strategies impacts temperature in classic-style Philadelphia row houses.

Climate Urban Systems Partnership

The Climate Urban Systems Partnership (CUSP) is a collaborative project funded by the National Science Foundation to explore novel approaches to community climate education in four cities. In Philadelphia, CUSP and PDPH worked with the Franklin Institute to conduct community workshops on climate change, extreme heat, and health in summer of 2017, using the row house demonstrations. Following Hurricanes Harvey, Irma, and Maria, PDPH worked with its partners to map flood-vulnerable areas and held community workshops to discuss flood vulnerability and resilience strategies. In 2018, CUSP will host additional community workshops focused on climate change, severe storms and flooding, and health.

Future Work and Lessons Learned

PDPH—in collaboration wit the Mayor's Office of Sustainability—will use the heat vulnerability maps to identify high-risk neighborhoods and work with community based organizations to prioritize and implement interventions to reduce urban heat, including cool roofs, green space, and better access to cooling centers and spraygrounds. PDPH will continue to work with the CCHAG and many diverse stakeholders who together have demonstrated the power of robust partnerships to advance efforts to improve community climate resilience.

For More Information

- Growing Stronger: Toward a Climate Ready Philadelphia

Key Action Steps:

- Identify key stakeholders and form a Climate Change and Health Advisory Group (CCHAG) with CBOs, local government agencies, health care providers, and academic partners, to prioritize strategies and solutions
- Support local CBOs to develop culturally appropriate materials on climate and health and conduct community workshops
- Partner with local academic institutions to assess and map climate vulnerability.

6.5 Public Health Emergency Preparedness

Every LHD engages in public health emergency preparedness, using an "all-hazards" approach that combines planning, exercises, training, and community education to prepare the LHD, first responders, the local health care system, and the community to prepare, respond, and recover effectively from public health emergencies ranging from infectious disease or radiation emergencies to terrorism/bioterrorism to earthquakes and extreme weather events.

As awareness has grown that community risk results from an interplay of the magnitude of an emergency event and the level of community vulnerability, many LHD PHEP have shifted from a focus on emergency response to a more holistic approach that emphasizes community preparedness, risk reduction, and community resilience. Climate change makes it more important than ever that PHEP programs embrace a broad and intersectoral approach that endeavors:

"…to prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience."[1]

– Sendai Framework for Disaster Risk Reduction

Climate Change Poses New Challenges for Public Health Emergency Preparedness

Climate change is increasing the frequency and severity of extreme weather events.

Wildfires: Climate change causes higher temperatures, earlier snowmelt, and drier conditions that increase the frequency, intensity and duration of wildfires, as well as the length of wildfire season in the U.S.[2] Wildfire seasons are expected to be longer and stronger across all regions of the U.S. by 2050.[3] More people and homes are at risk with increasing development of the wildland-urban interface.[4]

Fire Fighters and emergency personal rush to control fires in Brea CA.
mikeledray / Shutterstock.com

Army Spc. Rafael Agudo, a UH-60 Black Hawk mechanic, washes a helicopter to prepare it for a disaster response mission.
U.S. Air National Guard photo by Senior Airman Crystal Housman

Extreme precipitation: The number of extreme precipitation events is expected to increase by two to three times historical averages in every U.S. region by 2100, and these events are likely to increase in intensity by 6% to 7% for each degree Celsius of temperature increase.[5]

- In the U.S., the average 100-year floodplain is projected to increase 45 percent by the year 2100.[6]
- Climate change is expected to make "atmospheric rivers" wider and longer.[7]

Heat: As global temperatures rise due to climate change, extreme heat events are increasing in frequency, severity, and duration. Seventeen of the eighteen warmest years on record have occurred since 2001.[8] In 2017, extreme heat events shattered records across the U.S. and every state had an annual average temperature that was warmer than usual.[10] There has also been a dramatic increase in hot night-time temperatures in the US, reducing critical hours of relief during heat waves.[10]

Key Messages

Why Public Health Emergency Preparedness Should Care

- Climate change is increasing the frequency and severity of extreme weather events, including sequential emergencies, compounding emergencies, and slow-moving emergencies, all of which increase the need for comprehensive equity-oriented emergency planning, response, and recovery.
- Climate change exacerbates existing health, social, and economic inequities. Low-income communities and communities of color already bear disproportionate burdens of negative health impacts, and are less able to recover following a climate-related emergency.
- Public Health Emergency Preparedness programs are uniquely positioned to not only incorporate climate change impacts into emergency preparedness and response, but also advance community-driven climate resilience in preparedness recovery and rebuilding planning.

What Public Health Emergency Preparedness Can Do

- Enhance surveillance and mapping of demographic changes, disease prevalence, and vulnerable populations, infrastructure, and industry to improve disaster preparedness, response, and recovery in the face of climate change.
- Collaborate with other agencies, healthcare facilities and systems, and community-based organizations to increase health system and community resilience, while promoting GHGE reduction strategies with health and equity benefits.
- Prepare displacement, shelter, and recovery protocols specifically for vulnerable populations in cases of extreme weather events and disasters including children, elderly, people with disabilities, people with chronic diseases, people with compromised immune systems, migrant laborers, homeless people, and LGBTQ communities.

Climate change increases the likelihood of sequential emergencies.

- Greater variability in temperature and precipitation creates more contrast between drought and wet years, which can result in a significant increase in the severity and frequency of wildfires and mudslides.[11]
- Increasing frequency of extreme weather events heightens the likelihood that a new severe event will occur before full recovery from a prior event, and fosters "evacuation fatigue" making people tire of taking full precautions with each event.[12]

Climate change increases the possibility of "compounding" emergencies. Prolonged and/or extreme summer heat exacerbates the impacts of drought, increases ozone levels and the risk of wildfire, which in turn further worsens air quality.

Climate change is contributing to slow-moving emergencies. "Slow-moving" or "slow-onset" emergencies creep up on communities; the perception that there is "still time" may contribute to insufficient early action.

"A slow-onset emergency is defined as one *that does not emerge from a single, distinct event but one that emerges gradually over time, often based on a confluence of different events*."[13]

Sea level rise: All U.S. coastlines outside of Alaska are expected to see higher sea level rise than the global average. Sea level rise in the U.S. will increase the frequency and extent of extreme coastal flooding and coastal erosion, threatening tens of thousands of homes.[14]

- Without significant mitigation efforts there is a 67 percent probability that the San Francisco Bay Area will experience sea level rise of 1.6 to 3.4 feet by 2100. New scientific evidence has highlighted the potential for extreme sea-level rise; ice losses from Antarctica have tripled since 2012 and are causing sea levels to rise faster today than at any time in the past 25 years.[15,16]

As sea levels rise, saltwater intrusion into fresh water increases salinity of groundwater basins and well water. Higher salinity in drinking water has been associated with increased blood pressure and kidney disease; and, in Bangladesh, with higher risk of preeclampsia and gestational hypertension.[17,18] High salinity in groundwater in agricultural areas reduces crop yields.

"Preparing for sea-level rise will be expensive, but the price will be far lower than the alternative of waiting and reacting to these impacts as they occur. Planning should include consideration of both sea-level rise and extreme events."[19]

Drought: The frequency, severity, and duration of droughts is increasing due to less total precipitation, higher temperatures that increase evaporation rates, a higher proportion of precipitation as rain instead of snow, and less snowpack with more and earlier spring runoff.[20,21,22] The U.S. Southwest has already shifted to a much drier climate; the American West may experience a "mega-drought" lasting decades in the latter half of this century.[23] While the U.S. Dust Bowl in the 1930s lasted a decade, NASA analyses have found that future droughts throughout the U.S. may last at least 30 to 35 years, resulting in the driest periods of these regions in the last 1,000 years.[24,25]

"This is the new normal. We're facing a new reality where fires threaten peoples' lives, their properties, their neighborhoods and cost billions and billions of dollars…There have been very long droughts in California and we are getting some of those returning very badly, and we're going to get them retuning more often. And then, with climate change, some scientists are saying California is literally burning up."[26]

– California Governor Jerry Brown

Climate-Related Emergencies and Health Equity

Climate-related disasters hit the poor the hardest. Pre-disaster conditions in many communities are sub-optimal, and existing health and social inequities place some individuals and communities at greater risk of suffering health and other impacts from climate-related disasters. Climate change provides an opportunity for LHDs to pay more attention to disaster risk management and community resilience, so that all communities are prepared, resilient, and able to transform and thrive in the face of the impacts of climate change.

- In many low-income and historically disenfranchised communities aging and poorly maintained infrastructure increases the risk of flooding and other disasters.[27]
- Low-income households are less likely to have disaster insurance, less able to recover from flooding and property loss associated with SLR, and have fewer resources to relocate.[28]
- Undocumented immigrants are ineligible for FEMA assistance, but can apply for assistance on behalf of documented members of their household. However, as was evidenced in Sonoma County, during the 2017 wildfires, many 'mixed-status' families opted out of FEMA assistance due to fear that family information and status would be shared with immigration officials.[29]
- Agricultural workers and communities are more vulnerable to the adverse economic impacts of drought including job loss and food and water insecurity.
- In some regions, beachfront neighborhoods have historically been restricted to white homeowners. In Miami there is concern that, as nuisance flooding due to SLR becomes more common, wealthier homeowners are moving to higher ground, potentially displacing lower income communities of color.[30]

"Disaster risk reduction requires an all-of-society engagement and partnership. It also requires empowerment and inclusive, accessible and non-discriminatory participation, paying special attention to people disproportionately affected by disasters, especially the poorest. A gender, age, disability and cultural perspective should be integrated in all policies and practices, and women and youth leadership should be promoted. In this context, special attention should be paid to the improvement of organized voluntary work of citizens."[31]

– Sendai Framework

Recovery, rehabilitation, and reconstruction after a disaster provide opportunities to "Build Back Better," both through integrating disaster risk reduction considerations into rebuilding, and through using rebuilding to redress any long-standing inequities in community development and infrastructure.

Inclusive Rebuilding After Northern California Fires—Sonoma County, CA

In October 2017, wildfires raged across Sonoma County CA, displacing thousands, killing 44 people, destroying 5100 homes and demonstrating the challenges of responding to the disaster needs of immigrant populations. News reports suggest that county officials struggled to send evacuation alerts and disaster information in Spanish, placing Spanish-speaking families at greater risk and impacting their ability to effectively seek support during and after the fires.[32]

The roughly 38,500 undocumented immigrants in Sonoma County faced particular challenges after the fires.[33] "Undocumented immigrants do not qualify for assistance from the Federal Emergency Management Agency (FEMA). Even when they or their children are eligible for disaster relief services, their lack of immigration status, limited English proficiency, and fear of immigration enforcement prevent them from seeking assistance. Their discomfort or lack of familiarity with law enforcement, county government, and mainstream aid organizations present additional barriers…[they] predominantly work in sectors that have been or will be hard hit, including service, hospitality, child and elder care, day labor, wine, and agriculture more broadly. Many lost wages in the weeks following the fires, and others worked for companies whose operations were affected at varying levels, from temporary disruption to complete loss."[34]

The disaster highlighted the need for greater community engagement in emergency preparedness, response, and long-term recovery. Sonoma County Rises / Sonoma County Se Levanta, a community based coalition that sprang up after the fires, is intent on putting equity at the center of decision-making and bringing the voices of all members of the community into the recovery and rebuilding process.[35,36] Whether that will be successful is still an open question.

An Equitable Path for Rebuilding—Galveston, TX

In September 2008, Hurricane Ike hit Galveston, Texas with 110mph winds and a 22-foot storm surge, damaging or destroying 70% of the buildings on the island-city.[37] Two neighborhoods facing the worst devastation were those with the highest poverty levels, low access to healthy foods, and high levels of pollution from neighboring industries.[38] To date, rebuilding these areas is proceeding slower than on other parts of the island, as money earmarked to rebuild public housing remains unspent and efforts to build back these neighborhoods are stalled.[39,40] Of the 544 families displaced from public housing, only 101 had returned as of mid-2018.[41] The stall in public housing construction dramatically impacted the demographic makeup of the island, as the communities of color who primarily inhabited these regions before the storm now have no homes to return to.[42]

In 2014, a health impact assessment (HIA) was conducted to assess how Hurricane Ike recovery efforts might support health equity through public housing and neighborhood development.[43] The HIA recommended that health impacts be incorporated into the process for designing new scattered site housing and that specific needs (e.g. toxics exposures, transportation and schools proximity, crime prevention) be included.[44] The team also recommended more input from affected community members, through a coordinated multi-stakeholder initiative to address neighborhood needs.[45] Though yet to be fully funded, the recommendations provide guidance for equity-focused recovery and rebuilding following climate-related disasters.

Hurricanes Hit the Poor the Hardest—New Orleans, LA

A recent Brookings Institute report documents three key ways in which hurricanes hit the poor the hardest:

- Lower income people are more likely to live in neighborhoods or buildings with substandard infrastructure, more susceptible to storm shocks. Poor families were more concentrated in flood-prone parts of Houston before Hurricane Irma. Low-income and minority families often live closer to industrial facilities, placing them at higher risk of toxic leaks or spills from storm damage.[46]
- Poorer families are less well insulated against economic shock associated with disasters. Only 17% of homeowners had flood insurance policies (held more commonly by wealthier households) in the areas most affected by Hurricane Harvey. Ten years after Hurricane Katrina, residents whose homes flooded during the storm had lower credit scores and rates of home ownership than other New Orleans residents.[47]
- Greater affluence makes relocation to safer areas easier. Following severe disasters, county-level poverty rates increase and housing prices decline. Either wealthier residents are moving out and poor people are migrating in, or pre-disaster residents area transitioning into poverty after a severe weather event.

Conclusion: "Severe weather shocks exacerbate inequality."

What Local Health Departments Can Do

Assessment and Surveillance

A climate, health, and equity vulnerability assessment (CHEVA) is the foundation for integration of climate change into public health emergency preparedness (See Section 7.1—Surveillance). In California, Senate Bill 379 (2015) requires local jurisdictions to address climate adaptation and resiliency strategies in their hazard mitigation plans or in the safety element of their general plan.[48]

Collaborate with LHD epidemiology and assessment colleagues, local emergency management and planning agencies to develop climate vulnerability assessments.

- Identify high-risk populations, structures, and industries. Whether an extreme weather event becomes a public health emergency is largely dependent on the pre-existing conditions and resiliency of a community. Assessing vulnerability and resiliency prior to an emergency reduces the potential negative impacts.[49]
    - Identify at-risk individuals (e.g. limited mobility, socially isolated) and residences (e.g. skilled nursing and assisted-living facilities) and develop proactive strategies to address their needs in an extreme event.
        - After Hurricane Irma knocked out power and air conditioning, eleven people died in a Florida nursing home.[50]
    - Map the location of facilities that use and store toxic chemicals that may increase exposure risks in an extreme event.

- Use community-based participatory research to engage youth and community residents in selecting indicators, surveying residents, mapping community assets, and identifying solutions to risks identified in the CHEVA.
- Integrate CHEVA results into PHEP and local hazard mitigation plans.

Use the CDC's CASPER Toolkit to assess immediate and long-term impacts and on-going community needs following a disaster.[51] The CASPER methodology can also be used in Community Health Assessments (See Section 7.1—Surveillance).

Integrate Climate Vulnerability Information into PHEP Planning

Make sure contingency plans address all potential climate-related disasters, for example:

- Be prepared for shelter needs specific to various climate-related events.
  - Plan for "clean air" shelters for wildfires and smoke—facilities with tight-sealing windows and doors and ventilation systems that significantly reduce intake of outdoor air.[52,53]
  - Identify shelters that are well out of potential flood zones
- Use information on urban heat islands and heat vulnerability to identify neighborhoods and facilities for targeted outreach in an extreme heat event and to locate accessible cooling centers.
  - See EPA's Extreme Heat - Incident Action Checklist and this Extreme Heat Toolkit from Wisconsin Department of Health Services.[54,55]
- Develop flood plans that use up-to-date projections on flood inundation zones; integrate information on facilities with hazardous materials and on sewage and drinking water infrastructure vulnerability.
- Be prepared for longer and more severe wildfire seasons
  - See Oregon's Wildfire Response Protocol for Severe Smoke Episodes for examples of partners, actions, and communications (See Section 4.3—Wildfires).[56]

Prepare displacement and shelter protocols specifically for vulnerable populations in cases of extreme weather events and wildfires including children, elderly, people with disabilities, people with chronic diseases, people with compromised immune systems, migrant laborers, homeless people, and LGBTQ communities.

Work with Infectious Disease to plan for appropriate immunizations for evacuees and displaced persons. See the CDC's recommendations on immunizations.[66]

- Inform providers about infectious risks related to floods
- Inform Medical Reserve Corps of tetanus and HepB vaccines recommendations for disaster responders.[67]
- Prepare for enhanced medication and vaccine cold chain protection as extreme events and heat can disrupt power and refrigeration.[68]

Collaborate with LHD colleagues to provide surveillance for early detection of disaster-related infectious disease outbreaks associated with water or food contamination or increased vector activity due to climate-related extreme events.

LGBTQ Populations and Climate Emergencies

Lesbian, Gay, Bisexual, Transgender, and Queer (LGBTQ) communities have unique needs and vulnerabilities during and following climate-related emergencies.[57]

- LGBTQ young adults are more than 120 times more likely to report homelessness compared to their heterosexual and cisgender peers, putting them at greater risk for heat illness, injury and displacement during emergencies.[58]
- LGBTQ seniors are more likely to be socially isolated than other seniors, increasing risk of illness or death in an emergency.[59]
- LGBTQ couples and families may live in a state or be evacuated to a state that does not recognize same-sex marriage, second-parents or joint adoption, which may make it more difficult to access resources for families or be reunified with family members.[60]
- Destruction of safe community spaces and displacement from individual homes and neighborhoods can place LGBTQ people at greater risk of harassment, including in shelters.[61]
- Emergency response protocols, evacuation procedures, and emergency shelter policies are generally designed for heterosexual and cisgender populations, which can "heighten the vulnerability of groups already facing discrimination and marginalization," and lead to lower use of shelters and other resources.[62]
    - For example, strict "male" and "female" divisions in emergency housing and sanitary facilities can be problematic for LGBTQ people and may lead to denial of services, discrimination and violence.[63]

Collaborate with hospitals, nursing homes, prisons, and other group living facilities to establish protocols for climate-related extreme events, including evacuation plans and power outages during heat waves.

- Plan for home recovery actions to remove mold and debris safely.

Communications and Education

Clear, timely, accessible, and culturally and linguistically appropriate communication and robust community engagement are core elements of public health emergency planning and response.

Collaborate with community based and neighborhood organizations to engage residents in all neighborhoods in emergency preparedness and planning, including training and exercises.[69]

- Provide financial support for trainings and events in under-resourced communities; provide these in accessible locations for vulnerable groups. Offer transportation, food, childcare, and translation services to encourage participation.

Ensure that plans include a suite of communications tools for use in various climate-related emergencies, including Health Officer orders, alerts, evacuation orders, and information notices.

LGBTQ Populations and Climate Emergencies

What Local Health Departments Can Do

Public Health Emergency Preparedness programs and other emergency management agencies can implement simple strategies in improve physical and mental health outcomes for LBGTQ people during and after climate-related emergencies:

- Collaborate with LGBTQ community organizations and community members to ensure individuals and families have emergency preparedness plans in place.
    - Share the Family Equality Council's Disaster Preparedness for Families with Parents Who are LGBT with community groups and leaders, and care providers.[64]
- Include LGBTQ community organizations and community members in emergency preparedness planning to ensure unique vulnerabilities and needs are included in emergency plans and policies
- Collaborate with LGBTQ community organizations and media organizations to ensure culturally appropriate emergency messages are distributed to the community
- Facilitate training for LHD staff and other emergency management agencies in culturally competent emergency response protocols for LGBTQ populations
    - Use and disseminate the Human Rights Campaign's Working with the LGBT Community: A Cultural Competence Guide for Emergency Responders and Volunteers.[65]
- Collaborate with emergency management agencies, evacuation shelter coordinators and volunteers to create safe spaces for LGBTQ people, including housing and sanitation facilities.
- Work with Medical Reserve Cops and other service providers to ensure adequate services—including mental health services—are available to LGBTQ populations.

Ensure communications plans include outreach, language barriers, legal status (immigration status, age, guardianship/vulnerable adults) and occupation.

- Establish an accessible information hotline for residents with multiple language options.
- Ensure that all orders are translated in advance into the languages used in your jurisdiction, and have plans in place for translators during emergency events.
    - During the Thomas Fire in Ventura County (CA) in December 2017, a Boil Water order was posted in English on December 5, while the advisory in Spanish was not posted until December 6.[70]
- Collaborate with local CBO and/or advocacy organization that can access and communicate with vulnerable populations who may be uncomfortable seeking information or assistance from local government agencies

Work with other emergency management agencies and local news broadcasters to agree on common language for use in communicating levels of risk to the public.

- The Philadelphia Department of Public Health collaborated with agencies to establish an agreement on common language for extreme heat warning systems, in order to reduce confusion among the public and agency partners.

Communicate with impacted communities about the hazards that remain after the acute disaster (e.g. toxic ash in wildfire debris, water contamination after wildfire, mold risks following flooding).[71]

- Inform residents, workers, and businesses about appropriate personal protective equipment during cleanup.

Communicate and collaborate with first responder agencies to provide enhanced training and equipment in the face of emergency conditions that may be hotter, more severe, more extensive and more extreme due to climate change.

Collaborate with Health Care Providers and Systems

Work with your provider community to ensure awareness of climate-related risks and to encourage provider participation in surge capacity planning/training.

- Integrate climate projections into your assessment of medical surge capacity needs to ensure there are adequate personnel, pharmaceuticals, and medical support devices to accommodate more frequent and severe climate-related emergencies.
    - Ensure emergency plans include clinical triage systems and environmental health considerations.
    - Ensure there are adequate personnel, pharmaceuticals, and medical support devices to accommodate more frequent and severe climate-related emergencies.
    - Ensure power continuity to clinical facilities and settings with institutionalized or sensitive populations during outages
- Ensure a robust network of mental health/behavioral health service providers, including access to pharmaceuticals.
    - Work with mental health services providers before a disaster to ensure that they are fully integrated into Medical Reserve Corps and medical surge capacity planning, and ensure mental health services are available in shelters (and recovery assistance centers).
    - Seek out mental health services providers who can provide services in the languages spoken in your community.
    - Children and youth are more at risk for severe mental health consequences and trauma post climate-intensified extreme events. Planning should establish networks of pediatric support for trauma and mental health care.

Building Climate Resilience

As climate-related disasters become more frequent and more severe, the role of community climate resilience becomes ever more important so that local response capabilities are not overwhelmed. A resilient community:[72]

- Is committed to the transformative change required to build a healthy, equitable, and sustainable community.
- Takes action to build individual and collective capacity to recognize problems and to respond proactively to and influence social, economic, and environmental change.
- Nurtures diversity, respects the experience and knowledge of all community members, and proactively engages all segments of a community in understanding and responding to change.
- Fosters social cohesion and collaboration across networks through bonding, bridging and linking.
- Builds community capitals including economic, social, built, political, and environmental capitals.
- Supports investment in physical infrastructures and services that meet the needs of all residents.
- Recognizes the value of environmental resources and works to protect, enhance, and maintain them.

Community Engagement and Community-Driven Resilience

Community-driven resilience refers to full engagement of community residents to:[73]

- create a vision of climate resilience based in community priorities;
- participate in assessment of climate vulnerability and assets, including selection of indicators
- prioritize problems
- select and implement solutions that incorporate community experience and knowledge

LHD PHEP programs can help to build resilience.

- Actively engage residents in a climate and health vulnerability assessment that incorporates climate risk and identifies populations most vulnerable in the face of climate-related emergencies.
- Build robust community engagement into public health emergency planning, including the most vulnerable and historically disenfranchised groups and neighborhoods.
- Integrate and support activities that build social cohesion within and across different segments of the community.
- Support the integration of health, equity, and sustainability into jurisdiction planning, investments, and post-disaster recovery and rebuilding.

Community Cohesion Saves Lives

Sociologist Eric Klinenberg finds that social cohesion protects people from natural disasters. During the 1995 Chicago heat wave, two adjacent, low economic, nearly demographically identical neighborhoods reported very different fatality rates, with Englewood at 33 per 100,000 residents and Auburn Gresham at 3 per 100,000 (one of the lowest in the city).

Why the difference? Klinenberg observed that Auburn Gresham has "sidewalks, stores, restaurants, and community organizations that bring people into contact with friends and neighbors." Whereas Englewood had lost over half of its population due to disinvestment and neglect over the previous 30 years.

After Superstorm Sandy, Klinenberg found that organizations with deep community ties were able to get assistance into neighborhoods even before government aid was fully mobilized. In boroughs with multiple strong networks, even when the networks came from different backgrounds, their intrinsic strength made them all able to join in and collaborate for recovery efforts.[74]

Intersectoral Collaboration for Community Climate Resilience

"Our hospitals and clinics need to be resilient and fortified so they can anchor the community response during extreme weather events. They need to be the last buildings standing in a hurricane rather than one of the first ones to go down."[75]

– Gary Cohen, Health Care Without Harm

As the frequency and severity of extreme events increases, it is ever more important to increase health care system resilience to allow uninterrupted provision of emergency medical services during and immediately following extreme events and mental health services.[76] LHDs can encourage public and private health services providers to proactively collaborate to assess regional health system vulnerability and resilience and to develop plans for assuring continued access to health services in the event of extreme events (See Section 6.6—Clinical Services).

- Educate health care providers and health care systems managers about climate impacts and the need to be prepared for more frequent and severe climate-related emergencies.
- Inform nursing homes, schools, and clinics about roles and actions to prepare for and respond to climate-related emergencies.
- Work with health care leaders to assess and improve health care system resilience (e.g. back up power and water, evacuation protocols)
- Encourage health care facilities to implement renewable and on-site energy systems and green buildings, and to locate new facilities in climate-safe and transit accessible locations.

See: NIEHS - Primary Protection: Enhancing Health Care Resilience for a Changing Climate[77] and WHO - Operational Framework for Building Climate Resilient Health Systems[78]

East Harlem COAD Leadership Team Members
ioby.org

Collaborate with public works, parks, and planning departments to implement heat island mitigation strategies, especially in heat vulnerable communities (See Sections 5.4—Urban Greening and 5—Health Benefits).

Collaborate with public works, planning, and sanitation agencies to develop strategies to reduce flood risk, especially in flood vulnerable communities and those with aging water and sewage infrastructure (e.g. use of green infrastructure to capture storm water, flood plain development restrictions, building codes that require elevation in areas at risk of flooding). Review and disseminate EPA's Flood Resilience Checklist to local CBOs and other partners (See Section 4.7—Storms and Flooding).

Work with local water districts, water utilities, planning and environmental health to assess drought and salt water intrusion risks, identify communities most at risk, and develop strategies to reduce drought risk and to protect and conserve ground and surface water sources (e.g. water conservation and reuse, watershed management, connection of small or private systems to larger water systems, equitable water rates).

- Review and disseminate information from EPA's Climate Ready Water Utilities Initiative to local drinking water, wastewater, and storm water utilities (See Section 4.2—Drought).

Before a disaster, collaborate with community partners and other agencies to develop a vision for a healthy, equitable, and sustainable community that can guide preparedness and recovery planning. After a disaster, work with other LHD programs, agencies, and community based organizations to establish a recovery and rebuilding plan based on that vision.

Public Health Emergency Preparedness and Climate Mitigation

Without significant and rapid reductions in GHGE, the risk is growing that the impacts of climate change will surpass our capacity to adapt and respond. Climate scientists forecast that temperatures in large parts of the Middle East will exceed the human body's physiological capacity to adapt, precluding rapid GHGE mitigations.[79] As GHG levels in the atmosphere continue to rise, so does the probability of surpassing "tipping points" that increase the risk of accelerated and unstoppable climate changes. Failure to act now to mitigate climate change thus risks impacts that will surpass our ability to adapt or respond and will place significant health, economic, and social burdens on society.[80]

Local public health preparedness programs play a critical role in helping the public and policy makers understand that our ability to protect human life and well-being in the face of climate-related disasters is not limitless, and that the best way to prepare for public health emergencies is to prevent them from happening in the first place. Just as LHDs may use a measles outbreak to remind parents to vaccinate their children, it's important to remind communities that taking action to reduce greenhouse gas emissions is an important component of emergency preparedness.

Strengthening Community Networks: New Orleans Health Department

New Orleans (NOLA)—a city of 350,000—sits near the mouth of the Mississippi River and the edge of the Gulf of Mexico. In recent years, NOLA has seen clearly the worsening impacts of climate change, including Hurricane Katrina, extreme heat events, and increasing mosquito populations, but only recently has the New Orleans Health Department (NOHD) more proactively addressed the impacts of climate change on health.

NOHD used a CDC framework (BRACE) and consulted with local and state climatologists to understand climate change projections and associated health impacts, focusing on heat, vectors, and air quality. NOHD staff then compiled and mapped climate vulnerability and health risk to identify neighborhoods most vulnerable to the adverse health impacts of climate change. This provided the foundation for further engagement with NOHD staff (including a training on climate and health for over 75 staff), other City agencies and community based organizations interested in climate resilience and equity in NOLA.

NOHD partnered with the Gulf Coast Center for Law & Policy (GCCLP) to host three community meetings in neighborhoods identified by the climate and health vulnerability assessment as most vulnerable. The overall goal of the meetings was to build community capacity to take community-led action on climate change to improve health and equity. The meetings were structured to: 1) map participants' knowledge of GNOs' extreme weather response protocol; 2) communicate impacts of climate change on health; 3) identify community health service needs and prioritize community action steps that address the intersection of climate and health; 4) strengthen participants' ability for increased civic participation; and 5) collect and deliver community recommendations to address the impact of climate change on health in at-risk communities in New Orleans.

After the meetings, GCCLP shared recommendations with NOHD:

- Build trust, in light of residents' concerns about how well the City will protect them in a climate-related disaster—based on the Katrina experience.
- Invest in community cohesion by supporting neighborhood groups with physical, financial, and educational resources and strengthening community networks to equip communities to bounce back from extreme weather events.

The vulnerability assessment and community meetings informed the development of a draft NOHD Climate Adaptation Plan, and NOHD participation in drafting the New Orleans Climate Action Plan, which addresses climate mitigation strategies with health benefits, such as active transportation.[81] The New Orleans Community Health Needs Assessment and the Community Health Improvement Plan also now include—under the goal to "Create social and physical environments that promote good health for all"—an objective to "reduce the impact of climate change on the health of New Orleans communities and vulnerable populations."

"The climate and health vulnerability assessment and the community meetings really gave health a seat at the table and provided so many others with the information they needed to understand not just how climate change affects health but why people and health have to be at the center of climate resilience."

– Sarah Babcock, NOHD Health Population and Planning Manager

Future Work and Lessons Learned

NOHD now plans to augment available data on heat illness and heat vulnerability through collaborating with a local CBO to collect temperature data from sensors placed in neighborhoods facing health inequities and built environments that foster urban heat islands. Additionally, NOHD will expand and update its heat outreach campaign, and continue in the role of front-line responder to climate-related disasters.

For More Information

- Climate Changes Health Overview – New Orleans Department of Health[82]

Key Action Steps:

- Work with local and state agencies to compile climate and health data to develop a climate and health vulnerability assessment.
- Support community based organizations to inform communities about climate and health risks and provide input on community priorities to local government agencies. representative of the vulnerable populations identified in the CHEVA to identify the appropriate approach to engaging with that community.
    - o Compensate CBO partners, provide meals, childcare, and compensate community members for their time and contributions.
- Collaborate with LHD partners to include climate change impacts into existing planning processes.

Stranded Ambulance in New York After Hurricane Sandy.
Alex Perkins (CC by 2.0)

Gunderson Health System: Gundersen Lutheran Medical Center
http://www.gundersenhealth.org/locations/la-crosse-campus/hospital/

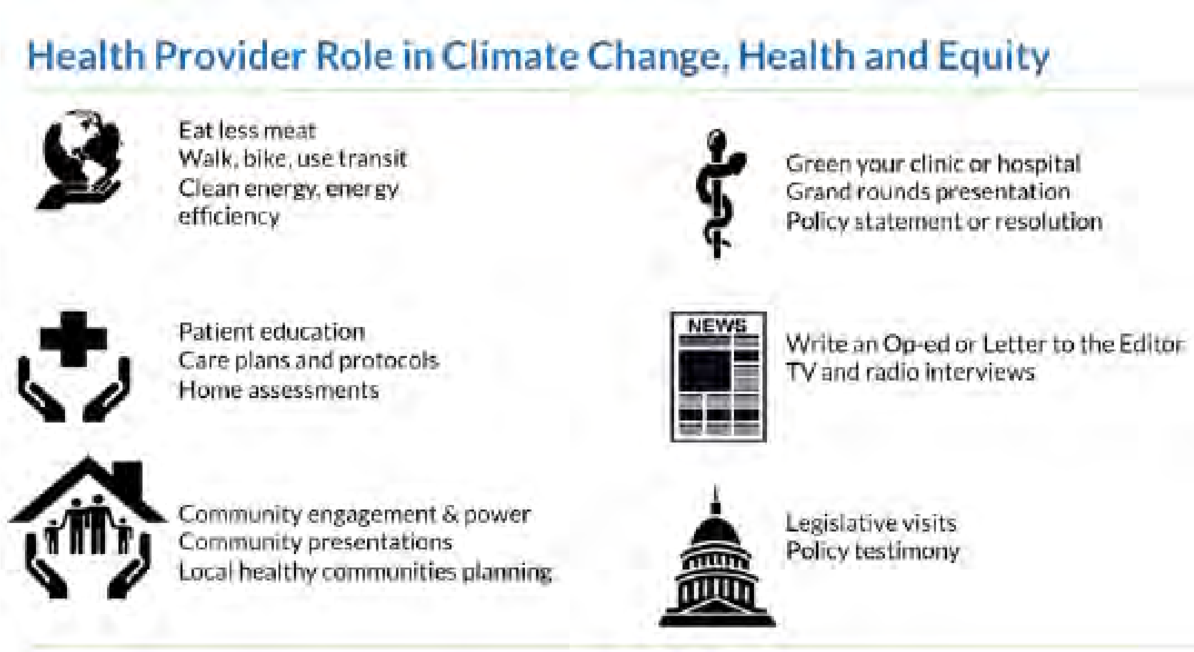
6.6 Clinical Services and Health Care Systems

Local health departments (LHDs) connect people to clinical services and educate and coordinate with health care providers and health care systems. Many LHDs also provide clinical services and/or are organizationally located in larger agencies that operate health care systems.

Key Messages

LHDs are uniquely positioned to assess and address the needs of the most vulnerable individuals, inform clinicians about climate impacts on health and their roles in addressing climate and health, and support the development of climate-resilient health care systems.

- The significant impacts of climate change on health affect the need for clinical care and case management, particularly in people with chronic illness, children and the elderly, some workers, and those impacted by climate disasters.
- Health care sector is a significant contributor to greenhouse gas emissions.
- Extreme weather events can seriously disrupt hospitals and health care.
- Health care providers and health care systems can:
    - Inform patients about climate risks, incorporate knowledge of climate impacts into patient care, and make referrals for climate-related services.
    - Integrate climate change into non-profit hospital system Community Health Needs Assessments.
    - Serve as “climate and health champions” to educate community residents and decision makers about climate health impacts and support climate actions with health benefits.
    - Work to reduce the carbon footprint of health care facilities.
    - Help to ensure that people have access to health care services and that health care systems can function during and after climate disasters, including through participation in Medical Reserve Corps programs.



Support Integration of Climate Change into Patient Care

Health care providers have an important role in educating patients about the health impacts of climate change, and steps they can take to protect their health and fight climate change (See Section 4—Health Impacts, and *A Physician's Guide on Climate Change, Health and Equity*).[1] LHDs can inform health care providers about climate risks and health impacts, provide materials for distribution to patients and other caregivers, and facilitate provider referrals to services that protect patients from climate-related illnesses.

Health care providers can help patients reduce the health risks of climate change:

- Integrate information about specific relevant climate risks into patient education and care management plans, for example: (See Appendix 5—Clinical Considerations)
    - Inform heat-sensitive patients (e.g. people with diabetes or those taking some psychotropic medications) of their increased risks of heat illness and how to prevent it, such as having working air conditioning in the home, knowing how to get to a cooling center, and staying hydrated.
    - Warn parents never to leave children in a car, even if the windows are 'cracked' or open, as temperatures quickly rise to unsafe levels in warm weather.
    - Advise patients with respiratory and heart disease to check the Air Quality Index for unsafe ozone and particulate levels, especially during heat waves, and to adjust outdoor activity on bad air days.[2]
    - Make sure patients—especially women of reproductive age—understand how to protect against mosquito-borne illnesses using insect repellent, clothing, and home window screens.
- Provide information on family emergency plans and local shelters and cooling centers.

- Connect low income patients to resources for financial and other support such as the Low Income Home Energy Assistance Program (LIHEAP), home weatherization, housing code enforcement, tree planting, and WIC and SNAP supplemental food programs. [4]
- Provide climate and health information in factsheets and posters for patient waiting rooms.[3]
- Ensure plans and processes are in place for appropriate immunizations for evacuees and displaced persons following a climate-related disaster (See Section 6.5—Preparedness).

Climate and Health Champions

Health care providers are seeing the impacts of climate change on patients now. They can be powerful voices in helping the public and policy makers understand that climate change is a health issue and that climate action is urgent.[5,6] LHDs can prepare these community leaders to serve as climate and health champions.

- Present on climate change and health at local hospital and clinic grand rounds and brown bag lunches; include exercises to build skills of providers to talk about climate change and reach out to local decision makers.
- Ask if you can have a table on climate change and health at a health system-sponsored community health fair.
- Help providers and health systems leaders to support local climate and health actions, e.g. inform elected officials about the benefits of bike and walk infrastructure for children's health or the need for reducing diesel pollution to reduce asthma.
    - Coauthor op-eds or letters to the editor, or connect them to opportunities to share their experiences with climate related illness on local radio or television or following extreme events.
    - See Climate Advocacy Resources for Health Professionals.[7]

Integrating Climate Change into Community Health Needs Assessments and Community Benefit Strategies

Community Health Needs Assessments

Under the Patient Protection and Affordable Care Act, all non-profit health systems are required to complete a Community Health Needs Assessments (CHNA) regularly.[8] CHNAs address financial and other barriers to health care, as well as "social, behavioral and environmental factors that address health in the community," and integrate climate change into planning for programs to address health needs. LHDs can encourage integration of climate change into CHNAs through providing information on the nature of regional climate projections and related health risks. LHDs can recommend indicators and provide data on climate vulnerability, climate risks, and community resilience (See Section 7.1—Surveillance). Additional data sources include: Community Commons and CDC's Climate and Health Data and Tools.[9,10]

Community Benefit Strategies

Informed by CHNA, community benefits programs address community health priorities, many of which are exacerbated by climate change. Community benefit strategies with climate and health benefits provide win-wins and the greatest value. For example:

- Creating walking and biking paths to encourage recreational physical activity and active transportation helps reduce cardiovascular disease and obesity while lowering air pollution and fossil fuel use.
- Investing in energy efficiency retrofits for low-income homes can improve financial and energy security while improving indoor air quality and reducing exposure to asthma triggers.

See Section 5—Health Benefits and Health Care Without Harm's Leveraging Hospital Community Benefit Activities to Address Climate Change and Environmental Risks.[11]

Climate-Resilient Health Care

"Our hospitals and clinics need to be resilient and fortified so they can anchor the community response during extreme weather events. They need to be the last buildings standing in a hurricane rather than one of the first ones to go down."

Gary Cohen, Health Care Without Harm

Recent hurricanes demonstrated the impacts of extreme weather events on health care systems.

- An estimated 40%–70% of those affected by Hurricane Katrina had a chronic illness, for which medication management was a key challenge during the days and weeks after the event.[12]
- At least two major New York City hospitals had to be evacuated during Super Storm Sandy, and the storm caused loss of significant bed capacity for months. A year after Sandy, several hospitals were still struggling to return to normal.[13]
- Three days after Hurricane Maria, only 3 hospitals on Puerto Rico were functioning, and 40% were still running on generator power two months after the storm.[14]
    - Two months after the storm, almost half the island's population lived in health professional shortage areas, and less than 2% of the need for physicians was being met.[15]

As the frequency and severity of extreme events increases, it is imperative to increase health care system resilience to allow uninterrupted provision of emergency medical services following extreme events and mental health services[16] LHDs can encourage and assist health care providers and health care systems to proactively collaborate to participate in Medical Reserve Corps, assess regional health system vulnerability and resilience, and develop plans for assuring continued access to health services in the era of climate change.

Medical Reserve Corps

The Medical Reserve Corps (MRC) Program coordinates the skills of practicing and retired health professionals to deliver services during a crisis, assist emergency response teams with patients, provide care directly to those with less serious injuries and other health-related issues, and assist with other ongoing public health needs. LHDs can support development and maintenance of an MRC including training on emergency response protocols.[17]

HEALTH CARE RESILIENCE: Following is a checklist for health care facilities resilience.[18]
☐ Where are health care services facilities located, and are they at risk of storm surge? Flooding? Wildfire?
☐ Can new facilities be sited out of risk zones and still accessible to community?
☐ Does the facility emergency response plan take climate change into account?
☐ Are all staff trained on the emergency response plan?
☐ Will transportation access be impacted by climate-related weather event?[19]
☐ Is there an evacuation plan and has it been exercised?
☐ Are there institutional agreements and triage protocols in place for patient transfer during extreme events?
☐ Could critical infrastructure (e.g. generators, electro-mechanical systems) in facilities at risk of flooding be relocated from lower floors and basements?
☐ Is it possible to implement on-site renewable electricity generation or co-production of heat and energy to maintain power in the event of a grid outage?
☐ Can trees and other green space be expanded to reduce flood risk?
☐ Invest in LHD clinics and urge other facilities to invest in hazard management to prepare for extreme weather.

For More Information

- DHHS's Primary Protection: Enhancing Health Care Resilience for a Changing Climate[20]
- WHO Operational Framework for Building Climate Resilient Health Systems[21]

Greening Health Care

In 2013, the U.S. health care sector was responsible for 10% of national greenhouse gas emissions and 9% of national criteria air pollutants emissions, primarily from hospitals.[22] Health care facilities can implement many practices to reduce their carbon footprint while producing immediate short-term and long-term health benefits. LHDs can encourage local hospitals and health care systems to "go green," and connect them with resources to do so. See the Healthcare Climate Council.[23] Following is a summary greening ideas LHDs can provide to health facilities to promote their sustainability and resilience.

Energy

Health care operations managers can reduce carbon pollution from dirty fossil fuel-based energy through energy efficiency and decarbonization of facility energy supply.

"A 30% cut in healthcare electricity's carbon pollution by 2030 would reduce greenhouse gas emissions, preventing an estimated 4,130 premature deaths, 85,000 asthma attacks, 4 million respiratory symptom events, and 3,750 visit incidents and save about $1.2 billion in medical costs."

Health Care Without Harm[24]

Energy Efficiency[25]

- Perform an energy audit and annually measure building energy use to prioritize energy use reduction efforts.
- Establish system-wide energy conservation programs and efficiency improvements, for example in mechanical systems; lighting upgrades; improved insulation; heating, cooling, and ventilation upgrades; and equipment purchases.
- Engage staff on energy conservation and efficiency practices, including custodial services staff.

Renewable Energy[26]

- Consider installation of rooftop solar on facility roofs or parking lots, and/or procurement of energy from renewable energy suppliers.
- Use Power Purchasing agreements and purchase of Renewable Energy Certificates to increase utility production of clean energy.

Transportation[27]

- Provide financial and other incentives to employees and clients to walk, bike, and take public transit, for example charging for daily parking, subsidized bike and transit commutes, bicycle parking and shower facilities on site, personalized commute planning, shuttle services.
    - Seattle Children's Hospital reduced workforce drive-alone commute trips from 73% in 1995 to 38% in 2015.[28]
- Invest in electric vehicles for fleet upgrades.
- Collaborate with local transportation agencies to improve bike and pedestrian infrastructure and transit operations.[29]

Waste Reduction[30]

- Annually conduct a waste stream audit identifying the types and amounts of waste at your facility.
- Create a "Waste Management Plan" and implementation strategies to prioritize waste reduction, reuse, recycling, and composting.
- Work with suppliers to purchase office supplies and medical supplies that have a reduced environmental impact.

- Review procurement policies and support local, sustainable materials and foods.
- When applicable, dispose of waste locally to reduce transport related emissions.

Food

- Establish local and sustainable food purchasing policies for facility cafeterias, meeting and event catering, and on-site food retail.[31]
- Implement policies and programs to reduce purchase and consumption of meat, for example "Meatless Mondays."[32]
- Promote healthy and sustainable food and beverage consumption through patient, staff, and visitor education.[33]
- Reduce food waste, through changes in meal selection processes, composting of food waste, and edible food recovery programs in partnership with local food insecurity organizations.[34,35]
- LHDs can encourage and facilitate collaboration of health systems with agricultural agencies, parks, planning, and local farmers and job training programs to:
    - Create on-site (including rooftop) community gardens and/or support gardens in other nearby locations.[36]
    - Contract with local growers for food procurement.[37]
    - Support and provide opportunities for training food service workers.[38]

For More Information

- Green Guide for Health Care[39]
- Environmental Impacts of the U.S. Health Care System and Effects on Public Health[40]
- Health in the Green Economy: Co-benefits to Health of Climate Change Mitigation, Health Care Facilities[41]
- Sustainable Healthcare Facilities[42]
- Greening Health Care: How Hospitals Can Heal the Planet[43]
- PolicyLink Local Food Procurement Guide[44]

Public Health Functions

7.1 Assessment and Surveillance for Climate Change and Health

Introduction

Assessment is a core function of public health and encompasses monitoring health status to identify community health problems and diagnosis and investigation of health problems and health hazards in the community. Local health departments are already engaged in disease surveillance, community health assessments, vital statistics, and program evaluation. The skills, data, and analysis used in these activities can be applied to assessment for climate change and health, which provides a foundation to:

- Inform the public and policy makers about climate-related health risks and outcomes.
- Determine the need for enhanced surveillance and environmental monitoring.
- Increase opportunities for realizing health benefits through greenhouse gas mitigation and adaptation strategies.
- Spur action to promote health equity and climate resilience.

To better integrate climate change into current surveillance and assessment activities, LHDs can:

- Conduct climate, health and equity vulnerability assessment.
- Enhance existing environmental monitoring.
- Enhance surveillance of climate-related health behaviors and health outcomes.
- Conduct health analyses and health impact assessments of climate-related policies and programs.

Climate, Health and Equity Vulnerability Assessment

"Climate vulnerability is the degree to which people or communities are at risk of experiencing the negative impacts of climate change."[1]

A community health assessment (CHA) is a collaborative process that "involves systematic collection and analysis of data and information to provide a sound basis for decision-making and action.[2]" A climate, health and equity vulnerability assessment (CHEVA) identifies climate-related risks, their likely health impacts, and the people and places at higher risk. Coupled with knowledge of community resources to reduce risks and promote health, it provides the foundation for guiding LHD actions to protect and promote health in the era of climate change.

Awareness within your LHD of the broad scope and scale of climate changes projected for your jurisdiction will allow you to provide a more evidence-based assessment of potential climate-related health risks, how climate change will exacerbate existing health problems, and appropriate interventions to reduce the health impacts of climate change.

CHEVA can be a stand-alone effort; but because climate change has such broad impacts on health and health equity, both the CHEVA and CHA will be strengthened if you integrate climate risks and vulnerabilities into your CHA process. Similarly, integration of climate change into Community Health Needs Assessments performed by not-for-profit hospitals provides another avenue for assessing the impacts of climate change on health and health equity. See: Leveraging Hospital Community Benefit Activities to Address Climate Chang and Environmental Risks.[3]

- The Alaska Department of Health and Human Services partnered with local Tribes, agencies, and organizations to assess potential health impacts from climate change. The assessment included climate predictions for Alaska based on the National Climate Assessment and described potential health impacts across mental health, injury, nutrition, infectious disease, chronic disease, environmental health, and health service capacity considerations.[4]
- The Macomb County Health Department (MI) used the MAPP (Mobilizing for Action through Planning and Partnerships) strategic planning framework to develop its Community Health Assessment, and identified climate change as one of the key "forces of change".[5]

Community Engagement in CHEVA

Climate and health vulnerability assessments are most valuable when they incorporate the perspectives and knowledge of community residents and are shared widely and seen as useful tools for informing community and policy decisions. Bringing community partners into the assessment process as early as possible will help to ensure that the information you produce will be disseminated and used.

Community residents and community-based organizations (CBOs) can share information about assets and needs in their communities, prior efforts to address problems, resources and challenges, and specific ideas for how to support and facilitate community efforts to promote health through climate mitigation, adaptation, and resilience. For more on community engagement see the Health in All Policies Guide.[6]

LHDs have invited and/or contracted with community partners to comment on an initial list of proposed indicators proposed, provide information on community assets and concerns that may not be reflected in available data, participate in data collection and interviews of community members, review the draft assessment, and present the assessment to residents in impacted communities as a tool for engaging in conversations about actions that can build preparedness capacity and climate resilience.

- Youth organizers in Richmond, California used community surveys, maps, and GIS applications to understand climate vulnerabilities and community risks and assets. The results helped spur youth-led proposals on job opportunities and policy changes for enhanced resilience.[7]

Steps in a Climate, Health and Equity Vulnerability Assessment

One common framework for assessing climate and health vulnerability combines geographically refined data on 1) current and future physical threats of climate change; 2) population vulnerabilities including social determinants of health; 3) "adaptive capacity" that reflects individual and community-based resources that could counteract the negative impacts of climate change; and 4) health impact projections.

The tables below list the common indicators used in CHEVA. Climate change and climate and health data sources are available through the CDC: Climate and Health.[8]

Current and Future Physical Threats of Climate Change

Understanding current and projected climate risks is the first step in developing a climate and health vulnerability assessment. What are the environmental impacts of climate change that are happening now and will be experienced? How will those vary across the jurisdiction, and over time? What difference will actions now make? Start by checking with planning and emergency management agencies to see if they have conducted an assessment of projected climate impacts in your jurisdiction. (See Table 7.1.1)

Table 7.1.1 INDICATORS OF CLIMATE THREATS

Category	Indicator	Data Source
Temperature	Maximum temperature	3rd National Climate Assessment, Human Health Chapter
	Minimum temperature	
	Extreme heat days	
Pollen	Pollen loads	
	Ragweed presence	
Wildfire	Annual average of area burned	
	Percent of population currently living in high fire risk hazard zone	
Drought	Palmer Drought Severity Index	
	NDMC's drought impact reporter	
	Water scarcity (water supply < 1,000 m3/person)	
	Annual mean precipitation (inches)	
	Snow water equivalent	
Air Quality	Three-year annual mean concentration of particulate matter ($PM_{2.5}$)	
	Three-year ozone concentration exceedance above state standard	
Sea Level Rise	Percent of population living in 100-year flood zone and 55 inches of sea level rise	
	Sea level rise scenarios	
Water Quality	Harmful algal blooms	

Understanding Climate Change Projections[9,10]

You don't need to be a climate scientist or understand complex climate change models to use climate projections in your CHEVA. But here are a few useful things to know:

- Climate projections are not the same as weather forecasts. Climate change will not make year-to-year variability in climate go away. There may be a very cold winter one year, but decade-over-decade warming persists. Climate projections tell us how conditions are likely to change in the future, on average, over multiple decades.
- Climate change impact projections and greenhouse gas emissions scenarios are not the same thing. Emissions scenarios use projections of population, demographics, economic growth, energy supply and demand, land use, and technological developments as inputs to complex socio-economic models that estimate emissions of greenhouse gas emissions. These scenarios represent different possible futures, for example business-as-usual with continued high levels of emissions or low-emissions scenarios based on aggressive efforts to reduce GHGE.
- Climate scientists use emissions scenarios as input into very complex computer models that use basic laws of physics and chemistry and information about oceans, land surface, ice, and the atmosphere to produce climate projections. These projections forecast environmental changes associated with various levels of GHGE at different points in the future for every part of the earth.
- Planners often average across different climate projections to assess the most likely outcomes for a particular emissions scenario. But they do not average across the emissions scenarios, because those represent different futures based on what actions society may take to reduce GHGE. Understanding the different climate projections for high emissions versus low emissions scenarios can help LHDs understand the health implications of our choices about climate action, and can help the public and policy makers decide how much cost and effort should go into emissions reduction.
- Climate change is the result of all of the GHG in the atmosphere cumulatively over time. Because GHG persist in the atmosphere for long periods of time, the cumulative amount changes with each incremental addition of GHGE. It also takes time for GHG in the oceans, earth and atmosphere to equilibrate, so warming will continue even if GHGE stop.
- Climate projections differ significantly for different time periods in the future. Both nearer term and longer term projections are important for planning. The nature of interventions required to reduce the health impacts of climate change range from very short-term (warnings for extreme weather events) to multi-decadal (working with other sectors to achieve systems transformations in energy and transportation) and everything in between (planting trees to provide shade).

Population Vulnerability

Table 7.1.2 provides indicators associated with increased population vulnerability to climate-related adverse health outcomes, including demographic characteristics such as age, and socioeconomic determinants such as poverty, education, and race/ethnicity. While the indicators below are most often used to assess population prevalence in a particular geographically defined area (e.g. census tract), it may also be useful to identify and map specific sensitive institutional populations such as schools, nursing homes, or prisons. In areas that are rapidly changing, for example due to gentrification or migration, consider updating these indicators more frequently.

Table 7.1.2 INDICATORS OF CLIMATE THREATS

Indicator	Definition	Data Source
Children	Percent of population aged less than 5 years	American Community Survey (2016) Uniform Crime Report (2017)
Elderly	Percent of population aged 65 years or older	
Poverty	Percent of population whose income in the past year was below poverty level	
Education	Percent of population aged > = 25 years with less than s high school education	
Race and Ethnicity	Percent of population of color	
Outdoor Workers	Percent of population employed and aged > = 16 years working outdoors	
Linguistic Isolation	Percent of households with no one aged > = 14 years speaking English	
Physical Disability	Percent of population living with physical disability	
Mental Disability	Percent of population living with mental disability	
Health Insurance	Percent of population without health insurance	
Violent Crime Rate	Number of violent crimes per 1,000 residents	
Linguistic Isolation	Percent of households with no one aged > = 14 years speaking English	
Physical Disability	Percent of population living with physical disability	
Mental Disability	Percent of population living with mental disability	
Health Insurance	Percent of population without health insurance	
Violent Crime Rate	Number of violent crimes per 1,000 residents	

Table continued on next page

Chronic Disease:		
Asthma	Prevalence of current asthma	CDC 500 Cities
Cardiovascular Disease	Prevalence of coronary heart disease	CDC 500 Cities
Diabetes	Prevalence of diagnosed diabetes	CDC 500 Cities

Identifying Indicators and Assets for Adaptation and Resilience

Several indicators of adaptive capacity are recognized to lower climate risks (Table 7.1.3). These include avoidance of the threats by temporary evacuation or using technologies such as air conditioning to create a safe environment during heat waves. Adaptive capacity may also leverage social and political relationships so resources can be shared before, during, and after extreme events.

Table 7.1.3 INDICATORS OF ADAPTIVE CAPACITY

Indicator	Definition	Data Source
Impervious surfaces	Percent of urban impervious surfaces	National Land Cover Database (2011)
Air conditioning access	Percent of the population with access to residential air conditioning	RAS Data
Motor vehicle access	Percent of households with access to a vehicle	ACS
Transit access	Percent of the population residing ½ mile from a rail or bus stop with 15 minute frequency during peak commuter hours	MPOs
Tree canopy	Population-weighted percentage of the census tract area with tree canopy	National Land Cover Database (2011)
Social cohesion	Percentage of registered voters who voted in the most recent general election	UC Berkeley Statewide Database

Resiliency and Asset Mapping

Communities have resources that are not easily identified through existing data but that are important in withstanding climate stresses and building climate resilience (Table 7.1.4). Community surveys provide information about social cohesion, strongly associated with better outcomes after climate-related extreme events as well as other improved health outcomes. Community-based participatory asset mapping will identify people, structures, organizations, and other intangible factors that may confer community climate resilience. To learn more, see UCLA's Center for Health Policy Research Asset Mapping Toolkit.[11]

Table 7.1.4 RESILIENCE INDICATORS

Short Title	Indicator	Data Source
Social cohesion[12]	Frequency of interaction with friends/family Available support networks Frequency in feelings of loneliness Inter-group bridging (e.g., cross-group socialization, integration of different groups) Trust (in neighbors, workplaces, government, social groups) Membership in voluntary associations, clubs, and religious institutions Presence of neighborhood associations Neighborhood and senior centers	Community surveys

Climate and Health Vulnerability Indices

Different indicators can be combined to create an index of climate vulnerability, either for a specific exposure such as heat, or for overall climate vulnerability. Index construction—such as choice of indicators and approach to weighting of indicators—requires careful consideration.

- The Climate and Health Program in the North Carolina Division of Public Health used a wildfire vulnerability index developed by the EPA to identify counties with high exposure and sensitivity to smoke health impacts.[13]
- The California Environmental Health Tracking Program mapped population climate vulnerability in Fresno and Los Angeles.[14]
- Denver Department of Environmental Health created a Heat Vulnerability Index and accompanying story map that shows heat vulnerability by census tract.[15]

Projected Health Outcomes Associated with Climate Change

An assessment of the burden of disease (mortality and morbidity) due to climate change asks how the number of deaths or other health outcomes would change if a future climate threat increased by a specific amount from the historical baseline. While LHDs can reasonably predict some of the ways and directions in which future health outcomes will change due to climate change, it is more challenging to develop quantitative projections of the magnitude of change in health outcomes that will accompany these impacts. These quantitative projections can inform public health adaptation and preparedness planning and may help communities and policy makers understand the longer term benefits of taking climate action now. Quantitative projection of health outcomes associated with future climate change requires:

- Data on current disease burden associated with a particular impact (e.g. baseline asthma hospitalizations).
- Estimates of the quantitative relationship between temperature, related weather metrics (e.g. humidity), and air pollution levels on mortality.
- Projections of changes in temperature, air pollution, etc. (and how those differ based on emissions scenarios).
- Projections of changes in future size and geographic distribution of sensitive populations.
- Assumptions about future use of adaptation strategies such as air conditioners or of strategies to reduce air pollution.

The CDC provides documents that address methodological issues in projecting future climate-related disease burden.[16,17] In particular is the need to integrate demographic change, since changes in populations exposed to climate risks can be significant. Between 2000 and 2016, while temperatures increased about 1.1°F on average in the U.S., the number of Americans exposed to heat wave events annually increased by an average of approximately 14.5 million, and the number of elderly exposed increased significantly.[18]

Communicating the Results of CHEVA

Report, websites, and community meetings have all been used to communicate the results of a CHEVA to community residents, stakeholders, agency partners, and policy makers. Maps are a powerful way to display information and make it more relevant and usable.

- Use geographic analysis systems to create color-themed maps that demonstrate the intersection of specific climate impact projections (e.g. heat islands, flood zones), social and population vulnerability, and assets at the census tract level. Add information on specific sites (e.g. schools). The LHD Spotlight below addresses flood health vulnerability assessment; it is one of a series of assessments of specific climate-related risks. See the end of this section for maps from Denver, Minneapolis, Multnomah County (OR) and others.

Enhanced Monitoring and Surveillance

Climate change is altering disease and illness dynamics globally. Enhancing current monitoring and surveillance protocols can detect emerging risks, track impacts on health outcomes, and assess effectiveness of public health interventions.

Community Engagement in Monitoring and Surveillance

LHDs can work with communities and academic partners to conduct community-based participatory research (CBPR) to engage community residents, understand local health impacts of climate change and the contributors to it, and identify strategies to promote health and equity. CBPR is "a collaborative process that equitably involves all partners in the research process and recognizes the unique strengths that each brings. CBPR begins with a research topic of importance to the community with the aim of combining knowledge and action for social change to improve community health and eliminate health disparities."[21]

- Coast Salish Tribal Communities in Washington and Oregon partnered with local agencies and academic institutions to conduct CBPR projects in local Native American communities on health inequities and exacerbations due to climate change. Project researchers interviewed local leaders and community members and held workshops to inform a set of six Indigenous Health Indicators to address health equity and climate change impacts. These indicators included measures that are often not seen in traditional indicator sets: community connection, natural resources security, cultural use and practices, self-determination, and emotional stability.[22]

Emerging community science programs also offer opportunities for enhanced surveillance and youth and community engagement. As climate change threatens to drive Chagas disease northward from South America, researchers in Texas established a project in which the public mailed "kissing bugs" for testing for *Trypanosoma cruzi*, the parasite that carries the disease, allowing assessment of vector distribution and infection prevalence.[23]

Air quality monitoring provides another opportunity to engage communities in surveillance and assessment. A variety of portable and lower-cost monitoring devices are being developed to enhance air quality monitoring capabilities and provide information about air quality in locations without permanently stationed monitors. The U.S. EPA resources for community scientists to do their own air monitoring—Citizen Science Opportunities for Monitoring Air Quality.[24] In 2016, a Salt Lake City advocacy group participated in the global Unmask My City initiative. In a campaign to support air pollution control measures, volunteers used personal $PM_{2.5}$ monitors with masks that changed color to show real-time air pollution measurements.[25]

LHD Spotlight: San Francisco Department of Public Health[19]

The San Francisco Department of Public Health (SFDPH) conducted a flood health vulnerability assessment in order to focus resources on and design interventions for vulnerable populations (Table 7.1.5). SFDPH included indicators on socioeconomic and demographic, exposure to flooding, pre-existing health conditions, and housing quality. To obtain data, the department used results from the American Community Survey and from the local police and fire departments, San Francisco Public Utilities Commission, California Office of Statewide Health Planning and Development, and the 2015 San Francisco Homeless Count.

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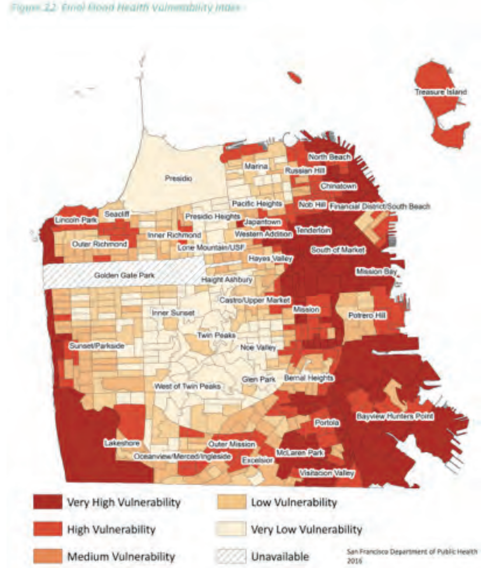
LHD Spotlight continued

TABLE 7.1.5	VULNERABILITY INDICATORS
Vulnerability	**Indicators[20]**
Social and Demographic	Age: Percent of residents who identify as under 18 and over 65
	Percent of residents who do not identify as white
	Percent of residents below 200% of the federal poverty rate
	Percent of residents over 25 with at least a high school degree
	Percent of households with adults who do not speak English
Exposure	Percent of land in 100-year flood plain with 36 inches of sea level rise
	Percent of land projected to have over 6 inches of precipitation during a 100-year storm
	Minimum elevation
Health	Adult hospitalization rate due to diabetes
	Adult hospitalization rate due to asthma
	Adult hospitalization rate due to schizophrenia and other psychotic disorders
	Percent of residents who report a physical disability
Housing	Homeless population, per 1000 residents
	Annual housing violations, per 1000 residents
	Percent of residents who report living alone

SFDPH overlaid available data, creating vulnerability indexes for each indicator set and a combined flood health vulnerability score by block group and neighborhood. The resulting maps defined areas that are most likely to experience flooding and areas that are most likely to experience its health impacts.



Environmental Monitoring

Share data with sister agencies to stay apprised of environmental changes associated with changes in disease risk:

- Changes in ocean or waterway temperature may enable growth of infectious agents.
- Changes in ambient temperature may put people at greater risk of heat illness.
- Buildout of impervious surfaces will increase risk of urban heat islands and heat illness.
- Community rain water collection could increase mosquito habitats without proper prevention.
- Bioengineered adaptation projects for storm water management and flood control may alter or create new vector habitat.

Water and food safety

As temperatures increase in the ocean and other bodies of water:

- Increase monitoring of water temperature in areas where seafood and shellfish are harvested, as *Vibrio* bacteria contamination can increase after periods of extreme heat.
- Increase frequency of monitoring for harmful algal blooms/toxins.
- Increase frequency of retail food inspections as higher ambient temperatures increase food safety risks.[26]

Disease vectors

The frequency and location of monitoring for disease vectors should incorporate likely changes in the distribution and types of these species with climate change impacts.

- Ideal habitats for disease vectors are expected to expand in some regions, which will require monitoring in areas that were previously outside endemic zones for these species.
- New vector species are expected to move into areas where they were not previously found, so surveillance procedures will need to be altered (i.e. new types of traps and different monitoring times).
- Plan for enhanced surveillance during droughts and after flooding and storm surge events.
- Notify vector-borne disease agencies of mosquitoes tentatively identified as *Aedes aegypti* or *Aedes albopictus*; confirm identification.
- Use data on blighted properties, substandard properties without protections against mosquitos to understand neighborhoods in need of response and education.

Environmental hazards

- Improve air monitoring capacity in areas at known wildfire risk for better warning systems during an event.
- Prepare to monitor for toxics, for example in floodwater in areas at risk of flooding and located in proximity to facilities that store or use hazardous materials or in ash residue following wildfire.

Health equity

Communities change over time, for example with aging; gentrification and displacement may create more rapid change in the economic, race and ethnicity, social and health status, and access to services of neighborhoods. Finding ways to monitor change at the micro level is challenging but important in keeping vulnerability assessments current. Providing information about social and health inequalities in conjunction with environmental and health monitoring data provides context and assists in identifying preventable inequities and the need for targeted interventions.

Health outcomes

Climate change may already be influencing patterns of health outcomes that are reported in vital statistics and other surveillance programs.

- Epidemic curves are a basic tool to describe extreme heat events and other climate-related events of multi-day duration. These curves may be constructed, for example, using the daily number of deaths, hospital admissions, and/or emergency room visits for heat illness and the larger pool of heat-sensitive diagnoses such as cardiovascular disease, diabetes, and kidney disease during and after extreme heat events.[3] Similar data can demonstrate health impacts (e.g. increases in asthma ED visits or hospitalizations) associated with wildfire smoke exposure. Analysis of ER visits during extreme weather events can also provide planning information for emergency services providers.

Data collection and analysis may be done in real time or post-event. Coupled with meteorological data, these data can generate dose-response relationships for longer-term analysis of climate health impacts.[4] Local health departments have established protocols with community physicians, laboratories, and hospitals to exchange data from electronic medical records, and climate-related conditions like heat-illness may be added to these protocols.

- Syndromic surveillance systems provide health data in real time (i.e. a patient comes to a health facility with specific symptoms). These systems are used in heat surveillance programs to:[28,29]
    - assess the severity of an ongoing heat event.
    - allow early detection in disease or injury frequency.
    - target messages to vulnerable communities.
    - justify additional response resources (more cooling center hours or water distribution sites)
    - prepare ER and clinic staff for visit surges.

Standardized search terms are available for heat and other conditions.[30,31]

For More Information:

- National Notifiable Diseases Surveillance System[39]
- National Syndromic Surveillance Program[40]
- BioSense Platform[41]
- Behavioral Risk Factor Surveillance System[42]

Rapid Epidemiologic assessment

CDC developed the Community Assessment for Public Health Emergency Response (CASPER) system to monitor for health outcomes in emergency and non-emergency settings using neighborhood cluster sampling and personal interviews or direct observation of residential areas.[34] In 2008, the Iowa Department of Public Health teamed with impacted county agencies to use the CASPER methodology to evaluate community needs following severe flooding in the region. Results demonstrated that many households had been displaced and that there were potential risks related to the presence of environmental hazards and disruption in medication access, highlighting the need for improved risk communication and ongoing surveillance during recovery efforts.[35] Other examples of LHD CASPERs include an evaluation of cooling center availability and access in Maricopa County, AZ and an assessment of the health impacts of the 2015 California drought in Tulare County.[36,37]

Surveys

Surveys are an important tool to understand community experience and knowledge of climate-linked extreme events and to assess impacts. In 2014, Macomb County, Michigan experienced unprecedented damage due to historic levels of flooding in areas with little flooding experience. In 2017, the Macomb Health Department (MHD) surveyed impacted residents to ascertain perceptions of the flooding and its long-term physical and mental health impacts.

Intersectoral Collaboration and Health Impact Assessment

Many local health departments are actively engaged in Health in All Policies, strategies that integrate a health lens into policy-making across sectors (See Section 7.3—Collaboration). Providing qualitative and quantitative assessments of the health benefits and/or adverse health consequences of climate action plans, programs and policies is an important strategy for promoting health and health equity.

- Representatives from the Springfield Department of Health and Human Services and the Williamsburg Board of Health collaborated with the Massachusetts Department of Public Health to conduct an HIA of local climate action plans, including assessment of approaches specific for vulnerable populations (i.e. cooling centers during extreme heat events for low-income communities without access to AC).[43]
- The city of Davidson, NC conducted an HIA on the city's Davidson Walks & Rolls: Active Transportation Plan, including a social and health equity analysis to identify priority communities for pedestrian and bicycle improvements. The assessment found that 29% of the city's population lived in areas considered high priority for future active transport infrastructure due to high prevalence of low-income communities and existing chronic disease. The assessment also demonstrated that small increases in biking and walking would result in over $1 million in benefits to the city due to health benefits associated with, in part, reductions in greenhouse gas and resulting climate impacts.[44]

These assessments draw on a wide array of qualitative and quantitative techniques, can be scaled for rapid as well as resource-intensive and rigorous implementation, and have been used to examine many aspects of climate change and health. Community engagement and health equity analysis are key components of health impact assessments (HIAs). For more information on how to conduct an HIA and related community engagement, see Human Impact Partners Health Impact Assessment Toolkit: A Handbook to Conducting HIA.[45]

Current Fossil Fuel Facilities and Projects

LHDs can provide assessments of the health impacts of facilities and projects that may contribute to climate change through supporting or expanding the fossil fuels infrastructure.

- In 2011, the Green River District Health Department in Kentucky completed an HIA on three proposed coal gasification plants to inform the community and policy makers on how benefits from job creation in the region compared to potential health impacts, including on low-income communities and other vulnerable populations.[46,47]

LHD Spotlight: Maricopa County Department of Public Health[32]

In Arizona, Maricopa County Department of Public Health (MCDPH) obtained hospital data from the National Syndromic Surveillance Program BioSense Platform to implement a heat-related illness (HRI) syndromic surveillance system. Health facilities throughout the county transmitted data from patient records to the BioSense platform. To use this data, MCDPH standardized queries for HRI specifying MCDPH ICD codes and symptom terminology related to heat-illness diagnoses. They also identified "exclusion terms" to prevent non-heat-related cases from being misclassified. The system was validated by comparing emergency room visits identified by the query with the final diagnosis for each result. For more information, see the Heat-Related Illness Syndrome Query: A Guidance Document for Implementing Heat-Related Illness Syndromic Surveillance in Public Health Practice.[33]

The Maricopa County Department of Public Health (MCDPH) is no stranger to extreme heat. In 2005, 35 individuals died over a 9-day period of extreme heat. In response to extended periods of extreme heat, the county set up cooling centers. In order to ensure that these centers were accessible to the most vulnerable populations, MCDPH partnered with the Arizona Department of Health Services and Arizona State University to evaluate community access to and perceptions of cooling centers by surveying facility visitors and managers and observing use during an extreme heat event.

There are 58 private and public cooling centers in Maricopa County. The evaluation found that many cooling centers were open only on weekdays, primarily in community centers, senior centers, and religious institutions without clear or visible signs notifying the public of the availability of a cooling center. The survey also found that 84% of visitors were unemployed, 33% had no permanent residence, and 11% of those who indicated a permanent residence had no air conditioning at their place of living.

Maricopa County subsequently developed a Heat Relief Regional Network to mitigate heat health risks. The Network maintains an updated list of operational cooling centers and their availability and services on a publicly available map, hosts trainings provided by MCDPH and the local National Weather Service, and identifies new cooling center sites.[38]

- In 2016, a public health advisory panel in Oakland, California reviewed the potential health impacts from the proposed transport, storage and handling of coal through the city and in a former army base. The HIA demonstrated the significant increase in concentrations of fine particulate matter ($PM_{2.5}$) this transport and handling would have on surrounding neighborhoods that were already suffering adverse health outcomes from low air quality, poverty, and discrimination. It also highlighted the adverse health risks to Oakland residents resulting from burning the exported coal.[48] This HIA contributed to the decision of the city council to vote to ban shipment of coal from the city, a decision recently overturned in court.

Assessments of the Health Benefits and Harms from Climate Mitigation and Adaptation Strategies

Strategies to reduce carbon emissions may have health consequences beyond reducing pollutants that are generated when fossil fuels burn.

Three such strategies have large potential health co-benefits. First, substituting walking and cycling for short car trips facilitates physical activity, which is associated with reduction in mortality and morbidity due to cardiovascular disease, stroke, dementia, depression, and some cancers.[49,50] Second, substituting plant-based protein for red meat in the diet reduces farm inputs based on fossil fuels (e.g., fertilizers, pesticides, tractor fuel) and methane emissions from ruminants and their waste products. Lower red meat consumption also reduces risk for cardiovascular disease and some cancers.[51,52] A third strategy to achieve health benefits is from improving energy efficiency in residential buildings, particularly through weatherization and ventilation controls that reduce fine particulate pollution.[53]

The Oregon Health Authority carried out an HIA in the transportation sector, using the Integrated Transport and Health Impacts Model (ITHIM). ITHIM quantifies the health benefits and harms of regional transportation plans, mobility goals of state and local transportation agencies, and health-based goals.[54,55,56,57,58,59] This HIA demonstrated that replacing short car trips with walking, cycling and transit would reduce overall mortality and that this benefit is greater than that from air pollution reduction. However, these assessments also show the potential for increased pedestrian and cyclist deaths as walking and cycling increase until better infrastructure for these activities is built.[60]

Knowledge of health benefits and harms can inform jurisdictional partners as they put forward their comprehensive plans, regional transportation and housing plans, and hazard mitigation plans.

Other Intersectoral Collaboration

Increased coordination and data sharing among public health, environmental, meteorological, water, agricultural, emergency responder, and other agencies can facilitate better understanding of the climate impacts, how they are expected to impact infectious disease transmission, and who in your community is most at risk.[61,62]

For More Information

Resiliency and Asset Mapping

- U.S. Climate Resilience Toolkit - Assessing Health Vulnerability to Climate Change: A Guide for Health Departments and Social Vulnerability Index and Metadata Access Tool for Climate and Health (MATCH)[63,64,65]
- GlobalChange.Gov - Climate and Health Assessment[66]
- San Francisco Public Health Department - San Francisco Heat Vulnerability Index[67]
- Centers for Disease Control and Prevention - Preparing for the Health Effects of Drought: A Resources Guide for Public Health Professionals[68]

Example Vulnerability Maps

- San Francisco Flood Vulnerability Maps[69]
- Denver Heat Vulnerability Maps[70]
- Multnomah County Urban Heat Island Maps7[1]
- Minneapolis Climate Change Vulnerability Maps[72]
- Contra Costa Heat Vulnerability Maps[73]

Addressing Heat Vulnerability: Denver Department of Public Health and Environment

Denver Department of Public Health and Environment (DDPHE) plays an integral role in climate change activities in Denver city government. Equity and place are strong themes in Denver's climate action and adaptation plans and its community health needs assessment. DDPHEs *Health in All Policies* program developed a Neighborhood Equity Index based on socioeconomic factors, access to care, built environment, and mortality and morbidity data. In 2014, the City and County of Denver released its first climate adaptation plan identifying increased temperature and urban heat island effects, extreme weather events, and reduced snow pack as priority vulnerabilities. The plan proposed activities to reduce vulnerability and assigned responsibility to specific city departments.

In January 2016, DDPHE began the *Denver Neighborhood Climate and Health Vulnerability Project* (DNCHV), aiming to DDPHE build on its Health in All Policies approach to explicitly incorporate climate change into its work on the upstream determinants of health and engage with diverse partners to integrate climate, health, and equity across divisions and agencies. The goal of the project was to conduct geographically refined climate and health vulnerability assessments and connect them with established city neighborhood-level planning activities such as *Strong Neighborhoods* and *Denver Moves*.

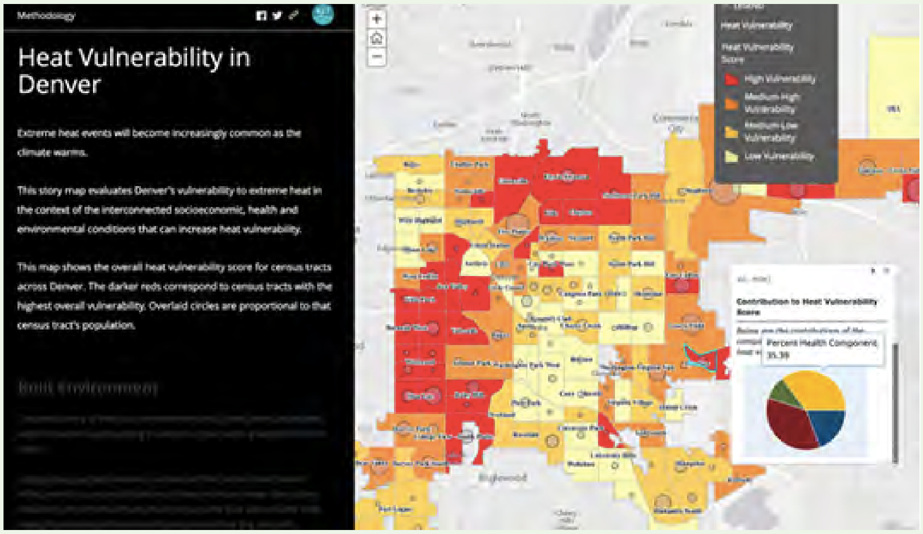
Moving the conversation from climate science to climate and health

DDPHE contracted to develop a heat vulnerability tool in which thirteen variables were combined into a heat vulnerability index using factor analysis. The analysis is displayed on a story map that shows census tract vulnerability to extreme heat in the context of the interconnected socioeconomic, health and environmental conditions that can increase heat vulnerability. The program then engaged with other local agencies and community based organizations (CBOs) to disseminate the tool widely for use in planning and policy development.

In partnership with the Trust for Public Lands (TPL), DDPHE hosted a community forum to discuss how to build a resilient Denver in the face of climate change. The Forum brought together a diverse group of health agencies, CBOs, and academic partners to enable partnerships to assess current health vulnerabilities to climate change and coordinate and prioritize interventions in the most impacted areas. DDPHE then co-hosted a series of climate, health, and equity walks, collaborating with the local Walk2Connect program. The walks provided an opportunity for Denver residents to join health department staff and local experts for fun physical activity on walks that showcased *Denver and Its Water, Denver's Urban Forest*, the *Green Roofs Initiative*, and *Gardening in Denver's New Weather*.

In summer 2018, DDPHE examined ways to create relevant messaging that connects climate change to injury prevention and other community concerns. DDPHE partnered with the National Highway Transportation Safety Administration to integrate climate change messaging into heat illness prevention public service announcements (PSA), which will be posted in 40 buses during the month of July. DDPHE also created PSAs for outdoor workers in collaboration with the Parks and Recreation Department and for pet owners in collaboration with Animal Protection division.

Future Work and Lessons Learned



Building on the success of the extreme heat vulnerability map to inform city plans, such as the Denveright Plans, the Ultra-Urban Green Infrastructure Guidelines, and the Neighborhood Plans, DDPHE will continue to disseminate the vulnerability map to partner agencies and organizations to prepare for extreme heat in Denver. Despite the challenges of limited staff capacity, DDPHE continues to work on systems and policy level changes to improve climate resilience and equity throughout Denver. Additionally, DDPHE plans to continue to identify existing messaging campaigns and seasonal health alerts to integrate simple climate change messaging.

Learn More

Department of Public Health and Environment - Heat Vulnerability

Key Action Steps:

- Build on existing *Health in All Policies* initiatives to integrate climate change and health and expand collaboration with new agency partners.
- Conduct a climate and health vulnerability assessment. Make accessible story maps based on the assessment to share with CBOs, policy makers, and other local agencies.
- Collaborate with local CBOs and other local organizations to host community meetings to share the CHEVA and discuss and prioritize community-driven climate resilience and adaptation strategies.
- Establish other avenues to continue community engagement around climate change, built environment, health, and equity (e.g., Walk2Connect).
- Continue meeting with other LHD program and jurisdictional agencies climate champions to support the *Health in All Policies* approach to climate change.
- Integrate climate change messaging into seasonal health messaging and established PSA

7.2 Community Engagement

"Building an equitable and just climate future will require that all our voices are heard, which also means that we should reject any efforts to diminish our political agency. We are, indeed, at a crossroads on how we will move forward to address one of the most challenging social and environmental problems in history. … The activism being undertaken by women, Indigenous, communities of color, and youth from around the world are leading the way in addressing climate change in just and sustainable ways…Achieving climate equity is about respect, inclusion and collective action."

– Dr. Cecilia Martinez, Center for Earth, Energy and Democracy[1]

A central tenet of patient-centered health care is "nothing about me without me."[2] The same principle applies in public health: community residents must be included in decisions that affect community health. Despite being disproportionately impacted by climate change, low income communities and communities of color have been, at worst, purposefully excluded from and, at best, under-represented in decision making that impacts their health and climate resilience. Climate justice and health equity require that the response to climate change is inclusive, transparent, and accountable.

Community engagement is a critical strategy to ensure that climate action optimizes health and equity co-benefits and avoids missed opportunities or unintended adverse consequences on disadvantaged communities. Community residents and community based organizations can share important information about assets and needs in their communities, nuanced history of neighborhood experience with heat, drought, and flooding, expert input about the likely acceptability and effectiveness of proposed strategies, and ideas for how government agencies can support and facilitate community efforts to build climate resilience and sustainability.

Community-Driven Climate Resilience Planning

- Improve infrastructure for community participation in decision making.
- Build authentic and equitable partnerships between local government and community-based organizations that bring expertise and capacity to build community leadership and facilitate the development and implementation of community- driven climate resilience solutions.
- Increase awareness of structural racism and other systemic issues contributing to disproportionate climate impacts.
- Create more comprehensive solution sets that address the root causes of climate vulnerability.
- Increase communication, coordination and collaboration across governmental agencies for effective disaster preparedness and for implementation of policy and systems changes needed to achieve climate resilience.

– National Association of Climate Resilience Planners[3]

There are many strategies for community engagement entailing a spectrum of involvement and control by the LHD and community, as shown in Figure 7.2.1 below. At all levels of the ladder, communication is critical in order to foster the trust and information-sharing necessary to develop solutions that work to meet community needs. Greater community participation is one measure of community climate resilience.

Figure 7.2.1: Ladder of Community Participation - Adapted from Contra Costa Health Services[4]

THE LADDER OF COMMUNITY PARTICIPATION

1. **HEALTH DEPARTMENT INITIATES AND DIRECTS ACTION**
   Local health department takes the lead and directs the community to act.
2. **HEALTH DEPARTMENT INFORMS AND EDUCATES COMMUNITY**
   Local health department shares information with the community.
3. **LIMITED COMMUNITY INPUT/CONSULTATION**
   Local health department solicits specific, periodic community input.
4. **COMPREHENSIVE COMMUNITY CONSULTATION**
   Local health department solicits ongoing, in-depth community input.
5. **BRIDGING**
   Community members serve as conduits of information and feedback to and from the local health department.
6. **POWER-SHARING**
   Community and local health departments define and solve problems together.
7. **COMMUNITY INITIATES AND DIRECTS ACTION**
   Community makes decisions, acts, and shares information with the local health department.

Conduct a scan to assess potential interest in climate change, health, and health equity. Look for current and new potential partners that address:

- Environmental justice, toxics, air pollution, water, farmland conservation, open space
- Healthy eating and active living, food justice, healthy food systems, transportation access and public transit
- Racial and gender justice, educational equity, economic justice
- Other community-based organizations in neighborhoods that have experienced climate impacts

Conduct outreach to local CBOs and community leaders to begin conversations regarding their interest and activities related to climate change, health, and equity.

- The Minneapolis and New Orleans Health Departments both mapped social and climate vulnerability and then identified community organizations in neighborhoods with higher levels of risk for climate-related health impacts. Formal agreements were made to compensate CBO staff for their time and knowledge in planning, recruiting for, and facilitating workshops held in the communities on climate change and health.
- The Seattle-King County Public Health Department surveyed and interviewed local community leaders to assess their interest in climate change and health and their perceptions and ideas about LHD involvement in addressing the health impacts of climate change. The results informed the *Blueprint for Addressing Climate Change and Health*, which will serve as a guide for LHD action on climate, health, and equity.

Meet potential CBO or community partners where they are: develop an understanding of their current priorities, concerns and challenges, membership and constituency, strengths and resources, and level of interest in climate change and health equity. Help to connect the dots between climate change and the issues various groups are currently addressing.

Recognize and acknowledge the inherent power dynamics between community members and government employees, and between people of color and White people and people with different educational and socioeconomic backgrounds. Provide space and processes—such as agreed on ground rules for meetings and opportunities for one-on-one conversations—to address those dynamics. Reflect on habits and patterns that perpetuate inequities and replace them with practices that support community empowerment.[5]

Share important information about how climate change impacts community health or the health benefits of actions to reduce GHGE. Listen respectfully to community residents who have much to share about their lived experience of climate change and health inequities, community strengths and assets, and how to improve community health in an equitable and sustainable manner.

Identify ways to build community capacity as you partner with CBOs.

- Share information and allocate resources transparently.
- Ask for input as you develop metrics or indicators for climate change and health, share data so that community partners can interpret it, and work with community partners to exhibit and communicate data in ways that are accessible and understandable to community residents.
    - In partnership with local community-based organization, Coalition of Communities of Color and the Portland State University Planning Department, the Multnomah County Health Department created a climate and health indicator tool built from input from community members.[6]
- Share decision-making with community partners
- Make sure that CBO partners and community members are aware of how their input and feedback will be used in LHD and other agency processes.
    - How will information from the community be used in a planning process or program implementation?

- Will the information be shared with other government partners?
- When they can expect to see the results of their participation.

- Establish fair and supportive mechanisms for participation when requesting CBO or community member participation in meetings or other partnership activities.
  - Compensate CBO staff and community members for time spent preparing for and participating in meetings, responding to surveys, providing feedback on reports, etc.
  - Provide food, childcare, and subsidized transportation.
  - Make sure to provide translation in relevant language at meetings, and to translate written materials for non-English speakers.
  - Address the needs of community members with communications impairments, e.g. disabilities such as blindness and deafness.
- Use collaborative Community-Based Participatory Research (CBPR) strategies to identify community challenges, use community knowledge, support community assets and develop community informed and relevant solutions (See Section 7.1—Surveillance).

Environmental Justice Principles For Policy Implementation At Regulatory Agencies[7]

The California Environmental Justice Alliance and its members developed the following principles to assess whether agencies are effectively integrating environmental justice (EJ) into their policy development and implementation. While most LHD functions are not regulatory in nature, the principles apply to all government agencies.

(1) **Prioritize and value prevention, human health and improving quality of life:** Impacts on health must be given full weight in decision-making, not overlooked in favor of business interests or cost effectiveness, as is often the case, and particular concern must be given to the health and well-being of residents in highly impacted neighborhoods.

(2) **Do no harm:** Regulatory agencies must commit to actions that do not further harms in environmental justice communities. The most egregious decisions are those that actively exacerbate environmental health and justice inequalities.

(3 **Prioritize environmental justice communities:** State regulatory agencies have a responsibility to address the historic legacy of pollution in low-income communities and communities of color. This goes beyond simply preventing future harms, but also providing redress for the impacts of long-standing, disproportionate burdens of pollution. There is an ethical, environmental and public health imperative to ensure environmental justice communities are prioritized for resources, programs, and receive special consideration within regulatory decision-making by state agencies.

Environmental Justice Principles continued

(4) **Meaningful community engagement:** Residents in environmental justice communities must have the ability and opportunity to inform design and implementation for policies that impact their health and quality of life. Many agencies use a flawed "decide, announce, defend," process whereby an agency determines and releases documentation on a policy devoid of any community input, engages with environmental justice communities in public discussions after-the-fact, and ultimately moves forward with implementing their initial proposed policy without incorporating significant feedback from environmental justice communities. Other times, community organizations and members are engaged in dialogue but agencies do not alter any decisions even after hearing significant feedback. Environmental justice communities must be engaged early, often and in a meaningful way.

(5) **Responsiveness:** Agencies must respond, and be willing to address, community concerns once they have been articulated rather than simply noting them in the public record. Without a clear commitment to responsiveness, community engagement efforts become a "check box" rather than a meaningful attempt to work with stakeholders in policy design and implementation.

(6) **Accountability:** Agencies must be accountable for any and all actions, or lack of action, commitments made, and decision-making processes that result in or perpetuate harm to environmental justice communities, related to the agency's area of jurisdiction.

(7) **Transparency:** Agencies must be clear in: (a) detailing the processes by which all decisions are made and regularly reviewing the processes to ensure accessibility by environmental justice communities, (b) disclosing all factors and stakeholders that inform and influence all decisions affecting all policies and projects, and (c) describing decisions made, in addition to upholding the principles of engagement and responsiveness outlined above.

(8) Proactive partnerships: To be truly stellar on environmental justice issues, agencies need to work proactively and in partnership with environmental justice communities and organizations to develop innovative ways of addressing key environmental justice issues.

For More Information:

- Contra Costa County Health Services - Community Engagement in Public Health[8]
- Urban Sustainability Directors Network - Guide to Equitable Community Driven Climate Preparedness[9]
- Center for Community Engagement & Service Learning - Community Organizing Handbook[10]
- International Association for Public Participation[11]
- Institute for Local Government - Inclusive Public Engagement[12]
- National Association of Climate Resilience Planners - Community-Driven Climate Resilience Planning: A Framework[13]

Supporting Community Resilience: Minneapolis Health Department

The Minneapolis City Council first established goals for greenhouse gas emissions in 2012 (now updated to an 80% reduction by 2050). The 2013 Minneapolis Climate Action Plan (CAP) focused on energy efficiency, renewables, reducing vehicle miles traveled and developing active transport infrastructure, and reducing the overall waste stream. However, the City did not start to actively consider adaptation and resilience until 2016 when the Minneapolis Health Department (MHD) and the Office of Sustainability (OoS) partnered with the University of Minnesota School of Public Affairs to conduct a climate, health, and equity vulnerability assessment. The goal of the assessment was to identify neighborhoods most vulnerable to climate-related heat and flooding, and work with local residents to develop community-driven strategies to increase resilience to climate-related changes and extreme events. Using indicators of social vulnerability as well as risk factors in the built and natural environments, the MHD/OoS team identified neighborhoods with underlying vulnerabilities that increase the risks due to climate impacts.

Bringing Science to People

The team then reached out to existing and new community partners in three vulnerable neighborhoods, and contracted with groups in each to work with City staff to organize a community climate and health workshop. Staff of the community based organizations (CBO) were compensated for their time spent working with MHD to plan, recruit for, and facilitate the community workshops, each of which included an overview of the health impacts of climate change, the specific climate, health, and social vulnerabilities of the neighborhood, a discussion of residents' experiences and ideas, and specific requests for LHD support and action.

CBO staff provided community connections, insight into issues of concern and community assets, and historical knowledge about prior events that impacted the neighborhoods. The success of the workshops was attributed in part to the willingness of the city team to share resources and decision-making with community residents. The workshops—and the process—increase both community capacity and social cohesion critical components of community climate resilience.

Building on the information from the CHEVA and the community engagement process, the MHD/OoS team contributed to the City's Comprehensive Plan to ensure that climate, health, and equity are prominently featured throughout and elevated as priorities across the City.

Future Work and Lessons Learned

The MHD/OoS team plans to provide continued financial and technical assistance to partner CBOs to organize additional community workshops focused on parental and family preparedness during extreme weather events. MDH is now participating in drafting and reviewing the City of Minneapolis Strategic Plan. For the first time, the plan will include information about the health impacts of climate change and the health and equity benefits of climate action, and an action step to increase community resilience through strategies that enhance social cohesion and build community capitals (See Section 6.5—Preparedness).

Learn More

Minneapolis Health Department - Climate Change Resiliency

Key Action Steps:

- Conduct a climate and health vulnerability assessment including climate and social vulnerabilities (See Section 7.1—Surveillance).
    - Reach out to other LHD programs/divisions and other city and county agencies to compile data (e.g. asthma ED visits, air quality, heat indexes, tree cover).
- Partner with local community-based organizations to hold workshops to review the CHEVA and brainstorm community-based solutions.
    - Provide funding to CBO partners and use their expertise to shape the workshops and expand resident capacity and engagement.
- Use resident insights and recommendations to inform LHD action on climate, health, and equity.
- Engage in local, regional, and LHD planning processes (e.g. climate action plans, strategic plans, community health improvement plans) to integrate health into climate planning and climate change into health planning.

7.3 Intersectoral Collaboration

As public health practice has deepened its focus on the upstream social determinants of health, it has also shifted from a siloed approach to a more collaborative "Health in All Policies" (HiAP) approach. HiAP is rooted in the recognition that the policies of non-health agencies have profound impacts on health and that integrating health into decision making across sectors is required for policy, systems, and environmental change to create healthy living conditions and opportunities for health for all. It brings together expertise, tools, and decision makers for effective health policy advancement based on five key elements: 1) promote health, equity, and sustainability; 2) support intersectoral collaboration; 3) benefit multiple partners; 4) engage stakeholders; 5) create structural or procedural change.[1]

To identify opportunities for intersectoral collaboration on climate change, health, and equity, ask:

- Which agencies are you already working with whom you can expand your collaboration to integrate climate-related work?
- What other agencies are currently addressing climate change efforts to reduce greenhouse gas emissions and/or efforts to prepare for climate impacts and reduce the effects on the community?
- Are there interagency initiatives that address climate change or impacts, and opportunities for LHD participation?
- Is any agency engaged in strategic planning related to climate change, for which you could offer to provide a health and equity lens and data?

Figure 7.3.1: Spectrum of Collaboration - Adapted from the Policy Consensus Initiative & National Policy Consensus Center[2,3,4]

COLLABORATION
Invites shared responsibility in decision-making and implementation.

ENGAGEMENT
Implies a more active partnership including opportunities for partners and stakeholders to propose solutions and choose priorities.

CONSULTATION
Provides for more specific information gathering for improved decisions, while explicitly reserving the decision-making prerogative.

INFORMATION EXCHANGE
Allows partners to guage reactions, gain insight into other viewpoints, and allay controversy or conflict due to misinformation.

Remember that building partnerships takes time. Be prepared to talk honestly with potential collaborators:

- What are their priorities, concerns, and constraints?
- Who are their partners and stakeholders?
- How do your interests and goals align?
- Why do you think it's important for the LHD to be involved?
- Does your partner have specific concerns about your involvement, or your perspective?
- What might the LHD bring to the table to help your new partner reach their objectives or strengthen a particular initiative or process?
- What specifically can you offer? (data, assistance with community engagement, information, contacts, staff resources)
- Is there something specific you want others to do? (integrate health data into their analysis, share resources)
- Are there specific opportunities for win-win climate action strategies with health and equity benefits (urban greening, local food systems, active transportation)?

Table 7.3.1 provides a few examples of potential opportunities for intersectoral collaboration for climate, health, and equity. Don't forget that robust community engagement and collaboration across programs and divisions within the LHD will strengthen your ability to partner effectively with agencies across the whole of government.

Table 7.3.1 INTERSECTORAL COLLABORATION FOR CLIMATE, HEALTH AND EQUITY

Opportunities	Policies & Programs	Agencies (city/county/regional)
Active Transportation	General and specific area plans Master walking and bike plans Safe Routes to Schools School siting Transit funding (route expansion, schedule expansion, operations, maintenance, reduced fares, youth transit passes, bus stop shading) Parks (location, amenities, funding, maintenance, programming) Trails development, maintenance Tree canopy and urban forestry (location, species)	Metropolitan planning and regional transportation organizations Planning, public works, transportation, parks, and forestry agencies School districts

Table continued on next page

Opportunities	Policies & Programs	Agencies (city/county/regional)
Healthy & Sustainable Food Systems	Farmer's markets (new, expanded, EBT) Community and school gardens Urban and peri-urban agriculture Healthy food retail Healthy food vending Food waste reduction Edible food donation Gleaning Farm to fork (school, hospital, other institutions)	Environmental health Planning and zoning, business development, agriculture, public works, parks, and waste management agencies School districts Community hospitals
Heat Adaptation	Tree canopy Parks, streams, and water features Hours/amenities/location of public cooling shelters Alerts and warnings School sports policies Cool and green roofs Cool pavements Prevention of utility shutoffs Home weatherization AC provision	Planning, public works, emergency management, parks, forestry, libraries, aging, building, social services, and law enforcement agencies School districts Hospitals Utilities
Flooding	Parks Trees Permeable pavements Green infrastructure (e.g. bioswales) Evacuation	Waste and sanitation facilities Planning and zoning, transportation, water quality, public works, waste and sanitation, and emergency management agencies

For More Information

- National Association of Climate Resilience Planners - Community-Driven Climate Resilience Planning: A Framework[5]
- APHA-CDPH-PHI: Health in All Policies Guide[6]

7.4 Organizational Capacity

Many local health departments recognize climate change as an important issue but are concerned that it's too complex to address without new and dedicated resources. But public health has a long history of taking on challenging emerging issues by building one step at a time on existing skills, resources, and relationships.

Building Organizational Capacity for Climate Change and Health Equity Efforts in LHDs

(adapted from NACCHO Local Health Departments Prepare for the Health Impacts of Climate Change[1])

- Assess current and future health impacts of climate and climate-related hazards in your jurisdiction.
- Develop a comprehensive plan to reduce and prevent health and equity impacts of climate change and increase climate resilience. Integrate local concerns and priorities, evidenced-based results and both mitigation and adaptation strategies.
- Increase cross-sector collaboration around climate change and health equity using a Health in All Policies approach.
- Engage in meaningful partnership with community residents, groups and organizations in climate change adaptation and mitigation efforts.

Getting Started: How ready is your LHD?

An informal assessment and scan may help to determine the level of interest, support, capacity, and resources for climate and health equity work, and to identify available information and potential partners. Many LHD staff have been surprised to learn how much climate-related activity is already occurring in their jurisdictions, and have built new partnerships based on shared interests in expanding climate work.

Climate and Health Equity Readiness and Capacity Assessment

(adapted from the Oregon Health Authority[2,3,4])

Internal

- Is departmental leadership committed to health equity and upstream public health?
  - Are these commitments reflected in the department's strategic plan? Are there upcoming program or department-wide strategic planning processes or community health assessments?
  - Has the department developed data and maps on health inequities?

continued on next page

Climate and Health Equity Readiness and Capacity Assessment *continued*

- Interest and support for climate and health work: Is there LHD leadership and senior management support for initiating work on climate and health equity? Are any staff currently interested in and knowledgeable about these topics?
    - o What resource might be available? e.g. local philanthropy interest?
    - o Is any funding available now or in the near future to support this work? Do any current funding streams allow integration of climate change and health equity, or could they?
    - o Can any interested staff devote some time each week to getting started?
- Collaboration: Are there mechanisms in the department that support learning and collaboration across programs? Is the department already engaged in Health in All Policies or other collaborative work with agencies in other sectors such as transportation, housing, agriculture, planning, parks, public works?

External

- Is there support for work on climate change in the jurisdiction broadly - e.g. among executive and elected leadership?
    - o Are jurisdiction leaders/managers engaged in work on climate change?
    - o Has your jurisdiction had experience with climate-related events, e.g. wildfires, floods, droughts?
    - o Are there other agencies nearby who are planning and/or taking action on climate change?
    - o Are local elected officials speaking about climate change (or against climate action)?
- Are there local people/resources that can help staff learn about climate impacts in your jurisdiction? e.g. Resilience or Sustainability office? Planning department? local NGOs? local academics?
- Community partnerships: Is the department working with community-based organizations who are concerned about or working on climate change and health equity?

o Are there potential new partners i.e NGOs, environmental justice organizations, academics, businesses - concerned about climate change and health equity?

- Are you familiar with any State laws and funding requirements that mandate or provide incentives for local involvement in climate change?

Depending on the informal assessment, think about how to use even limited capacity and resources to get started. If there is very little support or resources available, identify a couple of interested staff and work together to provide opportunities for staff and leadership to learn about climate change and health. Bring in a local speaker to talk about climate change that relates to a department priority, and use that for initial discussion about what your LHD might do. With management support, suggest conducting a survey to assess staff capacity and interest, or ask to provide an overview on climate and health at some routine trainings or staff meetings.

Understanding the nature of current and projected climate impacts in your region is an important first step to connect the dots between climate change and current LHD work. Look for existing climate assessments, and seek out organizations and individuals with information and expertise about climate impacts in your region.

Be opportunistic: Look for opportunities to connect with others who are interested in climate work, or to bridge current LHD work to climate change. Because climate change exacerbates health inequities and disproportionately impacts disadvantaged communities, and because health inequities and climate change share systemic causes, current work to address chronic diseases, the built environment, social determinants of health, and health and racial equity provide logical building blocks for work on climate change and health equity.

- Are there LHD efforts underway to promote policy and systems changes that also reduce greenhouse gas emissions (e.g. active transportation)? Talk to partners and stakeholders about how these changes have health and climate benefits.
- Has your community experienced climate-related events, such as extreme heat events? If so, talk to those in your department who were involved in response and recovery, or to emergency management agencies, about whether climate change may make such events more frequent or more severe.
- What climate-change related activities are your sister agencies engaged in? Has your jurisdiction done a climate action or climate adaptation or resilience plan? Has your mayor or local governing body signed on to any of the groups of elected officials that are supporting climate action, such as the C40 Compact of Mayors or We Are Still In coalition? Who are their community partners and stakeholders?[5,6]
- Is the LHD or local not-for-profit hospital starting a community health assessment process? Consideration of climate change impacts might be incorporated into that process, or included in the analysis of forces of change in the community. Macomb County Health Department collaborated with a stakeholder coalition to engage in the Mobilizing for Action through Planning and Partnerships (MAPP) process, subsequently incorporating the MAPP outputs indicating areas in which climate change and health could be addressed in the overall Macomb County Community Health Assessment.[7]
- Are any local health care systems engaged in reducing their hospital greenhouse gas emissions, reducing waste, procuring local and sustainable food, or preparing the health care system for extreme weather events?
- Which community-based organizations are engaged in activities directly related to climate change or in advocacy around healthy communities and/or health equity and social justice? Who in the LHD already works with them?
- Are there fossil fuels facilities or infrastructure in the jurisdiction and are there concerns about the health impacts of associated air pollution or water contamination? Has the LHD conducted an assessment of the health impacts?

Staff and Leadership Development

Few public health schools and health professional schools have yet integrated climate change into their curricula. This means that both LHD staff and leadership will need to deepen their understanding of climate change to build capacity to integrate climate change into LHD work.

Survey department leadership and staff to assess current perceptions of climate and health, and the role of LHD programs in addressing these issues. Develop staff and leadership training based on responses.

- Seattle—King County's Public Health Department developed key informant interview guides and survey instruments and interviewed department leadership and staff in Preparedness, Communications, Chronic Disease & Injury Prevention, and Environmental Health Services to assess current perceptions of the nexus between climate, health, and equity and the perceived role of public health. The interviews heightened awareness of the climate-health-equity nexus, and identified individuals interested in a Climate and Health Action Team.

Provide climate change, health, and equity trainings for leadership and staff and brainstorm potential entry-points for climate change in existing programs. Find nearby academics, staff from other agencies, or community partners with relevant expertise. Use this Guide and internet resources to provide more information.

- Faculty and students from the University of California, Los Angeles School of Public Health facilitated trainings on climate change and health for the Los Angeles County Department of Public Health. Participants identified climate impacts that may affect their programs or clients. These trainings served as the foundation for launching of a Climate and Health Workgroup that fleshed out a "Five Point Plan" outlining how LADPH can integrate climate change into its work.[8]

Integrate climate, health, and equity information and trainings into routine staff trainings and new staff orientation to support sustained institutionalization of climate change into LHD activities. New Orleans Health Department hosted an all-staff meeting on climate change, health, and equity as well as a training for Louisiana Health Department's Environmental Tracking Advisory Board.

Provide information to staff about local and regional conferences on climate change.

Develop a peer learning exchange with other LHDs.

- Several Colorado Front Range LHDs meet informally to discuss climate, health and equity priorities and action steps.

Seek to hire individuals who have a background in climate change and health equity/environmental justice.

Greater familiarity and expertise on the impacts of climate change and climate action on health and health equity is important, but promoting health in the era of climate change requires much more. Building LHD skills and capacity in health and racial equity, intersectoral collaboration, community and stakeholder engagement, and effective communication is also vitally important (but beyond the scope of this Guide) See additional resources below.

Organizational Structure

There is no "best" way to structure a climate, health, and equity program within a LHD. Climate change impacts all aspects of public health, so it is important to integrate it across departmental programs over time. It is also important fort LHDs to build relationships with local agencies likely to work to reduce GHGE, using a Health in All Policies approach, and develop partnerships with community-based organizations.

Integration across the LHD, intersectoral collaboration, and stakeholder engagement will be more effective with a "back bone" staff—staff designated at least part-time to coordinate climate-related activities across programs, facilitate the building of staff capacity, and build partnerships with other agencies and community-based organizations. Where this back-bone staff is placed depends on factors including the nature and scope of initial efforts, availability of staff resources and interest, level of commitment by leadership, and current levels of involvement in intersectoral collaboration. Basic administrative support will foster greater success.

Effective LHD climate and health initiatives have been led by staff in Environmental Health, Policy and Planning, Emergency Preparedness, Chronic Disease, and Epidemiology programs. In the California Department of Public Health, the climate and health program is located within the Office of Health Equity. The greater the level of visibility and leadership support for the work of the back-bone staff, the more that staff and external partners will understand that the LHD sees climate change as an urgent issue.

Strategic Planning

"A strategic plan sets forth what an organization plans to achieve, how it will achieve it, and how it will know if it has achieved it. The strategic plan provides a guide for making decisions on allocating resources and on taking action to pursue strategies and priorities."[9]

– Public Health Accreditation Board

Integrate Climate Change into LHD Strategic Planning

Strategic planning offers an ideal opportunity to engage in discussion across the programs about how climate change connects to what you are already doing, and to think through what your LHD can do to address climate change comprehensively. Incorporating goals for climate and health work and designating a responsible party for developing an action plan to meet those goals is critical to support sustained climate action for health within your LHD.

- The Philadelphia Department of Public Health's Preparedness Program established a Climate Change and Health Advisory Group. They engaged numerous divisions in their meetings, including Disease Control, Environmental Health Services, Ambulatory Health Service, Chronic Disease Prevention, and Air Management. The advisory group demonstrated the climate and health connection to each LHD program and reached leadership, resulting in the institutionalization of climate change as an objective in the department's strategic plan.[10]

Develop a Strategic Plan for Climate Change and Health

Development of a strategic plan focused on climate change, health, and equity work within LHDs is a foundational step for sustained action at the local level. Collaborating with division/program leads and motivated staff, local partners, and CBOs to develop priorities into action steps within a strategic plan can take LHD work to the next level.

- Public Health-Seattle and King County's (PHSKC) Climate and Health Action Team developed a *Blueprint for Addressing Climate Change and Health* that reflects the values and priorities of PHSKC, partner agencies, and community partners. The Blueprint builds organizational capacity to address climate change and health with equity as an overarching consideration. It covers climate and health impacts in King County, core public health functions, and strategies to develop internal expertise and assess opportunities to build on current work.

Build and Blend Funding

There is yet no dedicated funding stream for climate change and health. LHDs need to be creative in finding resources. Many LHDs have found that even very small amounts of funding can jumpstart activity and mobilize resources among community partners.

Use existing funding streams to provide resources for climate change work.

- Build work on climate change into proposed Scope of Work for funding from state and federal programs.
    - Propose a climate and health vulnerability assessment as a component of PHEP planning and assessment work.
    - Propose community outreach to prevent heat illness in people with diabetes in a funding proposal for diabetes case management.
- Integrate climate change into routine and new communications.

Talk to local foundations, many of whom are funding academics, environmental organizations, and others to work on climate change.

- Apply for a grant in partnership with local community organizations.

Partner with other agencies that are working on climate change to integrate health funding into their grants or contracts.

Use students, interns, and faculty at local colleges and universities.

- Students from the University of Minnesota worked with the Minneapolis Department of Health and Office of Sustainability to develop a climate and health vulnerability assessment.

For More Information

- Human Impact Partner's Health Equity Guide: Building Organizational Capacity Resources[11]
- Governing Alliance for Racial Equity: Resources[12]
- APHA-CDPH-PHI: Health in All Policies Guide[13]
- Contra Costa County Public Health: Community Engagement in Public Health[14]
- University of Kansas, Center for Community Health and Development: Community Tool Box[15]

A Blueprint for Equity and Justice: Seattle-King County Public Health

Public Health - Seattle-King County (PHSKC) has put the elimination of health inequities at the core of its mission. In 2015, after participating in the development of the King County Strategic Climate Action Plan, PHSKC staff formed a Climate Health Action Team (CHAT) to develop internal expertise on climate change and health, elevate the public health voice for climate action, and develop a strategic approach to PHSKC engagement on this critical issue. The team includes representatives from across the department, including Preparedness, Communications, Chronic Disease & Injury Prevention, and Environmental Health Services.

Building Capacity for Climate and Health

CHAT started with an assessment of internal and external perspectives on the role of public health in climate change. CHAT members conducted key informant interviews with 19 individuals on the Public Health Executive Team, as well as with leaders and staff of community-based organizations in disadvantaged communities. Several key themes emerged from these interviews plus two focus groups at community based gatherings and two surveys—one for PHSKC staff and the other for community stakeholders:

- **Knowledge:** While both PHSKC staff and community residents are aware of climate change and believe it is a health risk, they lack knowledge about specific impacts to health.
- **Priority:** Climate change is not seen as an urgent issue relative to other concerns.
- **Role:** PHSKC should take action and play a leadership role on climate change impacts on health. Action should be grounded in equity and in evidence, integrated into existing functions, and connected to community and to policy development.
- **Equity:** Work on climate and health must address equity and social justice, social determinants of health, at-risk populations, health in all policies, and increased preparedness and resiliency.
- **Collaboration:** Community representation and engagement are essential, including mechanisms to better participation in county decision making processes.

Source: Public Health Seattle-King County

Based on these themes, and with input from CBO partners Puget Sound Sage and Got Green, and from the County Climate Leadership Team, the CHAT team developed a PHSKC Blueprint for Addressing Climate Change and Health. The Blueprint discusses existing opportunities and gaps, outlines strategies to increase internal capacity, and identifies ways in which climate change can be integrated into existing public health programs and functions.

Additionally, CHAT recommended a series of climate and health trainings for PHSKC staff. The Climate Leadership Team requested that those trainings be made available to all county staff. Engagement of senior PHSKC leadership from the outset of the CHAT work has also helped to establish climate change as a priority within the executive team.

Complementary to CHAT's internal capacity building and community engagement efforts, they partnered with University of Washington to develop a comic zine series focused on extreme heat and heat coping strategies. The zine was designed to specifically reflect the cultural and ethnic diversity in the Chinatown-International District and Rainier Valley areas.

Future Work and Lessons Learned

Public health staff are now working with other agencies to determine the most relevant climate and health content for various county staff, and scheduling climate and health trainings across various agencies, to include issues such as storm water, food systems, air quality, extreme heat, and open space.

Learn More

- Beating the Heat, for Your Health

Key Action Steps:

- Establish a Climate and Health Action Team that includes representatives from as many LHD programs/divisions as possible. Include subject matter experts, CBOs, academic institutions, and other relevant stakeholders.
- Conduct interviews and/or survey LHD leadership and staff to assess current knowledge and perceptions about climate and health and LHD action on climate, health, and equity. Conduct interviews, surveys, and focus groups with CBOs, and stakeholders.
- Develop an internal and/or external guidance document for LHD climate action on health. Provide climate and health training for LHD staff and other local agency staff.
- Develop a series of public educational materials that are culturally linguistically appropriate and accessible.

7.5 Greening Local Health Departments

LHDs can implement many practices to lead by example and reduce their own carbon footprint, while contributing to improvements in community health. The National Academies of Science, Engineering and Medicine recommend that "every city should develop a cohesive sustainability plan," and many have already done so.[1] Find out what your jurisdiction and others in your region are already doing, and consult the many resources that are available on greening health care systems, businesses, schools, and government agencies that contain recommended practices that can be easily adopted and adapted for LHDs.

For example, in 2009 the Chattanooga Green Committee (TN) identified electricity production and transportation as the largest contributors of GHG in the region and established an ambitious goal to reduce GHG emissions by 20% by 2020 and 80% by 2050 compared to 1990 levels.[2] Initially the committee focused on increasing energy efficiency and renewable energy procurement, drawing upon nearby wind and solar farms; in 2012 the Chattanooga mayor issued an executive order mandating a 25% reduction in energy use by city departments and buildings by 2020. The committee, Mayor's Office, and other partners continue to advance their goals through green building initiatives, coupled with affordable housing and anti-displacement measures.[3]

Greening" your department reduces GHGE, creates a healthier work and community environment, and saves money through more responsible use of resources. Encourage all staff to be involved in green solutions to show that your department is leading by example to build a healthier and more sustainable community. Encourage all staff to be involved in green solutions and make climate change, health, equity more visible. This will show that your department leads by example and is building a healthier community.

Ten Reasons to Green Your Department

- Greening strategies reduce greenhouse gas emissions
- It promotes responsible use of resources
- Departments save money by lowering expenses
- It creates a healthier work environment
- It encourages teamwork by involving all staff in green solutions
- The climate change, health, and equity connections become more visible
- The department is seen as leading by example, because you will "walk the talk"
- It decreases air pollution, water consumption, and waste
- You can build a healthier community
- It helps to make sustainability a part of everyone's daily life

– Adapted from MyGreenDoctor.org[4]

Use "greening" as an opportunity to talk with colleagues, LHD leadership, and other agencies about climate change, its connection to health and equity, and why it's important for your jurisdiction to lead by example on climate action to improve and protect health.[5]

Establish a "Green Team"

The recommendations below are adapted from the Alameda County, California Green Ambassadors program.[6]

Some action steps require buy-in from senior leadership or other agencies, so it is helpful to seek leadership buy-in from the start by talking about the many benefits of greening the LHD.

Cast a wide net when inviting people to join or lead a Green Team: Green Teams provide an opportunity for staff in all classifications and across programs to work together for meaningful improvement in your work place.

- Use staff meetings and trainings to talk about the Green Team and recruit volunteers to participate. Reach out to other departments and programs in your LHD and request a few minutes during their staff meetings as well.
- Ask managers to send out an announcement about the first several Green Team meetings and to endorse use of work time to participate.

Ask if jurisdiction efforts are already in place to reduce waste, improve energy efficiency, transition to renewable energy, reduce vehicle miles traveled, or implement local and sustainable procurement practices. What resources or recommendations are available from others in sister agencies?

- Find out who is responsible for decision making in these areas, either within your LHD or in another agency, and share information with them about the health benefits of greening.

Identify goals and priorities—it may be helpful to think about ways in which greening relates to LHD goals or to a climate action or sustainability plan.

  - Alameda County encouraged employees to participate in a county Clean Commute Challenge that would also increase physical activity rates.
  - Los Angeles County Department of Public Health staff are developing proposals to adjust routes for staff who drive a lot for inspections or home visits to reduce miles traveled

Invite members from Green Teams from other agencies, institutions or LHDs in other jurisdictions to attend your meetings and share ideas for action.

Greening Actions

The Tables below provide recommendations for actions to green your LHD related to energy, transportation, waste, and procurement, ranging from those that can be taken by individuals to others that will require more coordination, support and authorization from LHD and jurisdiction leadership.

Table 7.5.1 ENERGY CONSERVATION, ENERGY EFFICIENCY, AND CLEAN ENERGY *(SEE SECTION 5.2—ENERGY)*

- Train staff on energy conservation and efficiency practices
  - Turn off lights, computers, monitors, fax machines, copiers, and printers when not in use
- Work with operations and facilities managers to adopt and implement sustainable, healthy energy practices.
  - Reduce "plug" load in LHD offices by removing personal equipment such as desk lamps and space heaters or installing smart power strips[7]
  - Set thermostats to 74°F (23°C) in the summer and 68°F (20°C) in the winter, put reminder stickers on thermostats, and inspect weekly[8]
  - Audit and monitor building energy use[9]
  - Regularly replace air filters and clean cooling towers to maximize equipment performance.
  - Replace all fluorescent lighting with LED lights.
  - Implement energy efficiency and toxics reduction protocols for custodial and cleaning services[10]
  - Develop and implement a financing plan and schedule for energy retrofit projects[11,12]
  - Use cool and green roofs on new roofs and repairs
  - Purchase energy efficient equipment
  - Incorporate natural ventilation and lighting in new or remodeled buildings
  - Use non-potable water for landscapes[13]
  - Procure renewable energy

Table 7.5.2 SUSTAINABLE AND ACTIVE TRANSPORTATION *(SEE SECTION 5.1—TRANSPORTATION)*

- Encourage and incentivize staff to use transit and active transportation to commute to work.
    - Provide discounted or pre-tax fare cards, showers and locked bicycle storage, and discounts on bike share.
- Support planning and financing of safe active transportation infrastructure (bike lanes, trails, sidewalks).
- Provide a shuttle service from public transit for employees, clients, and visitors to reach your facilities without driving.
- Expand opportunities for telecommuting and allow schedules (e.g. 4 day/10 hour) that reduce commuting.
- For workers who drive to inspection sites or home and provider visits, consider the use of vehicle routing and scheduling apps and scheduling trips so that first and last work assignments are closest to employees' homes, to reduce vehicle miles travelled.
- Limit parking availability, and offer preferred parking for vanpool/carpools
- Install EV charging stations in parking areas and offer preferred parking for electric vehicles.
- Invest in electric vehicles when making fleet upgrades; use low-carbon fuels until then.

Table 7.5.3 HEALTHY AND SUSTAINABLE FOOD *(SEE SECTION 5.3—AGRICULTURE)*

- Encourage staff to eat less meat by providing information about the health and climate impacts.
- Source vegetarian meals from local, sustainable, underrepresented community-based caterers for meetings and events.
    - Creating partnerships will local businesses and farmers for local will reduce transport-related emissions of the food you serve, reducing overall emissions from agriculture systems.
- If your department operates cafeterias or hospitals, implement purchasing/procurement guidelines for healthy foods and provide information to patients, clients, and visitors about healthy and sustainable food. See Health Care Without Harm's Purchasing Considerations—A Supplement to Redefining Protein—Adjusting Diets to Protect Pubic Health and Conserve Resources.
- Establish food waste prevention initiatives (e.g. trayless dining in cafeterias)
- Establish surplus food recovery or donation program in partnership with local non-profit hunger relief agencies.
- Establish composting or food/organics waste recycling program (e.g. partner with local farmer to divert food waste from the waste stream to compost or animal feed)

Waste Reduction, Procurement

Waste production leads to direct greenhouse gas emissions from incinerators and landfills, while also increasing emissions related to the extraction, transport, and processing of raw materials and to manufacture the products.[15] (Tables 7.5.3 and 7.5.4)

- According to the EPA, if the amount of waste generated in the US was reduced to 1990 levels, greenhouse gas emissions would be lowered by 18 million metric tons of carbon equivalent[16]
- Government procurement has immense power to direct public funds to particular food and service providers within a local economy.[17]

Table 7.5.4 WASTE REDUCTION

- Use compostable or reusable dishware in office kitchens and for meetings and events.
- Eliminate the use of bottled water for meetings and events whenever possible.
  - Provide hydration stations in office buildings, clinics, and hospitals.
- Work with operations and facilities managers to adopt and implement waste reduction practices
  - Conduct a waste audit and create a "Waste Management Plan" and strategies to incentivize reuse, recycling, and composting, such as easily accessible bins for recycling and compostable waste.
  - Implement procurement policies that favor office and medical supplies with lower environmental impact, such as those made from 100% post-consumer products.

For More Information:

- National Association of Counties, Green Government - Creating a Green County Team[18]
- New York State Department of Environmental Conservation - How to Boost Energy Efficient in Municipal Facilities/Operations[19]
- International Council for Local Environmental Initiatives - Virtual Library[20]
- Institute for Local Government - Sustainability Best Practices Framework[21]
- The City Fix - Seven Ways to Encourage Sustainable Community in Your Workplace[22]
- Health Care Without Harm - Purchasing Considerations[23]
- Practice Greenhealth[24]
- My Green Doctor[25]

Building Capacity: Los Angeles County Department of Public Health

The Los Angeles County Department of Public Health (LADPH) is the largest local health department in the nation, servicing over 10 million extremely diverse residents. LADPH appears to be unique among local health departments as it has employed a full-time staff member dedicated to coordinate the department's climate change and health efforts since 2014.

The first activities of the LADPH Climate and Health program focused on education and planning. In collaboration with the University of California Los Angeles Fielding School of Public Health, LADPH sponsored a sixteen week workshop series, open to all staff, that provided a comprehensive overview on climate and health, and offered staff an opportunity to brainstorm about how LADPH could expand its work on climate change and released a public-facing report on Your Health and Climate Change. The department also developed a Five Point Plan to Reduce the Health Impacts of Climate Change, which established 5 key priorities: 1) inform and engage the general public about the nature of climate change and the health co-benefits associated with taking action to reduce carbon emissions, 2) promote local planning, land use, transportation, water, and energy policies that reduce carbon emissions and support the design of healthy and sustainable communities, 3) provide guidance on climate preparedness to local government and community partners to reduce health risks and create more resilient communities, 4) build the capacity of departments staff and programs to monitor health impacts, integrate climate preparedness, and improve climate response, and 5) adopt best management practices to reduce carbon emission associate with department al facilitate and internal operations.

In 2015, LADPH sought to expand its climate change work through more intentional engagement of senior management and formation of a cross-department Climate and Health Workgroup. Staff met with 19 LADPH executive staff who were engaged in discussions on how their divisions and programs were addressing climate change, how they could enhance those activities, and who they would nominate for the workgroup In June 2016, a 22-member intradepartmental workgroup was established with representatives from the public information office, operations/facility management, chronic disease prevention and health promotion, environmental health and emergency preparedness, nursing, veterinary health, communicable disease control, health assessment and epidemiology, children's medical services, and women's health. Over the course of the next year, the workgroup identified 25 specific objectives based on the overarching Five Point Plan, guiding the work described below.

The Climate and Health Program also worked with an interagency group to address urban heat islands. LADPH has chaired a multi-agency intersectoral Healthy Design Work Group since 2012. That group created the LA Climate Committee—chaired by LADPH and comprised of Beaches and Harbors, Internal Services, Fire, Parks and Recreation, Public Works, and Regional Planning, specifically to develop an urban heat island reduction plan. The Urban Heat Island Reduction Plan outlines four strategic areas: 1) expand and maintain the urban forest, 2) promote cool roofs, 3) increase urban green space, and 4) promote cool and permeable pavements. Simultaneously, the Committee is also developing an outreach strategy to gain feedback and buy-in for the Plan from key stakeholders.

From 2017 to 2018 the Climate and Health Workgroup developed an Extreme Heat response Framework that outlines objectives and strategies that improve the department's preparedness and response for extreme heat, in order to help protect the public from the health impacts of extreme heat events. The strategies within the Framework reflect the importance of increasing accessibility to information and resources for vulnerable populations. For example, "Objective 1: Target Vulnerable Populations" includes strategies such as "1.2 Partner with organizations serving vulnerable persons to disseminate heat safety information and best practices." Other strategies address accessibility and distribution of cooling centers.

Though a partnership with the LA Department of Parks and Recreation's Parks After Dark program, set up booths at Parks After Dark resource fairs to engage with community members about extreme heat and distribute information about extreme heat resources such as maps to nearby cooling centers. Complementary to this community engagement effort, LACDPH published two articles in the physician newsletter, Rx for Prevention, on climate change, health, and the role of providers.

Future Work and Lessons Learned

Based on the robust foundation of internal capacity building, the LACDPH plans to expand their reach to more robustly engaging with the County's Board of Supervisors. In Summer 2018, LACDPH plans to deliver customized climate change and health presentations to each Board office in order to convey the specific climate, health, and equity impacts for unique populations and constituents.

Additionally, LACDPH plans to continue to engage in the Parks After Dark program to enhance the community engagement process regarding extreme heat.

KEY ACTION STEPS:

- Develop a climate and health training or workshop for LHD staff to increase interest and capacity within the LHD. See LADPH workshops sessions.
- Seek input from LHD leadership and staff to assess current climate and health knowledge and identify potential entry points for climate and health work
- Implement a climate and health work group with participation across LHD programs.
- Develop a plan that includes actionable steps for each LHD program/division to implement in order to meet shared goals
- Collaborate with other county agencies to identify venues and events for public outreach regarding climate and health.

Learn More

- Los Angeles County Environmental Health Division - Climate Change and Health
- Los Angeles County Climate and Health Workshops (LA Regional Collaborative for Climate Action and Sustainability)
- Los Angeles County CalBRACE Climate and Health Profile
- California Department of Public Health's LACDPH Case Story

Climate and Health Communications

"The main thing we can do about climate change right now is talk about it."[1]

– Bill Nye the Science Guy, 2016

Communicating about climate change and health requires the same public health communications skills that local health departments deploy every day in communicating about other complex public health issues. This section provides a brief discussion of crafting climate and health messages, some tips on climate and health communication, ideas about what LHDs can do to expand communication on climate and health, and sample language to integrate climate change into routine LHD messages.

The Role of Local Health Departments

Communicating accurate and timely public health information in a manner that can be interpreted appropriately and acted on by individuals, policy makers, and society is a core function of public health.[2] As trusted sources of health expertise, serving the most vulnerable and impacted communities, LHDs are uniquely positioned to help people understand that climate change is a serious and urgent health challenge and exacerbates health inequities, and that taking action on climate change benefits health. Local health departments have a professional responsibility to inform communities about the health risks of climate change and how to lessen them, and to foster and support climate action.[3]

Climate science ***is*** complex and there ***are*** many unknowns about our climate future. But you do not need to be an expert on climate science nor be able to forecast precise future impacts to talk about climate change and health. Most people in the U.S. already believe that climate change is happening.

"It turns out that the results of the fundamental material science of the environment are not sufficient to change enough brains."[9]

– George Lakoff

However, information alone is not sufficient to build the social and political will to vigorously tackle climate change. Prior public health success stories (think tobacco) demonstrate that social transformation requires a communication narrative that moves people to action and is linked to strategies for policy and systems change. Building will for climate action requires that more people connect climate change with their own lives and values, see change as possible, and see paths to join with others to take and demand action.[10] Effective communication is informed by impacted communities and serves to ***support*** advocacy and organizing to advance a robust agenda for change.

What Americans think about climate change

70% of Americans age 18–34 and 56% of Americans age 55 and older are worried about climate change and believe that global warming is happening, and more than 40% say they have personally experienced the effects of global warming.[4,5,6] Over 95% of Americans, agree (78% strongly so) that we have a moral responsibility to be good stewards of nature.[7] See the Yale Climate Opinion Maps to learn more.[8]

We're In This Together

"Yet if we ignore the dynamics of race and power, we are unlikely to devise climate solutions that benefit those who are most impacted or ensure solutions accessible to all. And if we do not hear, engage, and authentically include those most impacted, we will not benefit from the knowledge and ingenuity required to build climate resilience and move toward a just transition. ***The tension between transactional/technical and transformative approaches to climate change solutions informs very different communications strategies.*** Technical solutions alone will not achieve a society that is sustainable, equitable, and more harmonious with nature. That will require real democracy, full inclusion, and a social movement that addresses justice and climate change together."[11]

– Makani Themba

People interpret information through the lens of their own values and cultural identities. A core value underlying today's public health practice is that health is a ***collective*** responsibility. It takes societal and governmental action to make the policy, systems, and environmental changes required to address health inequities and the social determinants of health.

Frames are "interpretive storylines that set a specific train of thought in motion, communicating why an issue might be a problem, who or what might be responsible for it, and what should be done about it".[12] In the United States, the starting point for most people—their default frame— is that individuals must solve problems for themselves without involvement from government. This "you're on your own" frame focuses on what individuals can do in their own lives and households, and minimizes the importance of collective action for policy and systems change.[13]

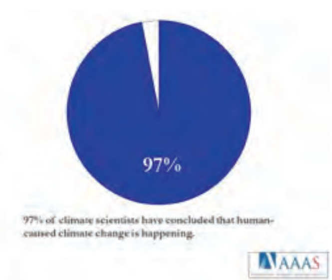
Public health communicators must start with a narrative of cooperation—"we're in this together"—that rallies people around a common cause, reframes the response to a problem from "What can ***I*** do?" to ""What can ***we*** do?" and helps people see how they can participate as ***social*** actors in defining problems and implementing solutions.[14]

Climate and Health Messages

There are many frames used in climate change communications, including environmental (glaciers and polar bears), economic, national security, preparedness, and health.[16,17] Fortunately for LHDs, there is evidence suggesting that a health frame engenders support for climate action.[18]

Climate and health messages are constructed like other public health messages. No single message can incorporate all of the information about climate change or its many solutions, but it is helpful to include language that reminds people about the scientific consensus on climate change.[19,20]

- **97% of scientists agree:** human caused climate change is happening



Public Health Messages[15]

- Establish or trigger an "environmental frame" that the places people live, work, and play affect their health.
- State values that allow people to connect your message with commonly held values such as fairness, opportunity, efficiency, and equality.
- State the problem and solution clearly so that the audience understands the need for unified societal action and specifically what you want them to do.

Environmental Trigger + Solution + Values = Public Health Message

Here's an example of a public health message that begins with an environmental trigger and uses the values of fairness and opportunity to promote more parks.

"Well-maintained parks provide people with safe places to play and be active. It's not right that children in some of our neighborhoods have plenty of nice parks and playgrounds nearby while others have none. That's why we are working with the Parks Agency to make sure there are sufficient funds to build new parks and playgrounds so that all children in our community have the opportunity for safe play and physical activity."

Climate and health messages:

- Establish or trigger an "environmental frame" to remind people that our health and well-being depend on clean air and water, healthy food, and a stable climate.
- State your values to allow people to connect your message with shared values such as fairness, opportunity, protection, preparedness, equality, responsibility, leaving the world a better place for our children.
- State the problem and solution clearly so that your audience understands the need for unified societal action, and specifically what you want them to do and when you want them to do it.
- Affirm that scientists agree that climate change is real, human caused, harmful, and solvable.

Environmental Trigger + Solution + Values + Scientists Agree
= Climate and Health Message

Here are some examples of climate and health messages that use this message equation.

Fossil fuels, air pollution, and climate change

Everyone should have the opportunity for good health and a long life, but pollution from burning dirty fossil fuels for electricity is stripping whole communities of that opportunity. Pollution is dirtying the air, and scientists agree that burning fossil fuels is causing harmful climate change. At the health department, we have a responsibility to *protect our children, seniors, and most vulnerable communities from the health effects of air pollution and climate change. It may seem daunting but in fact we can make headway by supporting the city council proposal to put solar panels on all city buildings. That will speed our transition to clean and renewable energy, reduce our reliance on dirty fossil fuels, and improve our community's health.*

Diesel pollution, climate change, and asthma

Our job at the health department is to protect the health of everyone in our community, particularly those who already bear disproportionate health burdens. Children in the Longview neighborhood are exposed to diesel pollution from nearby roadways and it is making them sick. Our latest data show that Longview children have higher rates of asthma than children in other parts of the city, and that they are missing school due to asthma attacks. This isn't surprising since older diesel trucks spew out air chemicals that cause air pollution. 97% of climate scientists agree that climate change is already happening and climate change also makes air pollution worse. Fortunately we have something we can do right now, in our own backyard, that will help the planet and help the children in Longview. A new low-interest loan program to help truckers purchase new, clean engines could significantly lower diesel pollution exposure in that neighborhood and increase economic opportunity.

Trees, urban heat islands, and equity

97% of climate scientists agree that climate change is happening now, and we can see that here in Warm Springs where our summers are getting hotter. Our job in the health department is to protect people from extreme heat—especially children and the elderly. Trees provide cooling shade and reduce the risk of heat illness. It's not fair that in some Warm Springs neighborhoods there are plenty of trees while others have almost none. We need your support so the health department and public works can work together to train youth to plant trees in tree-poor neighborhoods.

Climate change and meat consumption

We all have a responsibility to protect our children and their future. One easy way we can do that is by serving less meat to our kids. Eating too much meat increases the risk of heart disease. And meat production causes climate pollution. Scientists agree that climate change is happening and that it's going to get worse if we don't do something about it. We're asking the PTA to work with the Longview school district and us to start a Meatless Mondays program. Help our kids learn to eat healthy and fight climate change at the same time.

Climate change and safe routes for bicycling to school

Car pollution is now the biggest source of climate pollution in our state and 97% of scientists agree that climate pollution is causing climate change now. When children bike to school, there's no climate pollution and kids are more physically active. But in too many Los Carros neighborhoods, there's so much traffic that parents are afraid to let their kids bicycle. All of our kids should be able to safely bike to school so that they can be more physically active and we can reduce climate pollution. That's why the City Council put Measure X on the ballot to raise money for more protected bike lanes—it's a win for health and for the climate.

The Tobacco Industry and the Fossil Fuels Industry

Public health initiatives have faced aggressive attacks from powerful industries eager to protect profits in the face of public health efforts to promote health. Exhibit one is the multi-decade public health battle against the money, political power, and manipulation of Big Tobacco. The tobacco industry paid scientists to produce studies showing that smoking was not harmful and launched a well-funded public relations strategy to spread doubt about the increasing scientific evidence of tobacco's harms, attacking the credibility of science in general.[1] A 2006 ruling found three major tobacco companies guilty of racketeering and ordered them to issue corrective statements to the public on the health impacts of smoking.[2] More recently, the tobacco industry has targeted advertising at youth, low income, and communities of color, contributing to the persistent inequities in smoking-related deaths.[3]

> "Doubt is our product, since it is the best means of competing with the 'body of fact' that exists in the minds of the general public"[4]
>
> *Brown and Williamson internal memo, 1969*

There is strong evidence that for decades the fossil fuel industry also organized and financed a misinformation campaign to discredit the science of climate change and its impacts, undermine trust in the level of scientific agreement, equate climate science and climate action with a liberal political agenda, and cast doubt on the capacity to reduce fossil fuel use without exorbitant costs and at the expense of global development.[5,6,7,8,9] A 2013 study described a complex web of organizations funded to cast doubt on climate science and to obscure the connection between this effort and the fossil fuel industry.[10] As early as 1996, Mobil Oil made plans to account for sea level rise "due to global warming" in their offshore oil rig constructions while publically claiming that climate science was too uncertain to merit a response.[11,12]

Like the tobacco industry before it, the fossil fuel industry is targeting youth and communities of color that are disproportionately impacted by climate change and by more direct impacts of fossil fuel combustion. *Fueling U.S. Forward* is a Koch-funded campaign aimed at black voters purporting that they benefit the most from cheap fossil fuels and have the most to lose if energy costs rise.[13] The industry has spent tens of millions to fund curriculum and outreach materials that promote fossil fuels to K–12 students.[14,15]

Tobacco industry denormalization played an important role in successful anti-smoking campaigns. A key turning point in California's landmark anti-tobacco campaign was the decision to directly challenge the tobacco industry.[16] Denormalization rests on the "… fundamental and irreconcilable conflict between the tobacco industry's interests and public health policy interests."[17] It helps to erode industry's power to thwart tobacco control and to enhance public support and political will to tackle the reforms needed to end the tobacco epidemic.[18]

California's anti-tobacco social marketing campaign successfully:[19,20]

- Redefined tobacco from an individual problem (smoking) to a public issue (tobacco) to make room for a shift toward collective solutions through policy and environmental change.
- Shifted from blaming the smoker to focus on the need for rules that hold the tobacco industry accountable for the death and disability it has caused.

Continued on next page

The Tobacco Industry and the Fossil Fuels Industry *continued*

- Denormalized the use of tobacco
- Exposed industry as the "vector of disease" and showed how the industry was harming people in the pursuit of profit. An honest portrayal of the tobacco industry played a critical role in building public support for anti-tobacco policies at all levels.

To date public health communications on climate and health have not adopted an industry denormalization approach that exposes how the fossil fuel industry has knowingly deceived the public and imposed potentially catastrophic health and climate harms. A broad climate and health social marketing campaign that builds on lessons from successful public health campaigns is much needed.

Climate Communication Tips[21]

Keep these points in mind as you craft your climate and health communications:[22]

- Climate messages and communications strategies that integrate community knowledge, values, and beliefs can build a narrative of positive, transformational change and help to ensure that climate action builds toward a more just, equitable, and sustainable world. Talk to community residents about how they see the impacts and causes of climate change and what kinds of changes they want in their communities that will address their concerns ***and*** climate change.
- Communications serve to support strategy; the message is not an end in and of itself.
- Make it normal to support ***societal*** climate action instead of placing blame on the individual. Instead of saying "You need to reduce your carbon footprint", say "Communities across the state are taking steps to reduce carbon pollution and protect residents from the health harms of climate change."
- Ensure communications are culturally appropriate, available in multiple languages and low literacy formats.
- Use print and broadcast media, including ethnic, non-English, and very localized media; social media; telephone call-lines; print and broadcast marketing (bus ads, billboards); public forums and meetings. Pima County Health Department placed heat safety posters in local buses.[23]

Source: [Pima County Health Department]

- Use multiple messengers: weather forecasters, health care providers, school teachers, local business owners and service providers, youth, and community leaders.
- Repeat the message often.

"The most effective communication strategies are based on simple messages, repeated often, across multiple communications platforms, by many trusted messengers."

– Ed Maibach, George Mason University Center for Climate Change Communication

- Be consistent in what you say to different audiences, even if you say it differently.
- Try to use plain English:
    - Don't say "greenhouse gas emissions" when you can say "carbon pollution."
    - Say "clean energy" or "solar and wind energy" instead of "renewable energy technology" or "decarbonizing our energy system"
    - Talk about "preparation" for climate change rather than "adaptation" to climate change
    - Use the CDC "plain writing" guide[24]
- Use visuals that clearly convey the message
- Work with other agencies to harmonize messages
    - People may be confused about what to do when a health department alert cautions against outdoor activity on extreme heat days and air quality agencies ask people to "spare the air" by not driving on poor air quality days—often the same days!
        - "When it's really hot and air quality is poor, try to limit outdoor activity to early morning and evening, and use public transit instead of driving in mid-day."

- Work with other agencies to ensure common terminology and consistent messaging. For example, Philadelphia Department of Public Health recently convened all city departments that communicate or interact with the public about extreme heat and decided to use only two terms: “heat caution” and “heat health emergency.”

Make climate change salient

Humans have evolved to prioritize immediately tangible threats over seemingly abstract risks.[25] Many people still see climate change as something that is distant in space and time—“not here, not now, not me,” although that is changing as more communities experience devastating climate-related disasters.

- Show how climate change has already affected your jurisdiction. When people see climate change as a ***local*** issue, they are more likely to describe it as ***personal*** issue.[26,27]
- Tell stories about people’s personal experiences with the impacts of change. Use pictures, especially pictures of real people that have been affected by droughts, floods, wildfires, and storms.
- Extreme weather events create a “moment of proximity and heightened awareness” and an opportunity to start conversations about climate change and real climate solutions.[28]

Convey urgency

Climate science and the accelerating pace of climate change demonstrates that each day of inaction increases the risks of catastrophic climate change, but any discussion of a climate emergency is currently missing from the mainstream public domain. To convey the urgency of robust climate action, provide analogies that can help people understand that action now will prevent future harms.

> “Think about a chronic smoker. At age 20, he thinks he’s invincible, that cancer won’t happen to him. By 45, with early COPD, he’s addicted and assumes quitting won’t help him anyway. When he’s got lung cancer at 65, it’s too late. As a society, we’re like the 45 year old—we’re addicted to fossil fuels, we see the signs of harm, but we’re still not taking the actions needed to prevent a very bad outcome. The difference is that the smoker imperils himself and those around him, while our societal failure to act imperils us all. We can take a different path toward a healthy future if we act swiftly.”
>
> *– Linda Rudolph, Center for Climate Change and Health*

- Talk about climate change as an informed choice between better and worse outcomes: “… inaction is itself a choice in favor of severe climate change.”[29]
- Offer information about how the climate is already changing (See Section 3—Climate Change 101).

Always follow the message about the urgency of climate action with the message that solutions are available and being pursued now.

Recognize complexity and uncertainty

Climate science ***is*** complex and there ***are*** many unknowns about our climate future. But you do not need to be an expert on climate science nor be able to forecast precise future impacts to talk about climate change and health. Rely on the scientific evidence and knowledge of experts, as all health professionals do when addressing any issue outside of their own specialty.

"The science linking human activities to climate change is analogous to the science linking smoking to lung and cardiovascular diseases. Physicians, cardiovascular scientists, public health experts and others all agree smoking causes cancer. And this consensus among the health community has convinced most Americans that the health risks from smoking are real. A similar consensus now exists among climate scientists, a consensus that maintains climate change is happening, and human activity is the cause."

American Academy for the Advancement of Science, "What We Know."[30]

- Reinforce what is known.
    - 97% of scientists agree that climate change is happening.[31] "That's enough for me as a public health professional to focus on how we can help to keep people from being harmed by it."[32]
    - Surveys show that physicians in many specialties are already seeing the impacts of climate change in their patients.[33,34,35,36]
    - The health harms of climate change and health benefits of climate action are well documented (See Sections 3—Climate Change 101, 4—Health Impacts, and 5—Health Benefits).
- Acknowledge but don't overstate uncertainty. Scientists are sure that climate change is happening, and that it is causing major impacts, but there are still uncertainties about how quickly impacts will occur or whether every storm or wildfire is due to climate change.[37]
    - When speaking about a particular extreme event, lead with what is known about how climate change is affecting that type of event; add information, if available, about the attribution of similar events to climate change.[38]
- Frame uncertainty as a reason to act.[39] "We need to hedge our bets rather than waiting so long to see exactly what happens that it will be too late—or far more costly—to deal with the impacts."
- Use health analogies to emphasize the importance of action despite some level of uncertainty regarding the specific climate impacts. "If you were given a cancer diagnosis and told that it is 'very likely' that it will progress without treatment, would you wait to see what happens?"

Offer hope

Many people are motivated to take action when they hear a doomsday message about climate change, and it's important to be honest about the magnitude of the problem.[40] But too much emphasis on climate impacts can leave some people feeling overwhelmed and powerless, leading to disengagement rather than action. It is essential to offer hope, the most consistent driver of intentions to engage, support policies, or change behavior.[41] The best way to offer hope is to show that we can tackle climate change together, using available and effective solutions that offer important health benefits.

- Give people information that lets them reason their way to solutions: "When we burn fossil fuels it emits carbon dioxide into the air that traps heat like a blanket and disrupts the climate."[42] "Cows produce methane—a potent climate pollutant. When we eat a lot of beef more cattle are raised."[43]
- Show positive things real people in your community are doing to fight climate change, including images of solutions in action.[44]

- Emphasize the health benefits of climate solutions to make climate action an obvious solution. Show how clean energy, active transportation, healthy food, and community greening are good for health (See Section 5—Health Benefits).
- Remind people that we've tackled big problems before and we can do the same for climate change.
  - We reduced infant and maternal mortality by 90% and 99% respectively since the 1900s, due to a broad range of interventions including better hygiene and nutrition, antibiotics, greater access to health care, and advances in maternal and neonatal medicine. (Of course, much more remains to be done to address huge inequities in premature births and maternal mortality, demonstrating the need to integrate equity in our strategies to address a broad range of health issues, including climate change).
- Activate cooperative values and provide normalizing language that "people like us are concerned and taking action."[45]
  - For example, rather than tell people to get out of their cars, talk about an opportunity to support a bike-sharing initiative that will provide affordable transport and reduce air and climate pollution.
- Offer climate solutions that address community health concerns. Seek ideas for community-driven climate solutions. There are many climate solutions. Some individuals or communities may get excited about trying to reduce food waste in school cafeterias, and others about promoting community solar—both reduce climate pollution and provide health benefits.
- Avoid the individual solutions trap. Individual behaviors in daily life are important, but community action and policy/systems change are required to address the root causes of climate change and health inequities.[46] Instead of talking about what individuals can do, talk about what "we" can do together.
  - If people ask about individual behavior, share ideas (e.g. eat less meat, walk and bike more) but mention too the collective actions (e.g. increasing access to affordable fruits and vegetables or safe places to bike) that will increase opportunities for health for everyone in the community.

Acknowledge complicity

Nearly everyone in industrialized nations enjoys convenience, mobility, and comfort—such as driving, flying, using energy to light, heat and cool our homes, and consuming goods—made possible by abundant fossil fuel energy. But now we know the great magnitude of the health and climate costs of our dependence on fossil fuels and industrial agriculture. Now that we have more feasible and affordable options that allow us to move on to less polluting, clean, safe, and sustainable renewable energy, transportation, and food systems, we have a responsibility to do so.

Interrupt the spiral of silence

People are social beings. The more they hear family, friends, and respected community leaders talking about an issue, the more they see that issue as worthy of attention. Conversely, even people who care about an issue may shy away from discussing it if they infrequently hear other people talking about it. Unfortunately, climate change is in just such a "spiral of silence".[47]

While 60% of Americans say that climate change is important to them personally, fewer than 50% say they hear it discussed in the media at least once a month, only 20% say people they know talk about it once a month, and 70% say they rarely or never discuss it with family and friends.[48] Americans also routinely overestimate the prevalence of climate skeptic views, and underestimate levels of support for renewable energy and other climate solutions.[49]

One lesson from other public health challenges is that public health problems are hard to address without naming them and their causes, even if that means talking about "taboo" topics or confronting powerful interests. Effective STD and HIV/AIDS prevention requires talking about sex. Addressing health inequities requires talking about poverty and racism. Achieving the transformative systems changes required to effectively protect health and advance equity in the era of climate change requires naming climate change and its causes, while tailoring the message for the audience and context. LHDs have a professional responsibility to break the spiral of silence by informing communities about this urgent health threat and the actions needed to address it.

"We've been working on extreme heat for a few years, because it's clearly getting worse. But we never talked about climate change. About six months ago we started talking bringing together our partners for a community discussion on heat and other climate impacts. With the support of our Director, we even decided to put "climate change" right into the title for the forum. We were all worried that there would be backlash from more conservative community leaders. But none of them said a word. In fact we got a lot of really favorable responses from people who were glad that the subject was finally out in the open!"

Maricopa County (AZ) Health Department Program Manager

Do talk to conservatives

Climate change may have become a politically polarized issue, but that doesn't mean you shouldn't talk about climate and health to people in more conservative communities.[50] Very strong majorities in the U.S.—across party lines—believe their community should do more to address climate change and prepare for its impacts, including provide clean energy, expand public transportation and enhance walkability, reduce air and water pollution, and conserve energy.[51] 80% of Americans—including 62% of Trump voters—agree that the U.S. should regulate and/or tax carbon pollution.[52]

- Highlighting scientific consensus may neutralize polarizing worldviews, so be especially clear that 97% of climate scientists agree that climate change is happening and is caused by human activities.[53]
- Focus on local impacts: Conservatives are more likely to consider the need for action when they can see how climate change affects them personally.[54]
- Appeal to values such as accountability, conservation of resources, responsibility, caring for our children.[55,56]
- Emphasize solutions that have health benefits and are efficient and cost-effective.

"There is a tendency, particularly in government and politics, to avoid focusing on difficult problems until they balloon into crisis. We would be fools to wait for that to happen to our climate…When you run a company, you want to hand it off in better shape than you found it. In the same way, just as we shouldn't leave our children or grandchildren with mountains of national debt and unsustainable entitlement programs, we shouldn't leave them with the economic and environmental costs of climate change. Republicans must not shrink from this issue. Risk management is a conservative principle, as is preserving our natural environment for future generations."[57]

– Henry Paulson, Former (Republican) Secretary of the Treasury, 2014

Climate Change, Health, and Equity: The Essential Messages

- Climate change is happening now—97% of climate scientists agree.
- Climate change is caused by human activities.
- Climate change is harming our health and the health of our communities now.
- Some people and communities bear an unfair burden of these health harms, including low-income communities, communities of color, native and tribal communities, the very young and very old, and those with chronic illnesses.
- There is a real danger that those harms will be catastrophic unless we take action now. We can't afford to take that risk.
- Together we can do something about climate change: we already have solutions that are working and could be put into practice widely and cost-effectively now if we take and demand action.
- We can shift to clean renewable energy // make it easier to walk, bike and take public transit // increase access to healthy and local food // plant trees and green our communities // stop burning dirty fossil fuels that cause climate pollution // invest to prepare for and protect from the harms of climate change.
- These climate solutions bring substantial health benefits: clean air, soil and water; less asthma, heart disease, and obesity; more places to play and be active; less stress and improved mental health; and more resilient communities.
- People in every community deserve to have the opportunities and resources to be healthy in the era of climate change.
- There has been deliberate disregard for our health and the health of the planet. The fossil fuel companies have acted like the tobacco companies—intentionally misleading us about the harms of fossil fuels and climate change, and spending millions to oppose climate policy.
- The problem is urgent: climate change is a health emergency. We need to do more, and more rapidly.
- We all have the responsibility to take action for healthy people, healthy places, and a healthy planet.

In a nutshell

"It's real. It's us. It's bad. Scientists agree. There's hope."[58]

– Anthony Leiserowitz , Yale Project on Climate Change Communication

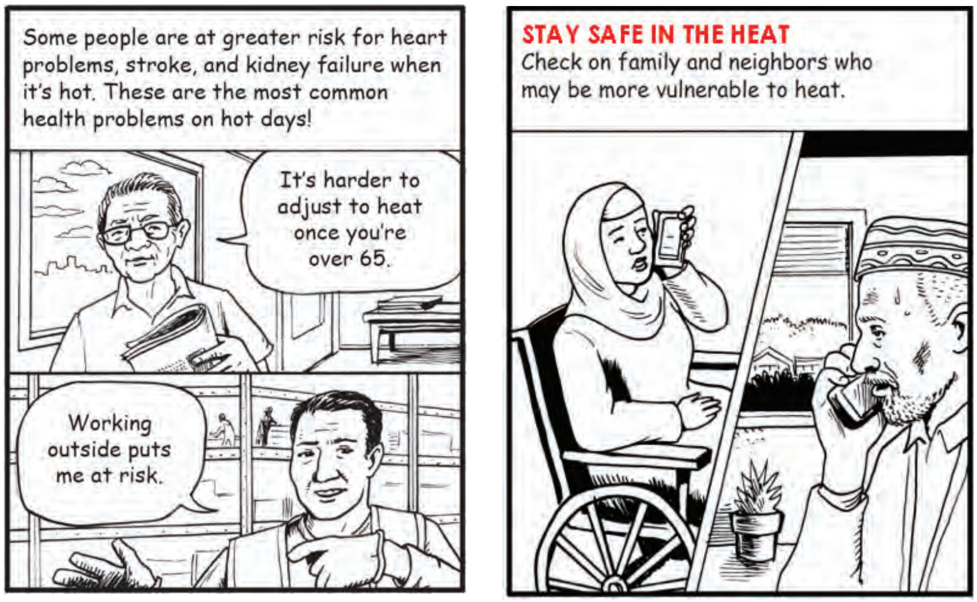
What Local Health Departments Can Do?

Local health departments have many opportunities to communicate to various audiences about climate change, health, and equity, including: (1) focused efforts to inform about climate change—health—equity connections; (2) collaboration with other agencies to integrate health into climate change communications; (3) integration of climate change into routine public health department messages.

> "We envision a community where there is a universal understanding of climate change risks, its effects, and actions that can be taken to mitigate or adapt to the effects of climate change. This is facilitated by consistent and unified climate and health messaging across agencies and organizations."
>
> *– Maricopa County Climate and Health Strategic Plan*[59]

- Develop strategies and design and disseminate materials and events to inform the community, public health and health care professionals, and policy makers about climate change, health and equity.
    - Prepare a report(s) on Climate Change, Health, and Equity in your jurisdiction to raise general awareness.
        - Los Angeles County published "Your Health and Climate Change in Los Angeles County" and "Framework for Addressing Climate Change in Los Angeles County" for the general public. For health care providers: Climate Change and Health in LA County: Opportunities for Clinical Intervention.[60,61,62]
    - Convene a Climate, Health and Equity public workshop.
        - Salt Lake City and County Health Department holds an annual Climate and Health Symposium.
        - Maricopa County hosted Bridging Climate Change and Public Health summits, which led to a Climate and Health Strategic Plan.[63]
    - Climate, health and equity vulnerability assessments (CHEVA) provide an excellent tool for initiating community conversations about climate change.
        - New Orleans Health Department partnered with Gulf Coast Center for Law and Policy to host community meetings to review a CHEVA, map the city's extreme weather response protocol, and identify community health needs.
        - Multnomah County Health Department partnered with Coalition of Communities of Color to conduct a CHEVA displayed as an interactive map, and to inform advocacy and guide county investments.[64]
        - Minneapolis Health Department used a CHEVA to identify vulnerable communities, partner with community organizations for workshops on climate change and health.

  - Collaborate on campaigns with businesses, schools, community partners, and other agencies to educate and act on climate solutions example.
    - Launch a Turn it Off campaign to reduce vehicle idling that produces air and climate pollution.[65]
    - Encourage energy conservation and efficiency to reduce climate and air pollution and energy costs, through a Switch Off campaign.[66]
- Coordinate with other agencies to integrate health messaging into their climate change materials.
  - Provide language on health impacts and solutions related to the climate work of other agencies.
    - Work with city/county Offices of Sustainability and planning agencies to integrate health into climate (mitigation and adaptation) action plans and sustainability or resilience plans.[67] The ReFresh Milwaukee community sustainability plan integrates language on climate change and health considerations.[68]
    - Collaborate with planning to integrate climate and health messages into General Plans.[69,70] The 2016 King County Comprehensive Plan includes multiple strategies and language on climate change and health.[71]
    - Incorporate climate change into local air quality agency Spare the Air alerts.
  - Coordinate with other agencies to make sure that your messages are not contradictory and confusing.
    - Philadelphia Department of Public Health convened all city departments that interact with the public about extreme heat, and standardized use of the terms ***heat caution*** and heat ***health emergency*** to describe health risks during an extreme heat event.
- Integrate climate and health messages into documents, educational materials, and health promotion information
  - Include climate change in the Community Health Assessment and Community Health Improvement Plans
    - Macomb County (MI) Health Department included climate change in the 2016 Forces of Change Assessment component of its Community Health Assessment.[72]
    - New Orleans Health Department included an objective to reduce climate impacts on health in its 2015 Community Health Improvement Plan.[73]
  - San Luis Obispo County Public Health Department partnered with the California Department of Public Health on the OutsideInSLO campaign in developing a series of informational materials: Healthy and Climate Friendly Food and Healthy and Climate Friendly Travel.[74,75]
  - Minnesota Department of Health developed a Health and Climate Film and Educational Materials for Middle School Teachers to inform teachers and student about climate change and health and adaptation and mitigation strategies.[76]



Source: Public Health Seattle-King County

- ○ Public Health Seattle-King County developed a series of "zines" depicting diverse people and communities discussing their risk and response during extreme heat events.

- Work with health care providers to post and distribute climate change and health information for patients
  - ○ Center for Climate Change and Health's Climate and Health Posters[77]
  - ○ University of California, San Francisco's Climate and Health Posters[78]
  - ○ Natural Resources Defense Council's Factsheets and Posters[79]
  - ○ CDC and APHA Climate Effects on Health Fact Sheets[80]
- Be opportunistic: Integrate climate messages into routine and emergency LHD communications

Below are some examples of how commonly issued educational materials, alerts, and advisories can be simply modified with a climate message to tell people that climate change is happening now and affects our communities.

Extreme Heat

Heat Press Release

Original: High temperatures need to be taken very seriously. People should protect themselves and watch out for others who may be vulnerable to extreme temperatures, especially the elderly, people with existing health conditions and people who are isolated.[81]

Modified: High temperatures need to be taken very seriously, ***especially since climate change is making our summers hotter***. People should protect themselves….

Health Department Twitter

Original: It is easy to get distracted. Look before you lock....[82]

Modified: ***Climate change is making extreme heat days more common.*** Never leave baby alone in a hot car. Look before you lock.

Water Quality

Harmful Algal Bloom Press Release

Original: The Department of Health is warning citizens to stay out of the water and to keep their pets and children out as well. ... Harmful algal blooms occur when warm water and nutrients combine to make conditions favorable for blue-green algae growth.[83]

Modified: Harmful algal blooms occur when warm water and nutrients combine to make conditions favorable for blue-green algae growth. ***Climate change is causing warmer water temperature, making harmful algal blooms more frequent.***

Wildfires

LHD Website on Wildfire Safety

Original: Droughts and dry conditions throughout various times of the year increase the risk for wildfires. Careless use of fire in highly wooded areas can also dramatically increase the chance of a wildfire, which can then quickly spread across trees and dry brush and threaten homes and businesses that are in vicinity.[84]

Modified: Droughts and dry conditions increase the risk for wildfires. ***Climate change is making our summers hotter and dryer.***

Air Quality

Air Pollution

Original: The EPA reports air pollution levels using the Air Quality Index (AQI). AQI reports the level of ozone and other air pollutants. When the AQI is 101 or higher, it is dangerous for people with asthma. You may have to change your activities and medicines.[85]

Modified: AQI reports the level of ozone and other air pollutants. ***Warming due to climate change is increasing ozone levels.*** When the AQI is 101 or higher, it is dangerous for people with asthma.

Allergens

Community Health Worker Pediatric Asthma Home Visiting Program

Original: Pollen comes from trees, flowers, grass, and weeds and can trigger asthma. High pollen counts in the spring and fall seasons are known to be asthma triggers for some children.[86]

Modified: Pollen comes from trees, flowers, grass, and weeds and can trigger asthma. High pollen counts in the spring and fall ***are increasing due to climate change*** and can trigger asthma in children.

Sea Level Rise

Seawater Intrusion Pamphlet

Original: Some coastal wells in Washington are now unusable because of seawater intrusion. This is particularly true in coastal areas where high population growth has placed increased demands on groundwater supplies. Seawater intrusion can potentially render large portions of Washington's coastal aquifers unusable through degradation of water quality. Health issues are a concern in seawater-intruded areas, particularly for people on salt restricted diets.[87]

Modified: Some coastal wells in Washington are now unusable because of seawater intrusion, ***which is worsened by sea level rise due to climate change***. This is particularly true in coastal areas where high population growth has placed increased demands on groundwater supplies…

Storms and Flooding

Flood Advisory

Original: Heavy rain causes floodwaters to rise and pool on streets and throughout neighborhoods. In these situations, be aware of the following…[88]

Modified: ***Climate change is increasing the frequency of intense storms with heavy rainfall.*** Heavy rain causes floodwaters to rise and pool on streets and throughout neighborhoods. In these situations, be aware of the following…

Nutrition and Food Security

Eat Local

Original: Local food is fresher and tastes better than food shipped long distances from other states or countries. Fresher food is more nutritious.[89]

Modified: Local food is fresher, tastes better, ***and causes less climate pollution*** than food shipped long distances from other states or countries. Fresher food is more nutritious and ***better for the environment***.

Eating Outdoors, Handling Food Safely

Original: Picnic and barbecue season offers lots of opportunities for outdoor fun with family and friends. But these warm weather events also present opportunities for foodborne bacteria to thrive. As food heats up in summer temperatures, bacteria multiply rapidly. To protect yourself, your family, and friends from foodborne illness during warm-weather months, safe food handling when eating outdoors is critical.[90]

Modified: Picnic and barbecue season offers lots of opportunities for outdoor fun with family and friends. ***But as climate change is making our summers even hotter***, these warm weather events also present opportunities for foodborne bacteria to thrive…

Food and Water Safety During Power Outages and Floods

Original: Emergencies can happen, especially with extreme weather conditions. When they do, the best strategy is to already have a plan in place. This includes knowing the proper food safety precautions to take before, during, and after a power outage—and being prepared to safely handle food and water in the event that flooding occurs.[91]

Modified: Emergencies can happen, especially with extreme weather conditions ***that are becoming more frequent and severe due to climate change***. The best strategy is to have a plan in place. This includes knowing the proper food safety precautions….

Nutrition and Healthy Eating

Original: "It can be challenging to serve healthy meals when you're trying to save money. Consider serving budget-friendly meatless meals once or twice a week. Meatless meals are built around beans, lentils, vegetables and whole grains. These plant-based proteins tend to be less expensive and offer more health benefits than meat.[92]

Modified: Consider serving budget-friendly meatless meals once or twice a week. Meatless meals are built around beans, lentils, vegetables and whole grains. These plant-based proteins are less expensive, offer more health benefits than meat, ***and reduce climate pollution from animal agriculture***.

Physical Activity

Original: "Walking and cycling trips help make the air we breathe cleaner. Also, walkers and cyclists breathe less air pollution than people inside an idling or slow-moving car."

Modified: Walking and cycling trips help make the air we breathe cleaner ***and slow climate change. Walking and cycling cause no harmful climate or air pollution!*** Also, walkers and cyclists breathe less air pollution than people inside an idling or slow-moving car.

Vector-borne and communicable disease

News Update- Zika Virus

Original Zika Alert: The announcement of three recent Zika cases in Hidalgo County, including one that appears to have been transmitted locally by mosquitoes, demonstrates that Zika remains a threat in the Rio Grande Valley….

Residents of the Rio Grande Valley should remain on alert for Zika and take precautions even during the winter months because it often stays warm enough there for mosquito activity to continue through much of the winter...[93]

Modified with Climate Messaging: Three recent Zika cases in Hidalgo County demonstrates that Zika remains a threat in the Rio Grande Valley… Residents should remain on alert for Zika and take precautions even during the winter months. ***Climate change is making our winters milder***, so mosquito activity is even more likely to continue through the winter.

For More Information and Resources on Climate and Health Communications:

- Climate Advocacy Lab - Climate Chat: An Everyday Guide to the Science of Talking about Climate Change[94]
- Climate Outreach[95]
- Don't Even Think About It: Why Our Brains Are Wired To Ignore Climate Change[96]
- Center for Climate Change Communication- Conveying the Human Implications of Climate Change[97]
- Toward Consensus on the Climate Communication Challenge[98]
- Climate Visuals[99]
- Communicating the Health Effects of Climate Change[100]
- Center for Climate Change and Health, Public Health Institute - Climate Change and Health Communications, Workshop Summary[101]
- ecoAmerica - Connecting on Climate: A Guide to Effective Climate Change Communication,[102] Let's Talk Health & Climate: Communication Guidance for Health Professionals[103]
- The Climate Reality Project - Communicating the Climate Health Connection[104]
- World Health Organization - Strategic Communications Framework for effective communications[105]

Conclusion

Climate change threatens the fundamentals that sustain life and health—fresh water, food, clean air, shelter, and security—and thus threatens the health and possibly the very survival of the communities that local health departments serve. To fulfill the very definition of public health—"what we, as a society, do collectively to assure the conditions for people to be healthy"—climate change must be integrated across all aspects of public health practice.[1]

Climate change is happening now, is largely due to human activities, and is amenable to action to slow its pace and reduce its impacts. Climate change is a global phenomenon, but it is people and communities at the local level that experience its consequences. Climate change exacerbates local and global health inequities because some people and communities bear an unfair burden of these health harms, including low-income communities, communities of color, native and tribal communities, the very young and very old, and those with chronic illnesses.

The root causes and upstream drivers of climate change and health inequities are often the same: Our energy, transportation, land use, housing, planning, food and agriculture, and socioeconomic systems critically influence levels of climate pollution and community living conditions.

Our actions now will affect the magnitude of climate impacts and the extent to which communities thrive in the face of climate change and recover in the aftermath of climate-related disasters. Local public health departments have a professional and ethical responsibility to address this urgent threat, just as they have done in addressing other emergent threats to the health of the public.

LHDs are on the front lines and public health workers are seeing the impacts of climate change every day. They can help policymakers and the public understand the breadth of climate health impacts, and the urgent need for climate action.

Interventions to address climate change and health inequities range from upstream structural, policies, and systems changes to downstream treatment, rehabilitation, and disaster recovery efforts. Interventions along the entire spectrum are needed to protect and promote health in the era of climate change. However, upstream solutions have the greatest benefits, providing primary prevention and promoting healthy, equitable, sustainable, and resilient communities.[2] Public health leaders can show how transformative upstream changes can protect people and build healthy and equitable communities in the era of climate change.

Building political and economic power and voice of marginalized communities are essential components of climate resilience. Especially for historically disenfranchised low-income communities and communities of color, imbalances in political and economic power have allowed the perpetuation of unhealthy living conditions associated with health inequities and climate vulnerability. LHDs can support genuine participation of community members in decisions about how local governments respond to climate change to ensure that those most impacted by climate change and climate action have a voice in shaping their future.

LHDs have a proven track record of succeeding against powerful forces to protect health from complex threats, resting on a commitment to addressing cultural, economic, political, structural, and corporate forces that shape the environments that determine health. With similar commitment and effort, LHDs can play an essential role in addressing climate change and its impacts on health and health equity.

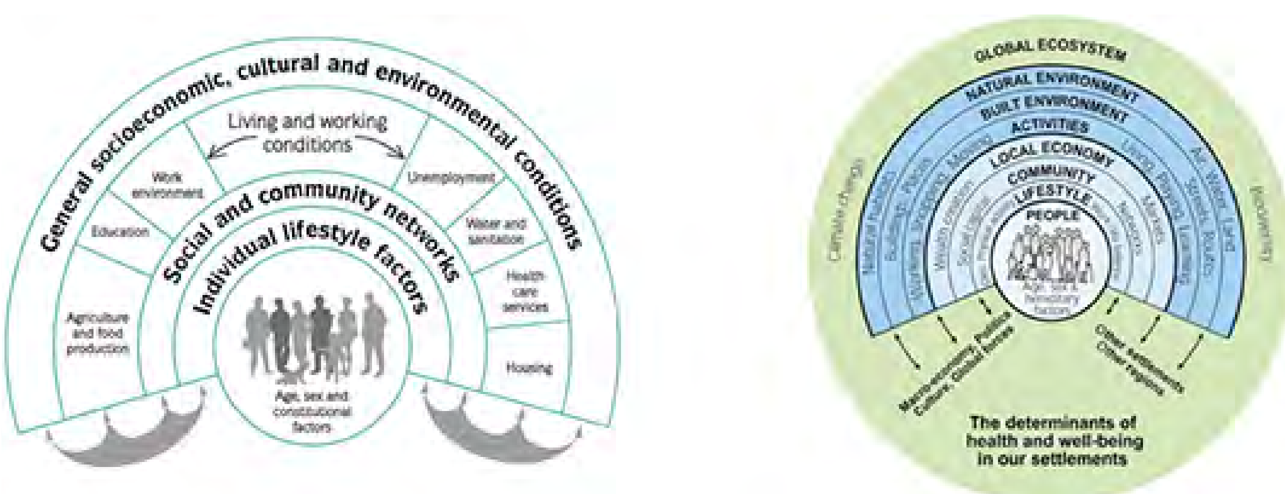
Climate change is a public health emergency. The time to act is now.

Appendix

Appendix 1: Development of Climate, Health, and Equity Framework

A number of well-established frameworks informed the development of the climate, health, and equity framework included in Section 2 of this Guide (see Figure 2.1.1). For a more complete version of this framework, see Figure A 1.4. In recent years, LHDs have recognized the need to address the social determinants of health in order to eliminate health inequities. The oft-cited social determinants "rainbow" (Figure A1.1) emphasizes the interactions among layers of health determinants: "individual lifestyles are embedded in social norms and networks, and in living and working conditions, which in turn are related to the wider socioeconomic and cultural environment."[1] Barton and Grant[2] expand on the social determinants rainbow (Whitehead and Dahlgren, 1991) to show how the natural environment and planetary ecosystems interface with other determinants of health. Climate change and other changes in the global ecosystem have significant impacts on the natural and built environments, and on economies, communities, and people. At the same time, individuals and communities experience the impacts of climate change in the context of their lived experience, current living conditions, assets and resources, and opportunities for health and well-being, all of which contribute to climate vulnerability and climate resilience, as described later in this section. The circle on the right in Figure A1.1 conveys the core message underlying this Guide: We cannot achieve healthy people and healthy places on an unhealthy planet, and fostering a healthy planet can do much to promote health and equity.[1]

Figure A1.1: Social Determinants of Health "rainbow," Barton and Grant, 2006 developed from a concept by Whitehead and Dahlgren, 1991



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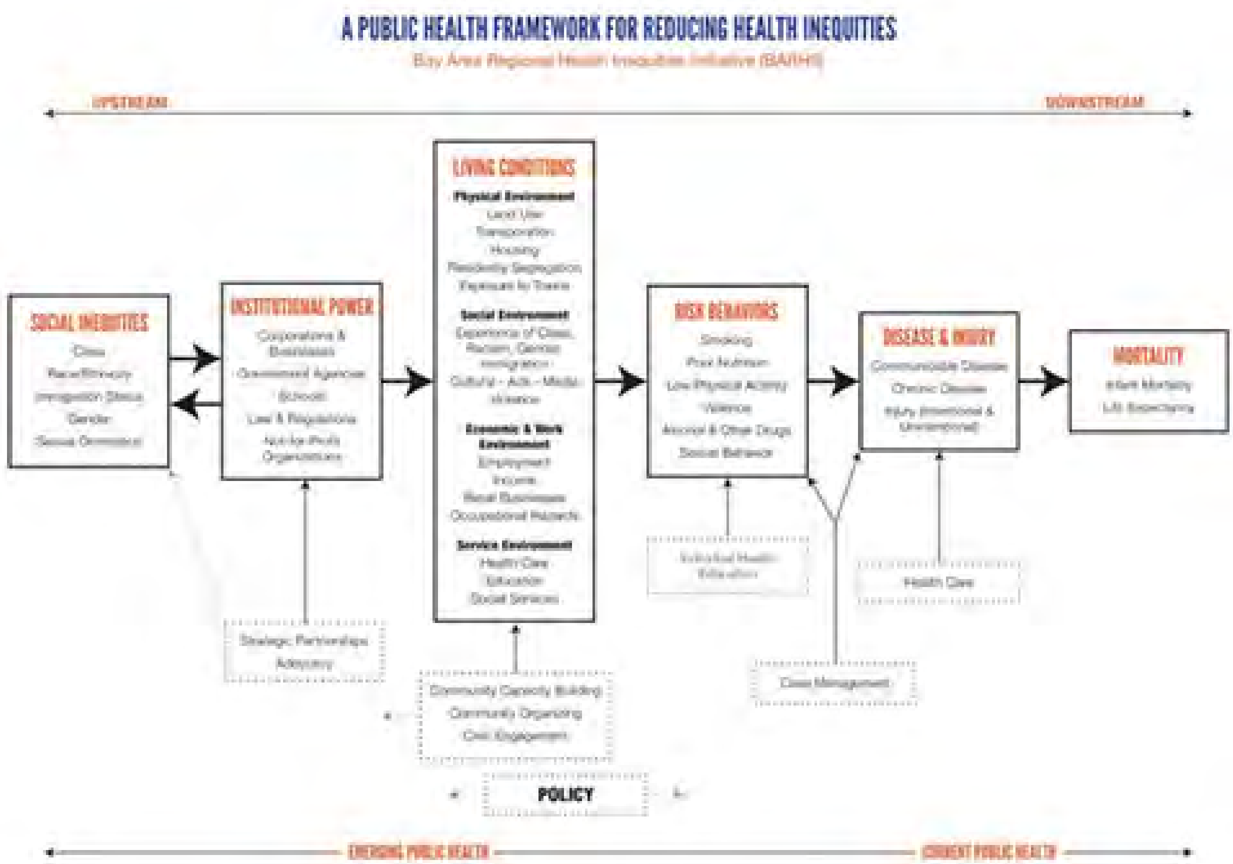
[1] Climate change acts in concert with other significant disruptions to the Earth's natural systems, such as habitat and biodiversity loss, soil degradation, toxic chemical pollution, and unsustainable water use. Many of these global ecosystem changes— including climate change—result from exploitation and excessive consumption of natural resources, combined with population growth. The emerging discipline of "planetary health," explores the full range of ecosystem degradation on human health.

In Figure A1.2, the Bay Area Regional Health Inequities Initiative framework highlights that there are *structural mechanisms* that shape the physical, social, working, economic, and services environments in which we live, work, study, and play. Structural mechanisms are defined by the World Health Organization as “those that generate stratification and social class divisions in the society and that define individual socioeconomic position within hierarchies of power, prestige and access to resources…[and] are rooted in the key institutions and processes.”[3]

Figure A1.2: The Bay Area Regional Health Inequities Initiative framework



Patz[4] and others have published conceptual frameworks that depict the pathways through which climate change impacts health (Figure A1.3). For additional frameworks from the Lancet Commission and U.S. Global Change Research Program, see Appendix 2.

Figure A1.3: Potential health effects of climate variability and change

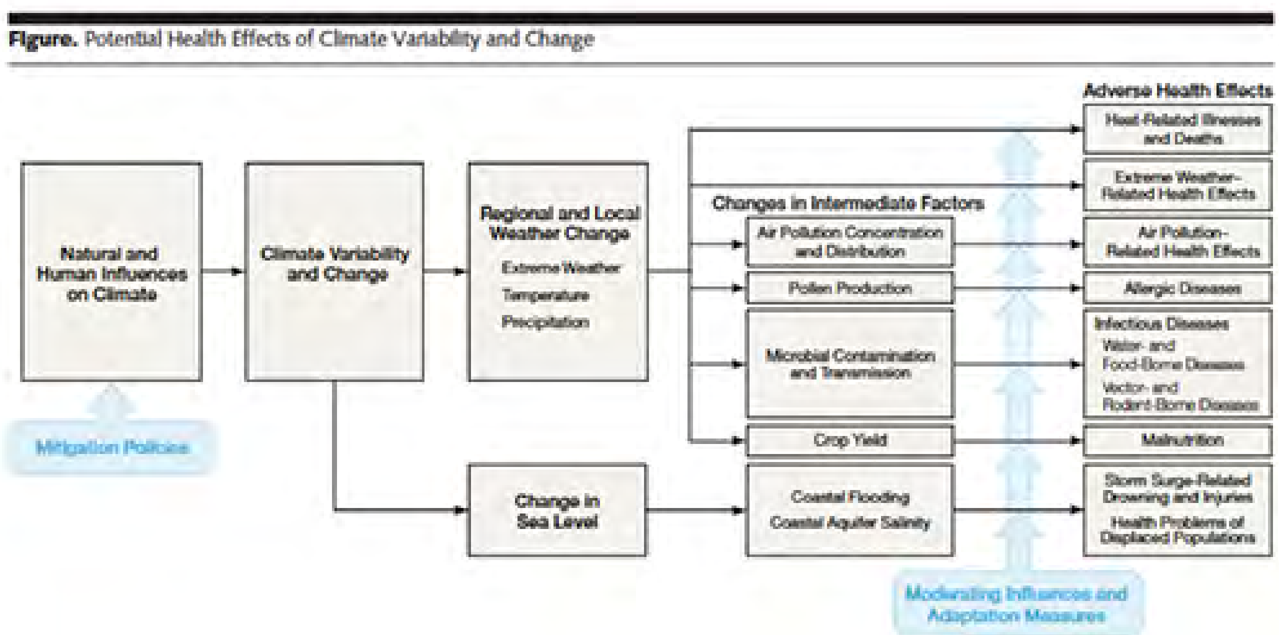
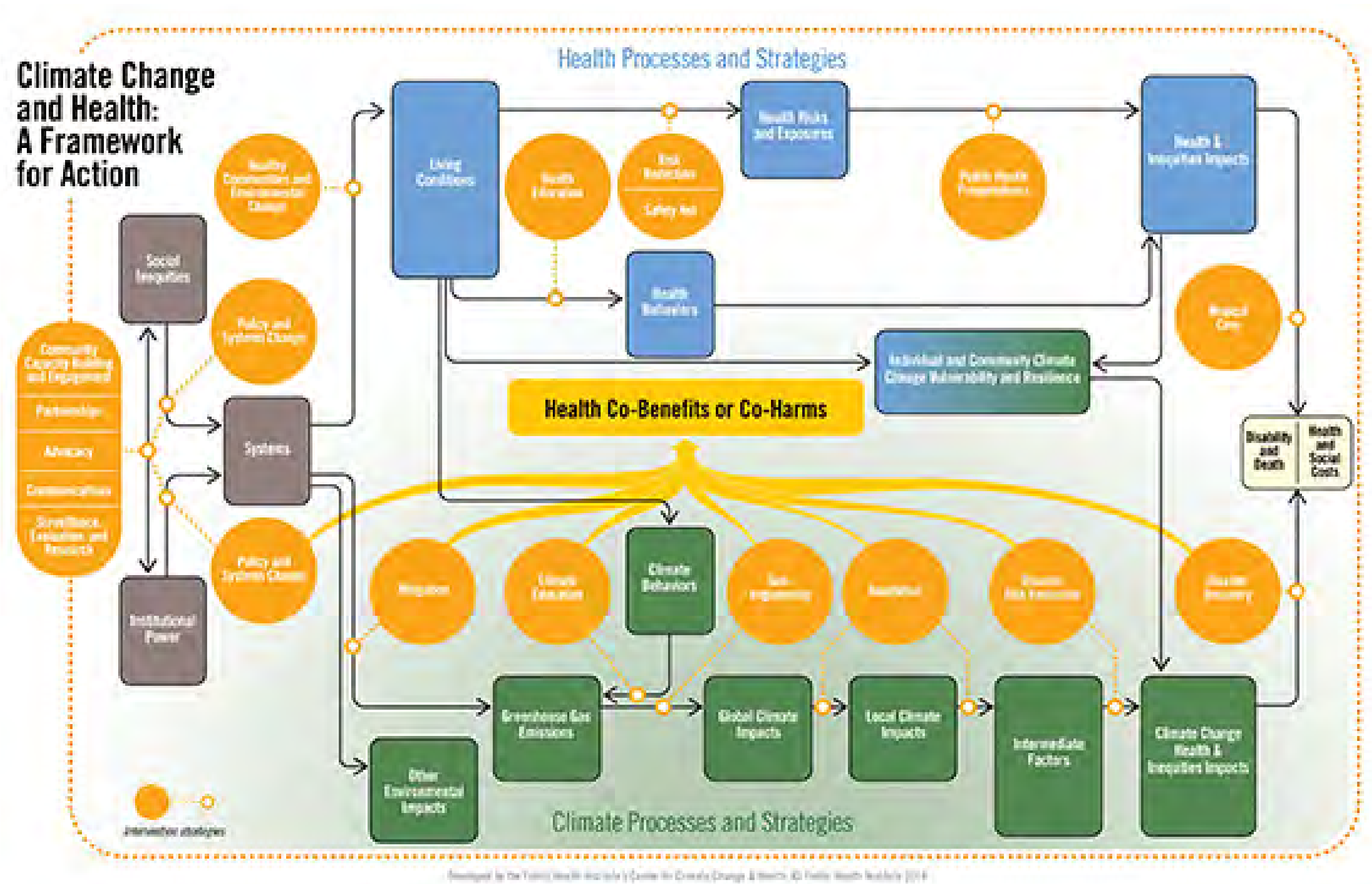


Figure A1.4: Climate Change and Health: A Framework for Action



See the live *Climate Change and Health: A Framework for Action* for more information.

Appendix 2: Additional Climate and Health Frameworks

Following are two climate and health frameworks. The first (Figure A2.1) is from the Lancet Commission. Figure A2.2 is a framework from the U.S. Global Change Research Program,.

Figure A2.1: The Lancet's climate and health model 5

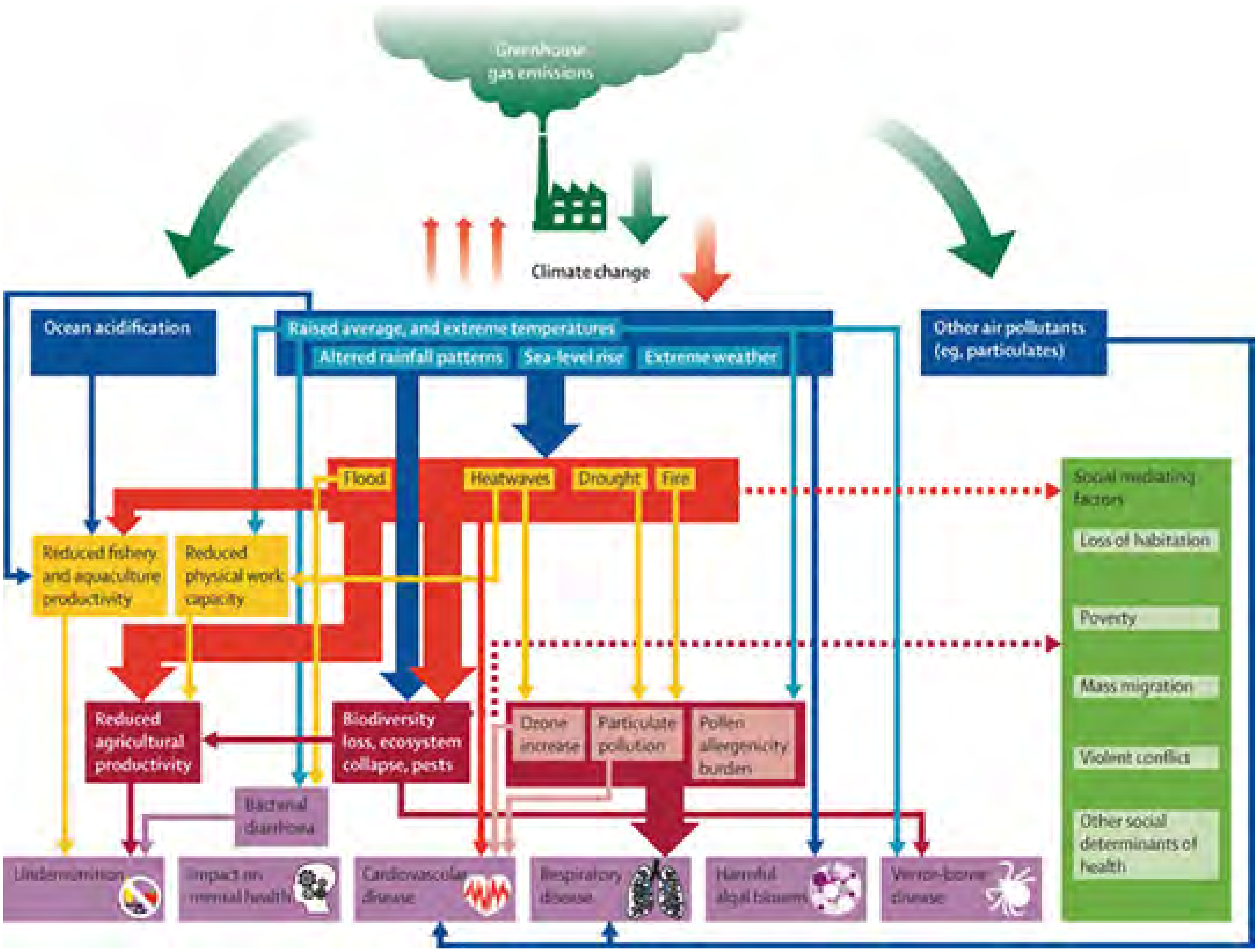
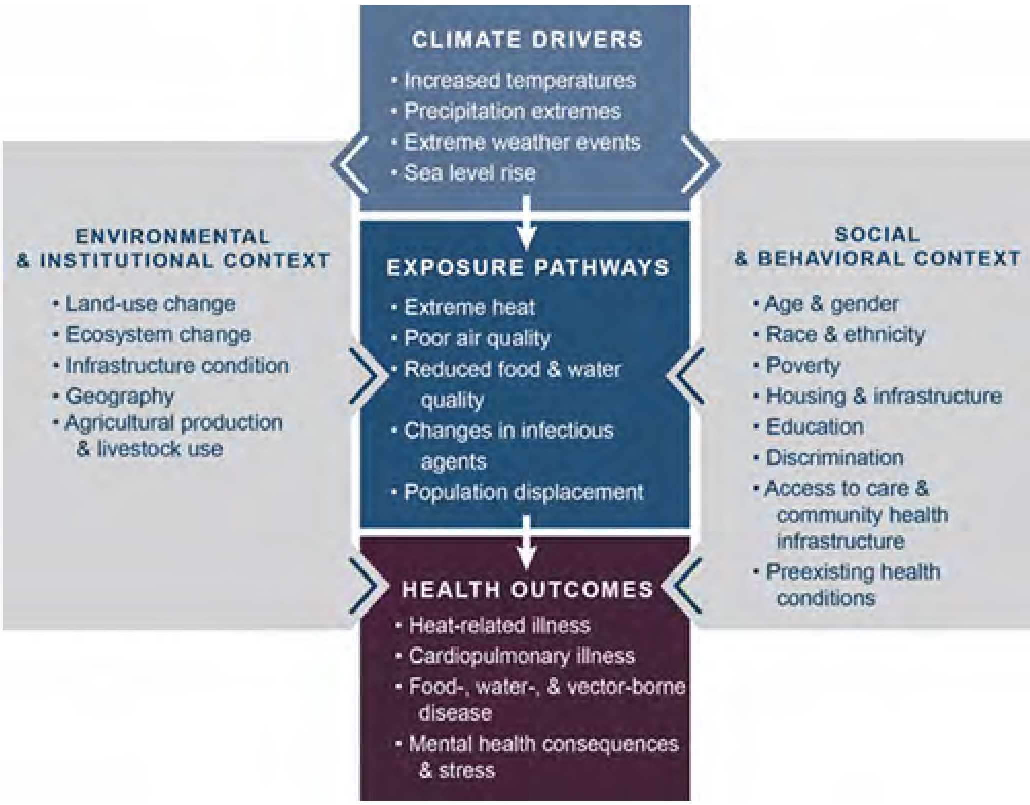


Figure A2.2: U.S. Global Change Research Programs' climate and health model[5]



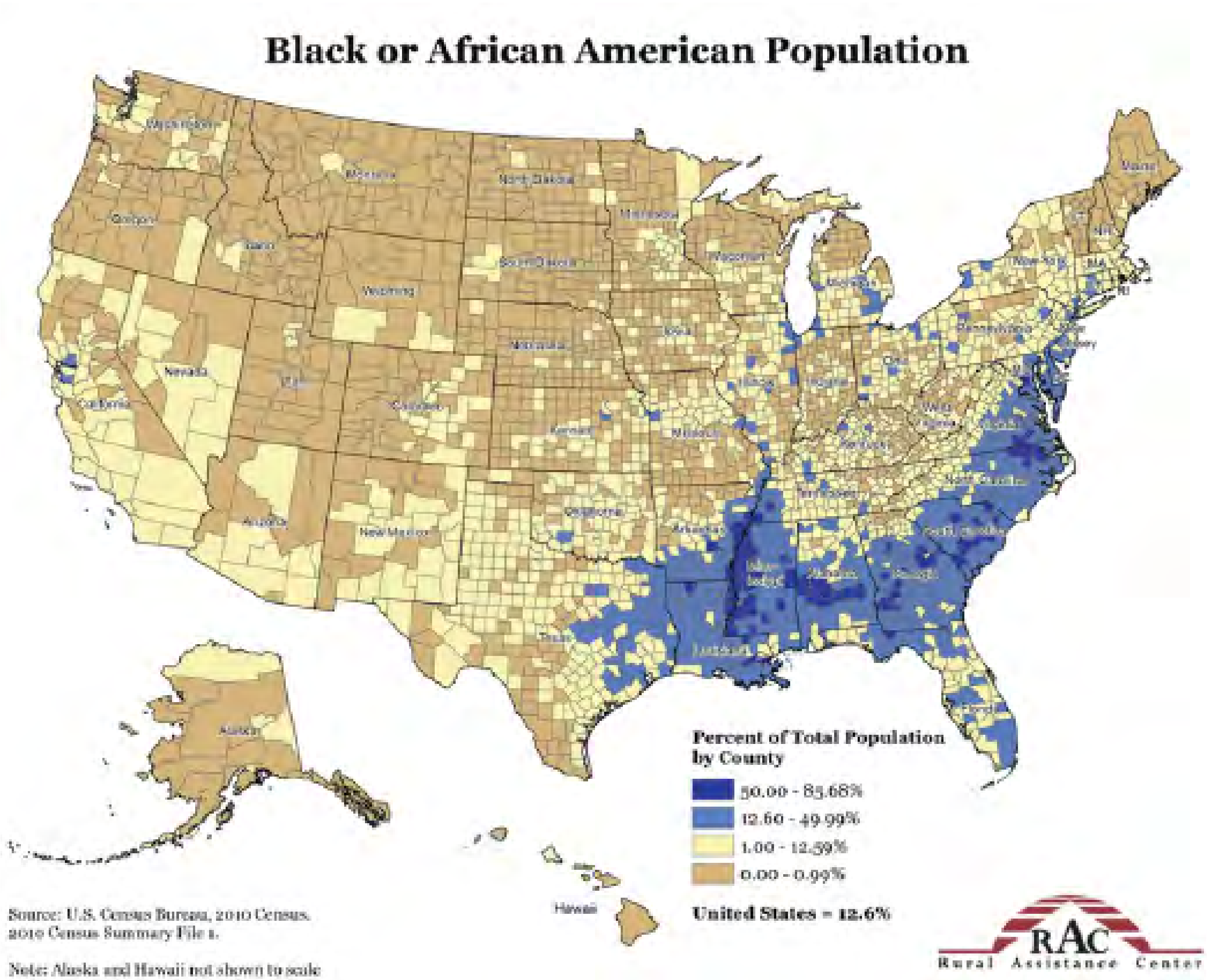
Appendix 3: Climate Impacts on Communities of Color

A3.1: African Americans, Climate Change, and Health

African Americans in the United States

As of 2016, there were over 42 million individuals who identify as African American in the United States, making up 13.3% of the population. This number grows to over 46 million (14.5% of the population) when those identifying as African American and another race are included.[6] Washington D.C. and the Southern states of Mississippi, Georgia, and Louisiana have the highest percentage of individuals identifying as African American as part of their total populations.[7] (Figure A3.1.1).

Figure A3.1.1: African American population in the United States



Social Determinants of Health and Health Equity

Present-day African American communities have lower income, less education, and poorer health status than non-Hispanic White communities overall, largely due to historical discriminatory practices in housing, education, employment, and healthcare.

Historical Influences

- **Slavery** – As far back as the 1600s, slavery of African and African American people was a precursor to more recent discriminatory policies and current day inequities due to the social, political, and economic divide it caused between African American and White populations.[8]
- **Jim Crow Laws** – In the late 1800s and early 1900s, Jim Crow laws enforced racial segregation and reserved the best educational, health, and social opportunities for Whites. This furthered resource and power divide between African Americans and White communities that endure to the present and impact health outcomes and healthcare access.[9]
- **Redlining** – In the 1930s, banks would deny loans to people of color in well-maintained and higher income neighborhoods, leading to residential segregation that hindered African Americans and other people of color from home ownership.[10] Present-day institutionalized racism towards African Americans still exists in subtle but similar mortgage lending policies and continues to perpetuate the social stratification of ethnic groups.

Key Social Determinants

Historical policies have led to present-day social and health inequities in African Americans that impact climate vulnerability and resilience:

- **Health care** – African Americans are less likely than non-Hispanic Whites to receive appropriate medical treatment when needed, even if they have the same coverage and access to care. This means lower access to treatment for climate-related health impacts such as heat stroke, exacerbated asthma, and injuries from extreme weather events.[11]
- **Neighborhoods** – Residential segregation has led to a disproportionate amount of African Americans in neighborhoods with greater physical hazards, such as air pollution; social hazards, such as lack of food access; and fewer resources, such as green spaces.[12] Data also shows that a higher percentage of African Americans reside in areas with low tree canopy coverage and a high amount of heat-trapping surfaces. This decreases their access to shady areas in hot weather and increasing neighborhood temperature due to the urban heat island effect.[13]
- **Poverty** – One out of five of African American families are in poverty, compared to one out of fifteen White families. These households have a smaller cushion against property damage or injuries caused by extreme weather events, and are more susceptible to extreme heat days due to lack of access to air conditioning.[14]
- **Weathering** – The cumulative impact of discrimination, racial violence, and social and political marginalization by African Americans over time has demonstrated lasting health impacts over time, materializing in earlier health deterioration in comparison to comparable White communities. The stress experienced by an African American living through daily discrimination can lead to chronic stress, and morbidity and mortality outcomes typical of an older White individual.[15]

Key Climate Change and Health Issues for African American Communities

African Americans are disproportionately impacted by climate change due to factors including geographic distribution and socioeconomic inequities leading to inequities in living and working conditions, neighborhood characteristics, and health care access.

African Americans: Less Responsible for Climate Change, More Supportive of Climate Action.

"African Americans are thirteen percent of the U.S. population and on average emit nearly twenty percent less greenhouse gases than non-Hispanic Whites per capita. Though less responsible for climate change, African Americans are significantly more vulnerable to its effects than non-Hispanic Whites."

The Climate Gap"[16]

- 60% of African Americans ranked global warming among the most serious issues in the U.S. in 2015.
- 67% of African Americans say that action should be taken to counteract climate change.
- 83% supported the Clean Power Plan.[17]

Extreme Heat

See Section 4.1—Extreme Heat

Heat-related deaths in African Americans occur at a rate 150 to 200% greater than that for non-Hispanic Whites.[18]

Extreme Heat and Climate Change

- Extreme heat results in excess death and illness through heat stroke, heat exhaustion, and exacerbations of chronic illness.[19]
- Heat increases ozone levels, exacerbating asthma, other respiratory disease and cardiovascular disease.[20]
- Due to climate change, extreme heat events are increasing in frequency, severity, and duration.[21]

Why African American Communities are at Risk

- **Neighborhood** – 43% of African Americans live in "urban heat islands," compared to 20% of Whites, and are therefore more likely to experience negative health outcomes associated with extreme heat.[22] The urban heat island effect occurs when heat is retained in an area due to heat-retaining asphalt and concrete and lack of cool green space and trees. Lack of tree canopy coverage also decreases access to shady areas in hot weather.[23]
- **Housing Quality** – Because a higher proportion of African Americans are low-income, they have less access to heat-adaptive housing features such as insulation or air conditioning in their homes, further exposing them to extreme heat events. [24]
- **Pre-Existing Conditions –** 46% of African Americans adults over 19 are diagnosed with cardiovascular disease.[25] Compared with non-Hispanic Whites African Americans have "1.3-times greater rate of non-fatal stroke, a 1.8-times greater rate of fatal stroke, a 1.5-times greater rate of death attributable to heart disease, and a 4.2-times greater rate of end stage kidney disease."[26] These disorders can all be exacerbated by extreme heat.[27]

Air Quality

See Section 4.4—Air Quality

Air Quality, Climate Change, and Health

- Climate change makes it more difficult to attain national air quality standards for ground-level ozone, a major component of smog, and is expected to cause increased exposure to particulate matter pollution in urban settings.[28]
- Common sources of greenhouse gas emissions (i.e. from motor vehicles and energy production) also produce many different air toxics, which are harmful to health.[29]
- Individuals with pre-existing chronic conditions, such as asthma, other respiratory disease, and cardiovascular disease, are at greater risk of disease exacerbations and complications due to air pollution.[30]

Why African American Communities Are at Risk

- **Neighborhood** – 71% percent of African Americans live in counties in violation of federal air pollution standards, compared to 58% of non-Hispanic Whites.[31]
- **Pre-Existing Conditions** – African Americans have a 36% higher rate of asthma incidents than non-Hispanic Whites, and an African American is 3x more likely to die or visit the emergency room from asthma-related complication in comparison to a non-Hispanic White individual.[32] Poor air quality exacerbates asthma.[33]

Extreme Weather Events

See Section 4.7—Storms and Flooding

Extreme Weather Events, Climate Change, and Health

- Climate change is expected to increase the strength and resulting destruction of storms due to increased water temperatures leading to more precipitation, flooding, greater storm surges, and strong storm systems and winds.[34]
- Extreme weather causes interruptions in medical care and disrupts critical infrastructure including electricity, sanitation and water treatment, food refrigeration, health care, communications systems and transportation.[35,36]
- Extreme storms can also impact indoor air quality through flooding damage and mold, spread of infectious and vector-borne disease, toxic exposures, and mental health outcomes and can lead to displacement.[37,38,39]

Why African American Communities Are at Risk

- **Geography** – The six states with the highest African American population—Mississippi, Louisiana, Georgia, Maryland, South Carolina, and Alabama—are also projected to be impacted by more Atlantic hurricanes and extreme storms.[40]
- **Homeownership and Insurance** – The homeownership rate for African Americans in 2015 was 33%, lower than the rate in 1960 and half the level for comparable non-Hispanic Whites.[41] Renter status leaves families vulnerable following storm damage. Racial discrimination is also still extensively seen in homeowner insurance markets, leaving more African American families with less protection following extreme storms and related damage.[42]

- **Poverty –** One out of five of African American families are in poverty, compared to one out of fifteen White families. During an extreme weather event, these households have a smaller cushion against property damage or injuries, further complicated by lack of access to medical care and insurance.[43]
- **Pre-Existing Conditions –** African Americans have higher rates of chronic illnesses such as cardiovascular and respiratory disease. African Americans also had the highest incidence and death rates from cancer in 2012, and individuals from this community face higher levels of mental health and trauma outcomes.[44] Extreme storms can disrupt access to care and services for these illnesses, leaving African American communities vulnerable.

Climate Resilience and Social Cohesion

During the Chicago heat wave of 1995, low-income communities of color generally fared the worst outcomes. In fact, overall, excess mortality rates from this event were fifty percent higher for non-Hispanic African Americans than for non-Hispanic Whites.[45] However, there was an exception to this. Some low-income African American communities were among the least impacted in terms of heat-related deaths, an effect thought to be related to high levels of community interaction and organization. Communities with high levels of social cohesion decrease isolation among residents, improve health and quality of life, and ultimately increase resilience against extreme events.[46]

Steps can be taken to foster resiliency throughout an extreme weather event, such as mapping vulnerable communities in advance and working with these communities to understand what strengths are present to plan and prepare for destructive weather.

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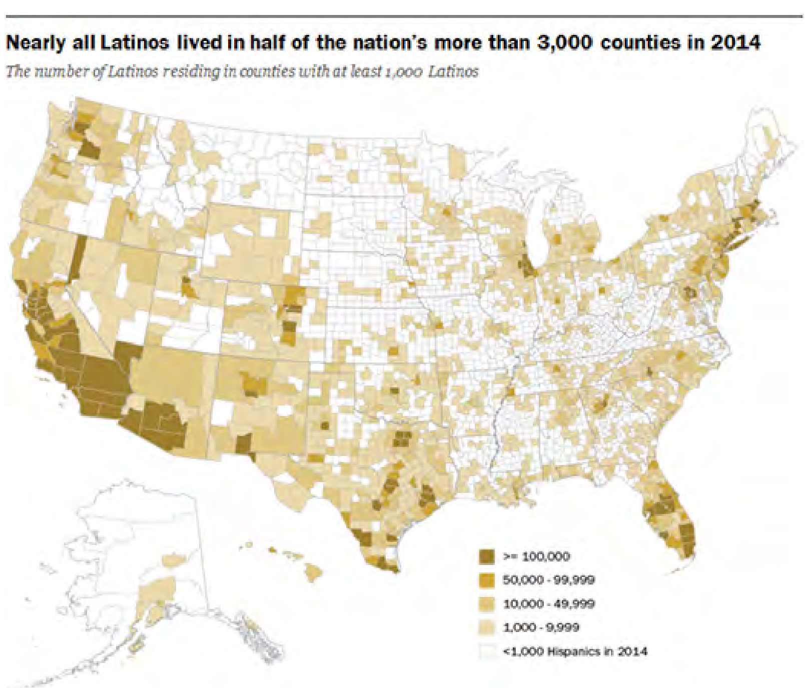
A3.2: Latinos, Hispanics and Latinx and Climate Change, and Health

Latinos, Hispanics and Latinx, in the United States

"Latino" is an umbrella term used to identify a diverse collective of peoples from different countries, cultures, and backgrounds (Table A3.2.1). An estimated 56 million Latinos live in the United States, the majority of whom are second or third generation U.S. citizens.[47] This number expected to double to 119 million by 2060, being driven primarily by native births rather than immigration.[48,49] Latino communities represent a rising share of the United States population, and Latino communities are dispersing further, beyond California, Florida, and Texas, and into more regions of the South and the Midwest (Figure A3.2.1).[50]

Table A3.2.1	LATINO IMMIGRANTS COUNTRIES OF ORIGIN (2015) [51]
Mexico	67.9%
Puerto Rico	10.1%
El Salvador	4.0%
Dominican Republic	3.4%
Guatemala	2.6%
Cuba	3.9%
Other	8.0%

Figure A3.2.1: Number of Latinos residing in U.S. counties



Social Determinants of Health and Health Equity

Present-day Latino communities have lower income, less education, and poorer health status than non-Hispanic White communities overall, largely due to historical discriminatory practices in housing, education, employment, and healthcare.

Historical Influences

- **Immigration** – In 2015, 41.4% of foreign-born residents of the U.S. came from Central and Southern American countries.[52] There are physical and mental health challenges related to immigrating, and these can be further exacerbated by related policies and discrimination in the destination country.[53] This is especially true for undocumented immigrants who face higher stress levels regarding their immigration status and safety.[54]
- **"Healthy Immigrant"** – Voluntary immigrants to the U.S. from non-western countries often demonstrate better than expected health and mortality outcomes—perhaps stemming from the difficulties of migration, barring less healthy individuals from being able to. This "paradox" can be used to overlook social inequities.[55]
- **Acculturation** – While evidence suggests that newly arrived immigrants are often healthier than comparable native-born persons, evidence also supports that immigrant health declines with time in the U.S.[56] This decline in health has been associated with changes in diet, work-related stressors, and stresses related to the immigration process and discrimination.[57]

Key Social Determinants

Such historical policies have led to present-day social inequities in Latinos. Additional social determinants will be discussed in relation to specific climate impacts discussed below.

- **Health care** – In 2014, 26.5% of individuals below the age of 65 who identified as Latino lacked health insurance, when compared to 10.4% of those in the same age group who identified as Non-Hispanic White.[58] The gap was higher for individuals over the age of 65 and those earning below the federal poverty line.[59]
- **Poverty** – In 2015, despite a 6.1% increase in household income for Latino families from 2014, the average household income for Latinos was close to 30% lower than that of Non-Hispanic Whites.[60] Close to one out of five of Latino families are in poverty, compared to one out of twelve Non-Hispanic White families.[61] These households have a smaller cushion against property damage or injuries caused by extreme weather events, and are more susceptible to extreme heat days due to lack of access to air conditioning.

Key Health Inequities

- **Obesity** – 42.5% of adults who identified as Hispanic in 2014 were classified as obese, growing from 20% in 1990.[62] The prevalence of obesity within Latino communities varies wildly based on gender and country and culture of origin. Disparities also exist between U.S.-born and foreign-born Latinos, as 47.1% of U.S.-born Latinos are obese, compared to 36.3% of foreign-born individuals.[63] Obesity increases the risk of different health issues, including CVD and stroke.[64]

Key Climate Change and Health Issues for Latino Communities

More than 60% of Latino communities live in areas that are most impacted by extreme heat, air quality issues, and flooding, largely as a result of inequities in housing, occupation, socioeconomic status, and structural and historical factors.[65] At the same time, their carbon footprint is smaller—they drive and fly less, use public transit, live in smaller homes, and purchase fewer items that have travelled thousands of miles.[66] Despite this quandary, Latinos do and will experience thousands of additional illnesses and deaths per year in the decades ahead due to climate change impacts.

Air Quality

See Section 4.4—Air Quality

Air Quality, Climate Change, and Health

- Climate change makes it ever more difficult to attain national air quality standards for ground-level ozone, a major component of smog, and is expected to cause increased exposure to particulate matter pollution in urban settings.[67]
- Common sources of greenhouse gas emissions (i.e. from motor vehicles and energy production) also produce many different air toxics, which are harmful to health.[68]
- Individuals with pre-existing chronic conditions, such as asthma, other respiratory disease, and cardiovascular disease, are at greater risk of disease exacerbations and complications due to air pollution.[69]

Why Latino Communities Are at Risk

- **Neighborhood** – Nearly 1 in 2 Latinos live in counties frequently violating clean air and ozone standards, exacerbating air quality issues, and across the U.S., over 1.8 million Latinos live within a half-mile radius of oil and gas development.[70,71]
    - In 2010, 28.3% of Latino individuals in the U.S. lived near a major highway, which is associated with higher rates of respiratory and cardiac health outcomes, higher cancer risk, and poorer pregnancy outcomes.[72]
- **Pre-Existing Conditions** – Latino children as a whole are twice as likely to die from asthma as non-Latino Whites.[73] Puerto Rican children, in the highest incidence of any ethnic group, are almost three times as likely to have asthma; compared to non-Hispanic Whites.
    - Latino children who live in areas with higher levels of air pollution have a heightened risk of developing Type 2 diabetes than Latino children living outside of these neighborhoods.[74]

Extreme Heat

See Section 4.1—Extreme Heat

Extreme Heat, Climate Change, and Health

- Extreme heat results in excess death and illness through heat stroke, heat exhaustion, and exacerbations of chronic illness.[75]
- Heat increases ozone levels, exacerbating asthma, other respiratory disease and cardiovascular disease.[76]
- Due to climate change, extreme heat events are increasing in frequency, severity, and duration.[77]

Why Latino Communities Are at Risk

- Latinos are 21% more likely than non-Hispanic Whites to live in urban heat islands, or immediate geographic areas dominated by heat-retaining asphalt and concrete where cool, shade-producing green space and trees are lacking.[78]
- More than 4.3 million Hispanics households lack air conditioning.[79]

Sea Level Rise and Flooding

See Section 4.6—Sea Level Rise

Sea Level Rise, Flooding, Climate Change, and Health

- Climate change is causing sea level rise around the world, as a result of melting glaciers and thermal expansion due to rising ocean temperatures.[87]

Latino Workers and Extreme Heat

Latinos are more likely to work in outdoor occupations that expose workers to environmental health and climate change risks, including farming, construction, and transportation.[80] The majority of occupational heat-related deaths occur in these industries, and **Latinos have three times the risk of heat-related death on the job** than do non-Hispanics.[81] The relative risk of heat-related death was 3.4 among Latino agricultural workers and 1.7 among Latino construction workers when compared to non-Hispanic Whites.[82]

Across the U.S., Latinos make up nearly half of all farmworkers and their representation in California is 92%.[83] From 2003–2006, 71% of heat-related crop worker deaths in the U.S. occurred within the Mexican, Central or South American farmworker communities.[84] Results from an Oregon survey of farmworkers—97% of whom were foreign-born, primarily from Mexico—64% of respondents reported experiencing a symptom of heat-related illness during a hot day at work in the past week (i.e. heavy sweating, headache, etc.). 15.6% of participants reported being "very concerned" about the health effects of working in hot conditions but less likely to be "very comfortable" taking a break, which could lead to more heat-related illness.[85] There are approximately 120,000 children farm laborers across the country, making them an often-hidden subpopulation at risk for heat illness.[86]

- Flooding and storm surges associated with sea level rise increase risks for drowning, injury and displacement, which can lead to additional mental health outcomes and trauma, developmental impacts on children, and difficulties with chronic disease management.[88,89,90,91]
- Areas with waste facilities, landfills, smelters, ship yards, and military bases along the coast, rising sea level could also lead to the spread of toxic sediments and contamination of ground and surface waters.[92]

Why Latino Communities Are at Risk

- **Neighborhood** – Property values are a key factor in determining protections for sea-level rise and flood barriers. Latinos in hurricane-prone areas have median home values lower than those of non-Hispanic Whites. As a result, Latino neighborhoods do not receive the same protective infrastructure as wealthier neighborhoods.
    - Latino communities make up 40% of the population in the areas of Florida that are very likely—regardless of any climate action—to experience high tide flooding from sea level rise.
- **Disaster Aid** – Undocumented Latino individuals are ineligible for federal disaster aid to help cope with extreme weather events and may not seek assistance or services following an extreme flooding event due to fears of deportation.[93,94]

- **Housing Quality** – Latino populations living in substandard housing are at greater risk of flood-related exposures, like mold, worsening health conditions like asthma.[95]

Food Systems

See Section 4.8—Food Security

Food Security, Agriculture, and Climate Change

- Crop yields are reduced by extreme heat, drought, and extreme weather events, all of which are increasing in frequency and severity due to climate change.[96]
- Increased atmospheric carbon dioxide results in a reduction in the levels of protein and micronutrients (e.g. calcium, zinc, iron) in important crops like barley, sorghum and soy.[97]
- Extreme weather events can prevent transportation of food products, disrupting food supply chains, increasing prices, and increasing loss due to spoilage.[98]
- As climate change increases, pressure will build for greater crop yields, and pesticide use is expected to increase with this building pressure.[99]

Why Latino Communities Are at Risk

- **Occupation** – In California, 92% of farmworkers are Latino and 73% of all farmworkers earn less than 200% of the Federal Poverty Level.[100]
- **Food Security** – 21% of Latinos are food insecure, compared to 10% of non-Hispanic Whites and 13% of Americans overall.[101]
    - In 2012, Latino households spent an average of 15.5% of their income on food, compared to 12.6% that non-Hispanic Whites spent from their incomes.[102]
- **Pesticide Exposure** – Latinos account for 70% of the population in the ten zip codes with the highest pesticide use in California.[103]

Climate Action

Despite bearing less of the responsibility and more of the impact for climate change, Latinos are leading the nation on this issue. Not only do Latino communities overwhelmingly support action on climate change policies, in many cases, these communities take the lead within environmental justice movement.[104]

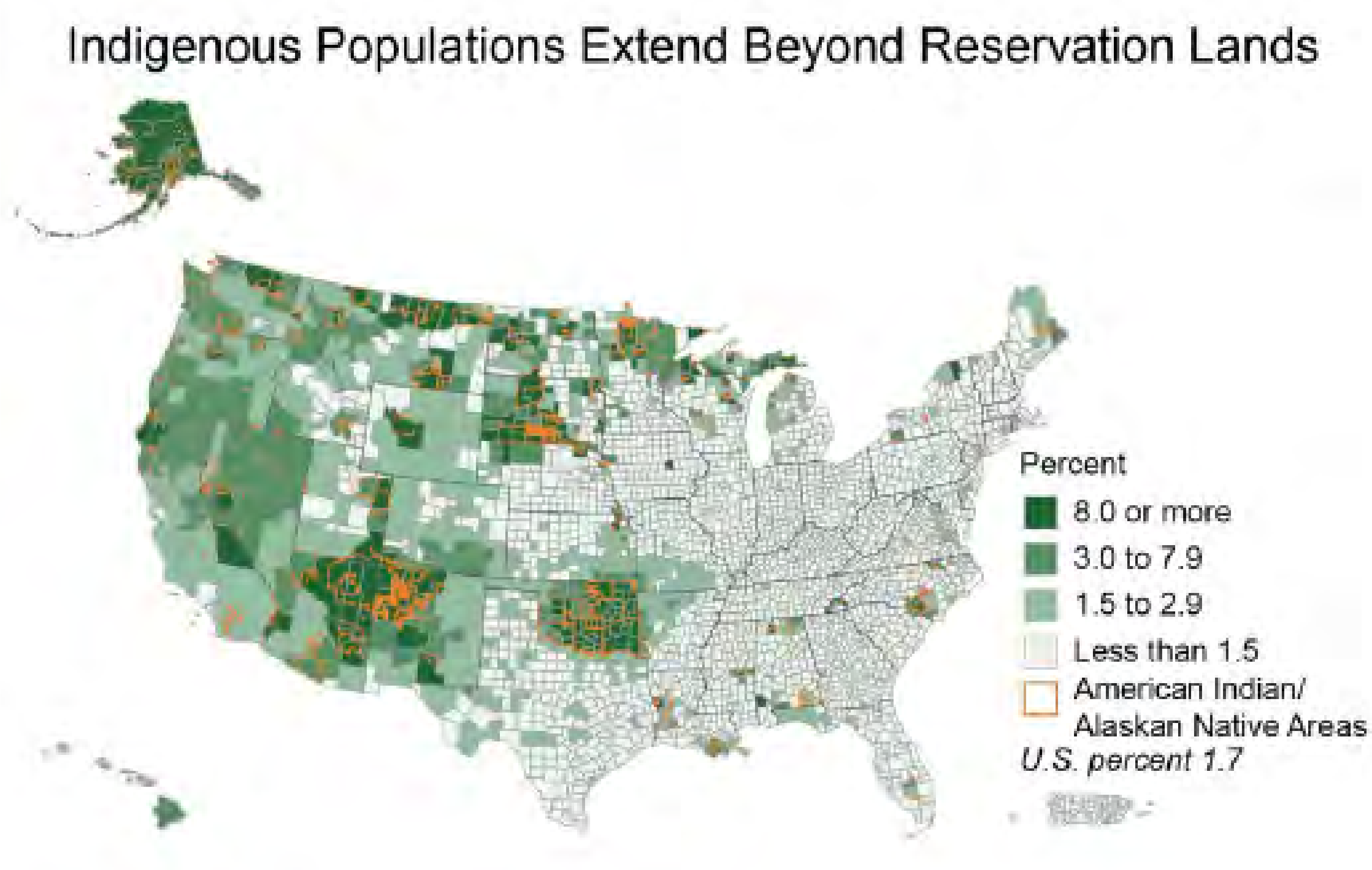
- In the 2016 Presidential election, concern for environmental issues tripled among Latino voters compared to 2012. More than three-quarters (77%) of voters, including half of those who voted for President Trump, support the U.S. moving to 100% renewable energy by 2050.[105]
- 82% of Latinos in the U.S. feel the U.S. should move away from fossil fuels and invest in renewable energy.[106]
- 90% of Latinos in the U.S want climate action and reject the notion that climate action will hurt the economy or cost jobs. In fact, many believe that progressive environmental policies will be good for the country's economic state. In their own lives, many are willing to pay $5 to $10 more per month for renewable energy.[107]

A3.3: Native Americans and Alaska Natives, Climate Change, and Health

Native Americans and Alaska Natives in the United States

There are approximately 5.2 million Native Americans and Alaska Natives in the U.S., a population divided between 566 federally recognized tribes. 1.1 million NA/ANs live on or near reservations, mostly in the Northwest, Southwest, Great Plains, and Alaska.[108] Despite historical decimation of tribes during the Colonial period in the U.S., in the past 10 years, the NA/AN population has increased by 27% since 2000, triple the rate of the total U.S. population.[109] Alaska, Oklahoma, and New Mexico have the highest proportion of Native Americans and Alaska Natives in their populations, and California, Oklahoma, and Arizona have the largest number of Native individuals living within their borders (Figure A3.3.1).[110]

Figure A3.3.1: Indigenous populations of Native Americans and Alaska Natives



Social Determinants of Health and Health Equity

Historical Influences

- **Colonization, Genocide, and Disease:** Throughout the colonization of the United States by Europeans and U.S. history, Native communities have been the targets of violence, bioterrorism, and forced relocation. While it is believed that there were more than 5 million Native peoples in the U.S. before European settlement, there were only 200,000 by 1900.[111]
- **The Indian Removal Act of 1830:** This act sought to displace NA/ANs from their tribal lands to resource-deficient, isolated and infertile land to allow for European settlement across the country. This process resulted in numerous wars against resisting tribes, as well as the "Trail of Tears"—a forced relocation journey in which 3000–4000 Cherokee Nation members perished. Throughout U.S. history, tribes have been actively split into disparate communities and dispossessed of their land, culture, and resources, leaving them vulnerable to physical and mental health challenges.[112]
- **Residential Schools for Native American Children** – In the late 19th and early 20th centuries, boarding schools were opened to assimilate Native Americans children to Western, European culture, which served the purpose of systemically erasing native culture, language, and traditions. Children were punished for speaking their native languages, and sometimes mocked by teachers for traditional practices—effectively making the children see their culture as inferior.[113]

Key Social Determinants

Such historical policies have led to present-day social and health inequities in Native American and Alaskan Native communities. These policies led to a shift from traditional lifestyles, and left long-term secondary impacts of persistent poverty, food and resource insecurity, homelessness, inadequate education, substandard health services, lack of access to electricity and running water, and a lack of modern communication methods— many reservations have no cell phone reception, and less than 10% of residents have internet access.[114] A comparison of some social and economic disparities is seen in Table A3.3.1.

Table A3.3.1 SOCIAL AND ECONOMIC DISPARITIES BETWEEN NATIVE AMERICANS AND ALASKAN NATIVES AND THE GENERAL U.S. POPULATION (2015)

Indicator (2015)	Single-race NA/ANs[115]	General U.S. Population[116]
Have less than high school diploma	20.9%	12.9%
Unemployment	12%	6.3%
Median household income	$41,940	$55,775
Private	44.8%	67.5%
Poverty	26.6%	13.5%

Table continued on next page

Health insurance		
None	20.7%	9.4%
Public	42.8%	34.7%
Private	44.8%	67.5%
Poverty	26.6%	13.5%

Health Inequities

- **Trauma** –The trauma faced from the loss of people, land, and culture has been passed on to subsequent generations via conversation, practices, and attitudes towards these events.[117] The high rates of alcohol abuse in Native American and Alaskan Native communities is thought to be partially attributed to the low self-esteem, loss of cultural identity, and lack of positive role models that stem from this historical trauma.[118]
- **Chronic Illness** – Death rates from chronic liver disease and cirrhosis, diabetes mellitus, unintentional injuries, and chronic lower respiratory disease are significantly higher for NA/ANs than the general U.S. population. NA/ANs' rate of death from diabetes is three times that of the general U.S. population. [119]
- **Behavioral Health** – High levels of alcohol and substance abuse, mental health disorders, suicide, violence, and behavior-related chronic diseases contribute to the lower life expectancy in comparison to the general U.S. population.[120]

Key Climate Change and Health Issues for Native American and Alaskan Native Communities

As a result of discriminatory policies related to historical U.S. settlement NA/ANs often live in geographically isolated areas. They depend heavily on the environment to maintain cultural practices and ways of living and are thus stewards of the environment. Tribal communities' food security, water quality, and land are at risk due to climate change-related weather events, and these in turn have widespread health consequences.

Food Security

See Section 4.8—Food Security

Food Security, Agriculture, and Climate Change

- Crop yields are reduced by extreme heat, drought, and extreme weather events, all of which are increasing in frequency and severity due to climate change.[121]
- Increased atmospheric carbon dioxide results in a reduction in the levels of protein and micronutrients (e.g. calcium, zinc, iron) in important crops like barley, sorghum and soy.[122]
- Extreme weather events can prevent transportation of food products, disrupting food supply chains, increasing prices, and increasing loss due to spoilage.[123]
- Warmer temperatures increase the growth of *Salmonella, Camphylobacter, Rotavirus*, and various *Vibrio*, and harmful algal blooms, increasing the risk of food contamination.[124]

Why Native American and Alaskan Native Communities Are at Risk

- Local Food Resources
  - NA/ANs often rely on traditional foods and subsistence living fishing and farming, impacted significantly by drought, heat, extreme precipitation, and ocean acidification.
  - Arctic communities are already facing issues such as decreased thickness of sea ice, coastal erosion, and altered geographic ranges of some fish. The disruption to hunting and subsistence practices could force relocation.[125]
  - In 40 to 80 years, a loss of more than half of the salmon and trout habitats is predicted throughout the United States due to increased ocean acidity caused by higher atmospheric CO_2 levels.[126]
- **Toxins** – Higher temperatures affect ocean water quality and can lead to increased mercury levels in fish. Mercury is a known neurotoxin disproportionality affecting pregnant women and children.[127]
- **Nutrition** – Loss of traditional foods leads to food shortages, increased food prices in isolated communities (up to 15 dollars for a gallon of milk) and contributes to a lack of proper nutrition.[128] Diagnosed diabetes rates from 6.0% among Alaska Natives to 24.1% among American Indians in southern Arizona.[129]

Infectious Disease

See Section [6.6—Clinical Services]

Infectious Disease, Climate Change, and Health

- The frequency and intensity of extreme precipitation and flooding is increasing with climate change, and more than 50% of water-borne disease outbreaks in the U.S. are associated with extreme rainfall.[130,131]
- Warmer water temperatures, in both ocean and freshwater sources, allow for greater proliferation of microorganisms such as *Vibrio* that cause gastrointestinal and more serious illness, including cholera.[132]

Why Native American and Alaskan Native Communities Are at Risk

- **Water Access** – Native American and Alaskan Native communities who reside in remote areas lack access to clean, potable drinking water at higher rates than other groups in the U.S.[133]
- **Local Food Resources** – Greater reliance on subsistence fishing and harvesting of coastal mollusks may put communities at greater risk of exposure to microorganisms that cause illness.
- **Existing Burden** – The rate of diarrhea-associated hospitalizations for Native American and Alaskan Native children from 2000–2004 was nearly twice the rate among all U.S. infants, and the rate of diarrhea-associated outpatient visits among Native children was higher than for all U.S. children.[134]

Extreme Weather Events

See Section [4.7—Storms and Flooding]

Extreme Weather Events, Climate Change, and Health

- Climate change is expected to increase the strength and resulting destruction of storms due to increased water temperatures leading to more precipitation, flooding, greater storm surges, and strong storm systems and winds.[135]
- Extreme weather causes interruptions in medical care and disrupts critical infrastructure including electricity, sanitation and water treatment, food refrigeration, health care, communications systems and transportation.[136,137]
- Extreme storms can also impact indoor air quality through flooding damage and mold, spread of infectious and vector-borne disease, toxic exposures, and mental health outcomes and can lead to displacement.[138,139]

Why Native American and Alaskan Native Communities Are at Risk

- **Water Access** – 20% of rural Alaskan homes lack access to piped water and a flush toilet, which can leave these populations without access to potable water and clean water to use for washing. [140]
- **Infrastructure** – Researchers have estimated that climate change could add $3.6–6.1 billion to future costs for Alaskan infrastructure repairs by 2030 Renter status leaves families vulnerable following storm damage.[141]
- **Poverty** – In these coastal regions and similarly vulnerable tribal lands, the costs associated with increased damage due to climate change are expected to far outweigh any local government or organization's ability to pay for them, and the high rates of poverty in these communities will make it difficult for tribes to support themselves.[142]
- **Pre-Existing Conditions** – Extreme storms can disrupt access to care and services for these illnesses, leaving Native communities, especially those located in remote areas with already limited resources, vulnerable.[143]

Drought and Wildfires

See Section [4.2—Drought]

Drought, Wildfires, Climate Change, and Health

- Rising temperatures will cause significant challenges to forest communities in the Southwest.[144]
- An increased risk of forest fire as well as a loss of culturally significant native plants and animal species has already been observed.[145]
- Due to climate change, megadroughts are expected Southwest and Central Plains, impacting drinking water availability.[146]

Why Native American and Alaskan Native Communities Are at Risk

"Fire affects the plants, which affect the water, which affects the fish, which affect terrestrial plants and animals, all of which the Karuk rely on for cultural perpetuity."[147]

- **Geography** – Native American and Alaska Native populations living in and near forested regions are at increased risk of displacement, smoke-exposure, injury, and property loss from wildfires, especially if more populated areas are prioritized for fire management response.[148]
- **Food Security** – Native American and Alaskan native populations face high food prices for healthy foods, and a lack of proper nutrition: one in four Native American children ages 2 to 5 years old is obese, and a third of those ages 6–19.[149]

Traditional Ecological Knowledge

NA/AN communities view the natural environment as a living entity to be honored and respected. This relationship has fostered the development of traditional ecological knowledge, or TEK, "an accumulating body of knowledge, practice, and belief…about the relationship of living beings (human and non-human) with one another and with the environment."[150] It is developed through centuries of direct contact and careful observations of animal and plant species, natural processes, and landscapes, and is passed down from generation to generation.

TEK is an essential component of adaptation efforts in NA/AN communities and can be leveraged to develop strategies specific to a geographical region. While many traditional practices are becoming more difficult to maintain, some communities have merged TEK with western-based approaches for increased resiliency. The Pyramid Lake Paiute Tribe, Nevada's largest tribe, worked with scientists to develop key ecological indicators such as snow pack level, lake water temperature, and bird and fish counts to keep record of variations potentially linked to climate change.[151] These records can be used in developing effective natural resource management.

In an effort to decrease disaster risk, the Navajo Reservation has also employed a joint approach with climate researchers and Navajo elders working together to record meteorological and hydrological changes.[152] Thus, merging traditional practices and knowledge with modern advancements may be the key to developing effective adaptation strategies.

A3.4: Asian Americans, Climate Change, and Health

Asian Americans are the fastest growing racial group in the United States.[153] However, Asian Americans still represents a small proportion of the total U.S. population, so it is difficult to achieve a fully representative study of this diverse group. Little information is available on the potential for disproportionate health impacts from social or climate factors within these populations.[154]

This brief highlights how social determinants of health and climate change could interact to exacerbate existing health outcomes in Asian Americans communities, and how climate solutions offer opportunities for health.

Asian Americans in the United States

While Asian Americans are the fastest growing racial group in the U.S., in total, this group, which comprises individuals from many different countries, makes up a small percentage of the total U.S. population. In 2011, over 18 million individuals in the U.S. identified as Asian American, making up 5.8% of the total population. 83% of these individuals identified as Chinese, Filipino, Indian, Vietnamese, Korean, and Japanese American (Table A3.4.1).[155]

Social Determinants of Health and Health Equity

Asian Americans live with a history of discrimination and present-day inequities that may continue to grow as Asian American communities expand in the U.S.

Historical Influences

- **Immigration Restrictions** – Until the Immigration Act of 1965, immigrants from Asian countries were restricted in the U.S. Because of these restrictions, a large proportion of the current U.S. Asian American population are first-generation (in 2011, 76% of Asian Americans were immigrants), which has in part lead to difficulties in sampling and representing these different groups in health.[156]

- **Japanese Internment** – Following the Japanese attack on Pearl Harbor in 1941, over 120,000 Japanese Americans of all ages, mostly from the Western states of California, Oregon, Washington, and Arizona, were forced to live separated from society in camps.[157] Studies have found lasting impacts of traumatic stress, especially for younger individuals, and an increase in cardiovascular disease in interned adults.[158]

- **20th Century Discrimination** – Due to U.S. conflicts in Korea and Vietnam and the rise of communism in China in the 1940s, immigrants from these countries faced discrimination based on what was portrayed as "dangerous" connections they had to U.S. enemies.[159] The lasting impacts from this discrimination, and its continual impacts in the present, have led to poorer mental health outcomes and increased risk of cardiovascular disease, diabetes, and other chronic health problems in various Asian American groups.[160]

- **"Model Minority"** – Originating in a 1966 New York Times article recounting the success of Japanese Americans in overcoming discrimination and assimilating to U.S. culture, this term has since been used to describe multiple Asian American groups, pointing out their higher educational attainments and financial security in comparison to the general U.S. population.[161] This label, while damaging to other minority groups who were painted as somehow less capable of achieving similar "successes," also diverts attention away from real health and economic inequities that Asian Americans face and applies pressure for Asian Americans to conform to mainstream culture.

Table A3.4.1 NUMBER OF ASIAN AMERICANS IN 2010

All Asian Americans in 2010 Census—17,320,856 Including those <18 years old	
Chinese (Including 215,441 Taiwanese)	4,010,114
Filipino	3,416,840
Indian	3,183,063
Vietnamese	1,737,433
Korean	1,706,822
Japanese	1,304,286
Pakistani	409,163
Cambodian	276,667
Hmong	260,073
Thai	237,583
Laotian	232,130
Bangladeshi	147,300
Burmese	100,200
Indonesian	95,270
Nepalese	59,490
Sri Lankan	45,381
Malaysian	26,179
Bhutanese	19,439
Mongolian	18,344
Okinawan	11,326

Key Social Determinants

- **Language** – Some Asian American populations have low English proficiency rates, which can lead to difficulties in accessing and receiving effective care.
  - In 2010, 53% of Vietnamese American, 46% of Korean American, 46% of Chinese American, 46% of Taiwanese American, 24% of Japanese American, 22% of Filipino American and 22% of Asian Indian reported limited English proficiency[162]
  - In 2014, 34% of Korean Americans, 29% of Vietnamese Americans, 19% of Asian Indians, and 18% of Filipino Americans, and 10% of Japanese Americans surveyed reported poor communication with their physician.[163]
- **Education** – Educational attainment varies widely throughout different Asian American groups, and educational access is a known determinant of health.
  - In 2007, one in three Vietnamese Americans and one in ten Korean Americans did not have a high school degree.[164]
- **Insurance** – Health care coverage varies widely among different Asian American populations.
  - 6% of Asian Americans are covered by employer-sponsored health insurance (compared to 26% of all Americans) (Table A3.4.2).[165]

Table A3.4.2 PERCENTAGE OF UNINSURED ASIAN AMERICANS

Population	Percent Uninsured (2010)[166]
Korean Americans in Los Angeles	50%
Chinese Americans in Oakland	35%
Southeast Asians in San Diego	37%
Vietnamese Americans in San Francisco	15%
Asian Women in Southern California	21%

Key Health Inequities

Many Asian American ethnic groups are not represented in current research due to their limited numbers in the U.S., diversity within sub-groups, wide geographic dispersion, and language barriers—all which present difficulties in understanding potential health inequities and vulnerabilities within Asian American communities.[167] Studies often assess all Asian American populations as one conglomerate group, overlooking potential inequities between these groups based on country of origin.[168]

- Asian Americans are 4.5 times as likely to be infected with Hepatitis B and 10% more likely to be diagnosed with diabetes than Whites.[169]

Key Climate Change and Health Issues for Asian American Communities

While no studies have assessed potential vulnerabilities in Asian American communities to climate change, there is emerging research on potential health impacts that burden Asian American populations in the U.S. These health outcomes are expected to worsen with climate change.

Asian American Environmentalists

Surveys from the California League of Conservation Voters found that 83% of Asian American Californian voters described themselves as environmentalists and 69% were extremely concerned about global warming.[170]

Air Quality

See Section 4.4—Air Quality

Air Quality, Climate Change, and Health

- Climate change makes it ever more difficult to attain national air quality standards for ground-level ozone, a major component of smog, and is expected to cause increased exposure to particulate matter pollution in urban settings.[171]
- Common sources of greenhouse gas emissions (i.e. from motor vehicles and energy production) also produce many different air toxics, which are harmful to health.[172]
- Climate change may impact the residence time of air toxics in the air, while also their impacting dispersal and transport through the air.[173]
- Individuals with pre-existing chronic conditions, such as asthma, other respiratory disease, and cardiovascular disease, are at greater risk of disease exacerbations and complications due to air pollution.[174]

Why Asian American Communities Are at Risk

- **Existing Burden** – Asian Americans eligible for Medicare have a higher estimated risk of death from PM2.5 exposure than the general population.[175]
    - Chinese American and Korean American populations were found to have the highest mean cancer risk from hazardous air pollutant exposure among all racial groups in the U.S., which could increase with climate change air impacts.[176]
        - Southeast and South Asian populations held the fourth and fifth highest cancer risk from hazardous air pollutants.[177]

- Cancer is the leading cause of death across all Asian Americans groups in the United States, and two leading cancer types—lung and breast—are linked with hazardous air pollutants and other environmental exposures.[178]

- Climate change impacts on air quality are expected to exacerbate cardiovascular disease, which is the leading cause of death in Asian Indians, Filipino and Japanese American men and Asian Indian women, and climate change's impacts on air pollution are expected to exacerbate the impacts of this chronic illness.[179]

Extreme Heat

See Section 4.1—Extreme Heat

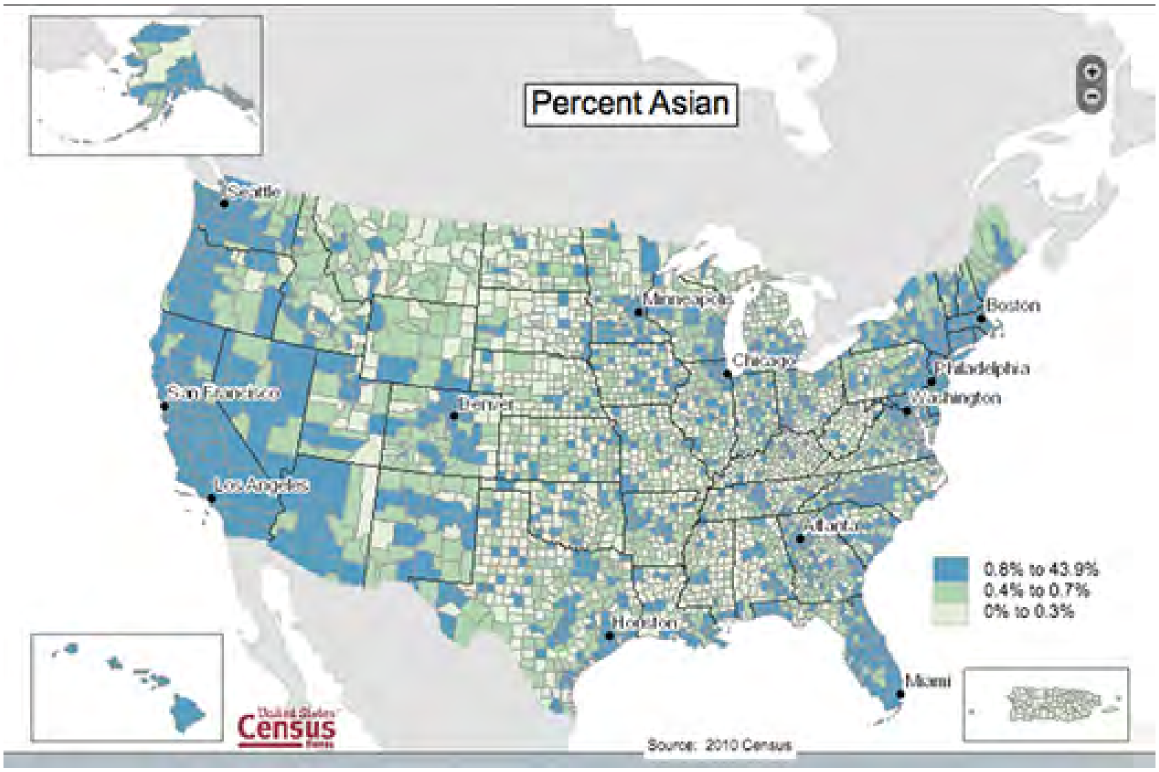
Extreme Heat, Climate Change, and Health

- Extreme heat results in excess death and illness through heat stroke, heat exhaustion, and exacerbations of chronic illness.[180]
- Heat increases ozone levels, exacerbating asthma, other respiratory disease and cardiovascular disease.[181]
- Due to climate change, extreme heat events are increasing in frequency, severity, and duration.[182]

Why Asian American Communities Are at Risk

- **Neighborhood** – Asian Americans are 32% more likely than Whites to live in areas where heat-retaining hard surfaces cover more than half the ground, and more than half the population lacks access to cool shade-producing green space and tree canopy.[183]

Figure A3.4.1: Asian population by county in the U.S. according to the 2010 census.



Sea Level Rise and Flooding

See Section 4.6—Sea Level Rise

Sea Level Rise, Climate Change, and Health

- Climate change is causing sea level rise around the world, as a result of melting glaciers and thermal expansion due to rising ocean temperatures.[184]
- Flooding and storm surges associated with sea level rise increase risks for drowning, injury and displacement, which can lead to additional mental health outcomes and trauma, developmental impacts on children, and difficulties with chronic disease management.[185,186,187,188]
- In areas with waste facilities, landfills, smelters, ship yards, and military bases along the coast, rising sea level could also lead to the spread of toxic sediments and contamination of ground and surface waters.[189]

Why Asian American Communities Are at Risk

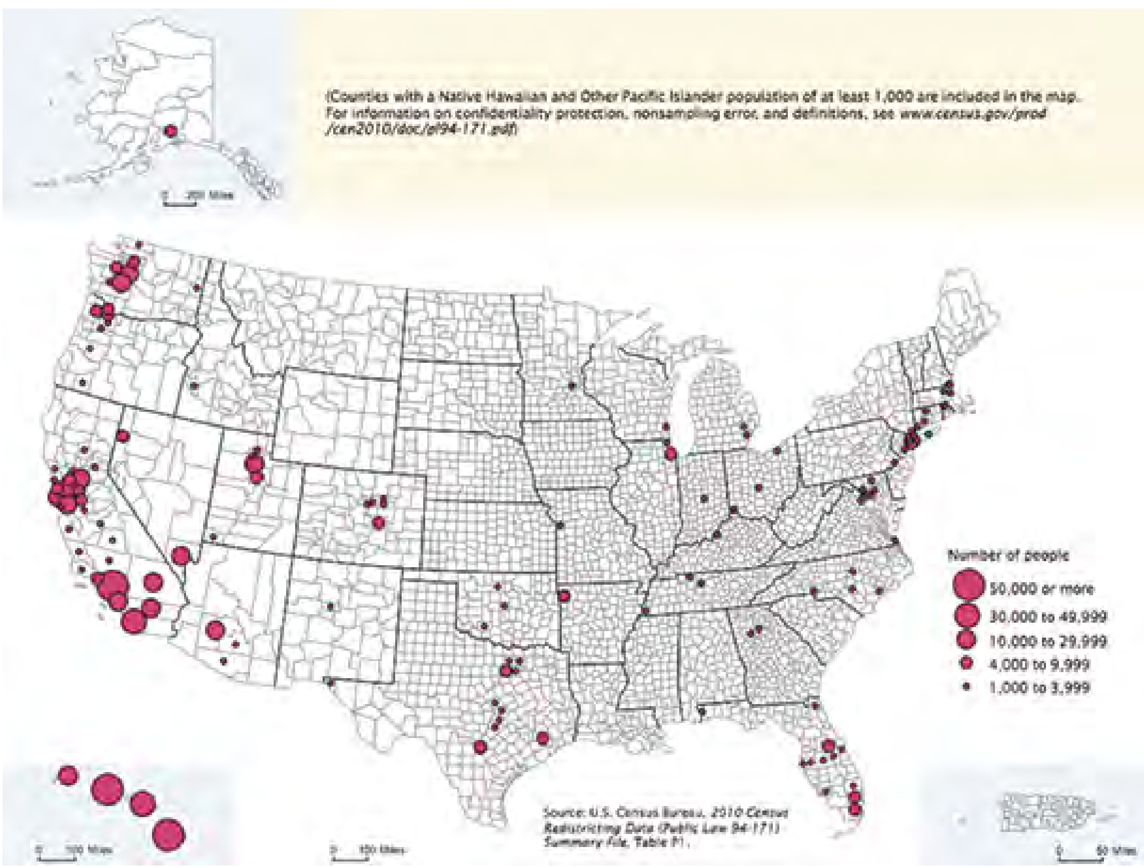
- **Geography** – Census data demonstrates that Asian American populations are highly concentrated in coastal regions, putting their communities, especially those that are low-income, at risk of displacement following rising sea levels.[190]

A3.5: Native Hawaiians and Pacific Islanders, Climate Change, and Health

Native Hawaiians and Pacific Islanders in the United States

Native Hawaiians and Pacific Islanders in the U.S. refer to individuals who have origins in Hawaii, Guam, Samoa, or other Pacific Islands. According to the 2010 U.S. Census, there were over 1,225,000 Native Hawaiian and Pacific Islanders (NHPI) in the U.S., making up .4% of the population (Figure A3.5.1).[191] This census data also showed that 29% of this population reside in Hawaii and 23% reside in California, the only states with over 100,000 Native Hawaiian and Pacific Islanders, though Iowa, Missouri, South Dakota, North Dakota, Nebraska, Kansas, Ohio, and Vermont experienced a growth greater than 50 percent in their NHPI populations between 2000 and 2010.[192] 74% of these communities are made up of Native Hawaiians, Samoans, and Guamanians/Chamorros individuals, with the remaining 26% made up of Tongans, Fijians, Marshallese, and other Pacific Islanders.[193]

Figure A3.5.1: Native Hawaiian and other Pacific Islanders by county (2010 census).



Social Determinants of Health and Health Equity

Historical Influences

- **Colonization** – The U.S. formed relationships with Pacific Island nations to aid trade and military advances with Asian countries, causing economic shifts away from communal agricultural living to industrialization and urbanization. Cultural shifts also had vast mental and physical health impacts.[194]
- **Aggregated Data** – Historically, census and health data for Native Hawaiians and Pacific Islanders has been aggregated with Asian American data, distorting views of health within both groups. This is particularly dangerous for NHPI because aggregated data tends to overshadow real health needs in these communities and prevents informed and active responses.[195]
- **Military Testing** – U.S. military operations tested nuclear bombs on Pacific Islands, such as Micronesia, in the 1940s and 1950s, which exposed thousands of Pacific Islanders to related toxics and nuclear fallout.[196]

Key Social Determinants

Such historical policies have led to present-day social and health inequities in Native Hawaiian and Pacific Islander communities (Table A3.5.1 and Table A3.5.2).

Table A3.5.1 INCOME, POVERTY STATUS, AND EDUCATION OF NATIVE HAWAIIANS AND PACIFIC ISLANDERS, 2011

2011 Demographic and Socioeconomic Profiles[197]

	Per Capita Annual Income	% of Families Below Poverty Line	% of Adults who Attained a Bachelor's Degree or Higher
General U.S. Population	$27,100	9.9	27.8
Native Hawaiian/Pacific Islander	$19,020	11.5	17.1
Fijian	$21,456	5.3	12.4
Guamanian/Chamorro	$20,054	9.6	18
Native Hawaiian	$20,954	9.4	18
Samoan	$15,567	13.6	12.6
Tongan	$11,907	18.4	15
Other Pacific Islander	$19,478	14.5	28.2

Table A3.5.2	2014 NATIVE HAWAIIAN AND PACIFIC ISLANDER NATIONAL HEALTH INTERVIEW SURVEY (NHIS)[198]		
Indicator	**General U.S. Population (%)**	**Native Hawaiian (%)**	**All Pacific Islander (%)**
Obese BMI	29.3	37.9	47.8
Hypertension	24.5	27.4	29.8
Heart Disease	10.9	11.3	10.1
Adults with Asthma	7.4	13.3	5.8
Children with Asthma	8.6	16.7	5.2
Adults with Diabetes	8.5	14.2	17.7

Health Inequities

Key Climate Change and Health Issues for Native Hawaiians and Pacific Islanders

Extreme Weather Events

See Section 4.7—Storms and Flooding

Extreme Weather Events, Climate Change, and Health

- Climate change is expected to increase the strength and resulting destruction of storms due to increased water temperatures leading to more precipitation, flooding, greater storm surges, and strong storm systems and winds.[199]
- Extreme weather causes interruptions in medical care and disrupts critical infrastructure including electricity, sanitation and water treatment, food refrigeration, health care, communications systems and transportation.[200,201]
- Extreme storms can also impact indoor air quality through flooding damage and mold, spread of infectious and vector-borne disease, toxic exposures, and mental health outcomes and can lead to displacement.[202,203]

Why Native Hawaiian and Pacific Islander Communities Are at Risk

- **Geography** – Models predict that by 2100, Hawaiʻi and some Pacific islands will experience about 1ft–2.5ft higher sea-level rise when compared to global average.[204] More tropical cyclones developed in the Pacific between 1991 and 2010 than were recorded in the previous century.[205] Communities who remain on these islands are at risk of physical and mental health outcomes from such disasters, as well as other long-term impacts of structural damage. Families and communities living in the Continental U.S. will also be impacted through the stress of experiencing these tragedies through familial suffering. Those who move will suffer the economic, social, and emotional losses associated with forced migration.

- **Infrastructure** – Hawai'i already closes beaches annually due to polluted runoff from storm water containing sewage or chemicals from industrial facilities.[206] This runoff is expected to increase, as storms grow stronger and more damaging.
- **Poverty** – Some Pacific Islander and Native Hawaiian communities lack socioeconomic resources to respond to the damage and health impacts resulting from extreme storms. During an extreme weather event, these households have a smaller cushion against property damage or injuries, further complicated by lack of access to medical care and insurance. [207]
- **Pre-Existing Conditions** – Extreme storms can disrupt access to care and services for chronic and infectious illnesses, leaving these communities vulnerable considering the high prevalence of illnesses such as diabetes and asthma.[208]
- **Existing Burden** – In 2001 and 2002, there was an outbreak of Dengue fever in Maui, during a period of warmer and wetter conditions, which are expected to increase with climate change.[209] Hawai'i has historically had outbreaks of Leptospirosis, an infectious disease from waste-polluted surface waters, and research has demonstrated that infection rates increase during wetter periods.[210] Hawai'i and other Pacific Islands are known tourist attractions, which could present additional risk of travelers bringing new disease vectors onto the island.
- **Neighborhood** – 84% of Native Hawaiian and Pacific Island neighborhoods in Los Angeles are located within one mile of a Superfund site, the highest of any racial group.[211] These communities are at additional risk following flooding due to the likelihood of runoff toxics and pollution from these sites into their neighborhoods and drinking water sources.

Extreme Heat

See Section 4.1—Extreme Heat

Extreme Heat, Climate Change, and Health

- Extreme heat results in excess death and illness through heat stroke, heat exhaustion, and exacerbations of chronic illness.[212]
- Heat increases ozone levels, exacerbating asthma, other respiratory disease and cardiovascular disease. [213]
- Due to climate change, extreme heat events are increasing in frequency, severity, and duration.[214]

Why Native Hawaiian and Pacific Islander Communities Are at Risk

- **Geography** – The average temperature in Honolulu has increased 4.4°F over the last century and research suggests it will continue to increase.[215]
- **Existing Burden** – The high prevalence of asthma, respiratory illness, and precursors to cardiovascular disease present additional vulnerabilities for these communities during extreme heat events.[216]

Food Security

See Section [4.8—Food Security]

Food Security, Agriculture, and Climate Change

- Crop yields are reduced by extreme heat, drought, and extreme weather events, all of which are increasing in frequency and severity due to climate change.[217]
- Increased atmospheric carbon dioxide results in a reduction in the levels of protein and micronutrients (e.g. calcium, zinc, iron) in important crops like barley, sorghum and soy.[218]
- Extreme weather events can prevent transportation of food products, disrupting food supply chains, increasing prices, and increasing loss due to spoilage.[219]
- Warmer temperatures increase the growth of *Salmonella, Camphylobacter, Rotavirus*, and various *Vibrio*, and harmful algal blooms, increasing the risk of food contamination.[220]

Why Native Hawaiian and Pacific Islander Communities Are at Risk

- **Local Food Resources** – For communities living on these islands, local food systems rely on seasonal rainfall, which could be impacted by climate change, further reducing these communities' access to local and healthy food sources.[221]
- **Pre-Existing Conditions** – Throughout the U.S. and Pacific Islands, the prevalence of obesity and diabetes is higher in Native Hawaiian and Pacific Island communities than the general public.[222] As climate change is expected to decrease nutritional value of foods while increasing wider food insecurity, the prevalence of these illnesses could increase in these communities, and individuals who have already been diagnosed will be even more vulnerable.

Air Quality

See Section [4.4—Air Quality]

Air Quality, Climate Change, and Health

- Climate change makes it ever more difficult to attain national air quality standards for ground-level ozone, a major component of smog, and is expected to cause increased exposure to particulate matter pollution in urban settings.[223]
- Common sources of greenhouse gas emissions (i.e. from motor vehicles and energy production) also produce many different air toxics, which are harmful to health.[224]
- Individuals with pre-existing chronic conditions, such as asthma, other respiratory disease, and cardiovascular disease, are at greater risk of disease exacerbations and complications due to air pollution.[225]

Why Native Hawaiian and Pacific Islander Communities Are at Risk

- **Neighborhood** –A higher proportion of Pacific Islanders in the U.S. live in counties with pollution exceeding the federal air quality standards when compared with Asians and other racial groups.[226]
- **Pre-Existing Conditions** – Throughout the U.S. and Pacific Islands, the prevalence of asthma is higher in Native Hawaiian and Pacific Island communities than the general public.[227] Worsening air quality due to climate change is expected to worsen such conditions and increase their prevalence.

Climate Resilience

The impacts of climate change are a daily reality for Native Hawaiian and Pacific Islander communities and projected impacts threaten the very existence of their lands and culture into the future. These impacts echo into NHPI communities in the U.S., as individuals fear for their families living on these islands while also facing their own vulnerabilities due to climate change. Despite these challenges, Native Hawaiian and Pacific Islanders have strengths that foster climate resilience.

- Cultural identity and family ties can build resiliency in Native Hawaiian and Pacific Islander communities, building social cohesion and allowing communities to prepare together for impending threats. [228]
- Regional culture of communication and collaboration among Pacific Islands allows for better adaptation planning, as larger and smaller islands can collaborate to use their different strengths to confront climate challenges.[229]

Appendix 4: Types of Greenhouse Gas Emissions

Table A4.1 GREENHOUSE GAS EMISSIONS: SOURCES, LIFETIMES, GLOBAL WARMING POTENTIAL

Name	% of U.S. GHG Emissions 2016	Sources	Lifetime in the Atmosphere	Global Warming Potential (GWP)
Carbon Dioxide (CO2)	81%	Electricity production, transportation, numerous industrial processes.	37.9	1
Methane (CH4)	10%	Livestock manure, food decomposition; extraction, distribution, and use of natural gas.	27.4	25
Nitrous Oxide (N2O)	6%	Vehicles, power plant emissions.	11.3	298
Black carbon (soot, PM)	> 1%	Diesel engines, wildfires, biomass in household cookstoves (developing countries).	13.3	3,200
Fluorinates gases: PFs, HFCs, NF3, SF6	3%	No natural sources. These are synthetic pollutants found in coolants, aerosols, pesticides, solvents, fire extinguishers. Also used in the transmission of electricity.	16.7	PFCs: 7,000-12,000 HFCs: 12,000-14,000 NF3: 17,200 SF6: 22,800

Appendix 5: Climate and Health Considerations for Clinical Care Providers

Table A5.1

RECOMMENDATIONS REGARDING HEALTH RISKS, CLIMATE-RELEVANT PATIENT EDUCATION, AND CARE MANAGEMENT

People with Asthma *(See Section 6.4—Chronic Disease)*

Climate-health risk	Climate-relevant patient education	Care management and coordination
• Exacerbation of asthma symptoms and attacks related to: • High ozone levels due to rising average temperatures and extreme heat • Smoke exposure from wildfires • Mold exposure after flood events and extreme precipitation • Dust exposure with drought • More pollen exposure with longer, stronger allergy seasons • Reduced medication access and management with disruption and displacement after extreme weather events	• Advise patients to check the Air Quality Index and adjust outdoor activity on bad air days. http://airnow.gov/index.cfm?action=aqibasics.aqi • For patients who smoke (or whose family members smoke), encourage them to quit and provide cessation support. • Educate patients to avoid climate-related asthma triggers: keep home and car windows closed on days with bad air from wildfire smoke, high pollen counts, dusty conditions; set home and car air conditioners to recirculate (close air intake); use HEPA air filters if available to decrease indoor air pollution. • Educate patients about indoor mold exposure; provide information about how to get help with home clean-up after flooding.	• Integrate reminders to check the Air Quality Index— especially on hot days—-into asthma management plans. • Work with schools, camps, and childcare providers to integrate heat and ozone considerations into asthma management plans; advise them on adjusting outdoor activities when air quality is bad. • Work with public health and home visiting agencies to screen and refer for asthma-related risks in the home, e.g. leaky pipes, windows and doors; flood risk; proximity to polluting sources; need for home weatherization, air conditioning or fans; and windows or doors that are not sealed.

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People with Diabetes *(See Section 6.4—Chronic Disease)*		
Climate-health risk	Climate-relevant patient education	Care management and coordination
• Increased risk of heat illness due to rising average temperatures and extreme heat events • Insulin storage and disease management risks related to rising average temperatures and extreme heat events, and power outages or displacement following extreme weather events	• Educate patients about risks of heat illness and how to prevent it. • Educate patients about the impact of heat on insulin, proper storage of insulin and how to maintain adequate temperature control during extreme heat or evacuations. • Educate and refer patients to the Low Income Home Energy Assistance Program (LIHEAP) to facilitate assistance with energy costs.	• Work with cooling centers and shelters to ensure proper storage capability for insulin. • Work with public health and home visiting agencies to assess insulin storage capacity at home and resources for proper hydration.. and to screen and refer for heat risks in the home, including shades, fans, air conditioning, and windows or doors that are not sealed.

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People with Cardiovascular Disease *(See Section 6.4—Chronic Disease)*		
Climate-health risk	Climate-relevant patient education	Care management and coordination

• Increased risk of heat illness due to rising average temperatures and extreme heat events.
• Increased risk of cardiovascular complications, including myocardial infarction and uncontrolled blood pressure, related to:
  ◦ higher temperatures and impacts of heat on cardiovascular medications
  ◦ ozone levels associated with higher temperatures
  ◦ smoke and dust exposure associated with wildfires and drought
  ◦ stress and/or medication management and access following extreme weather events
	• Educate patients about their risks of heat illness and how to prevent it
	• Inform patients about the risks of some medications and heat.
	  ◦ Some medications, including medications to treat hypertension, heart failure or other cardiovascular disease, increase the risk of heat illness, while others lose their potency or result in adverse side effects related to heat: https://www.polkcountyiowa.gov/media/189984/medication-handout.pdf
	• Educate and refer patients to the Low Income Home Energy Assistance Program (LIHEAP) to facilitate assistance with energy costs.
	• Educate patients on the impacts of ozone and wildfire smoke on cardiovascular health. Advise them to check air quality levels during wildfires and to limit outdoor air exposure when air quality is poor.
	• If patients are sheltering in place due to wildfire, advise them to keep windows and doors closed, set air conditioners to recirculate (close air intake) and use HEPA air filters if available to decrease indoor air pollution.
		• Work with public health and home visiting agencies to screen and refer for heat and air quality-related risks in the home, including shades, fans, air conditioning, and windows or doors that are not sealed.

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People with Mental Illness and Mental and Behavioral Health Considerations for all Populations *(See Section 6.4—Chronic Disease)*		
Climate-health risk	Climate-relevant patient education	Care management and coordination
• Extreme weather events, including wildfire, drought, storms and floods: ◦ Increased risk of post-traumatic stress disorder, depression, suicide, anxiety, substance abuse and interpersonal violence following extreme weather. ◦ Increased risk of complications related to medication access and management due to displacement. • Heat: ◦ Increased risk of violence, aggression, suicide and hospitalization for those with mental illness. ◦ Interactions between some psychotropic medications and heat increase the risk of adverse medication effects and/or heat illness.	• Educate patients with mental illness about their risks of heat illness and how to prevent it • Inform patients about the risks of some medications and heat. ◦ Some medications, including psychotropic medications, increase the risk of heat illness, while others lose their potency or result in adverse side effects related to heat: https://www.polkcountyiowa.gov/media/189984/medication-handout.pdf • Talk to all your patients about climate change risks and associated mental health impacts, and refer them for mental health services, as well as social support services to mitigate stress related to the economic and social impacts of climate change, including e.g. LIHEAP home energy assistance, SNAP and WIC food assistance. • Educate and refer patients to the Low Income Home Energy Assistance Program (LIHEAP) to facilitate assistance with energy costs.	• Closely monitor patients during and after extreme heat and weather events, including drought, and assess for exacerbation of mental illness, heat illness or adverse medication effects. • Coordinate with local mental health service agencies to provide outreach, screening and referral for services during and after climate-related weather events (heat, extreme weather, drought).

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Elderly		
Climate-health risk	**Climate-relevant patient education**	**Care management and coordination**
• Increased risk of heat illness due to rising average temperatures and extreme heat events. Risk can be related to decreased thermoregulatory capacity, decreased mobility and/or decreased social connectivity. • Greater susceptibility to dehydration in heat and drought. • Increased susceptibility to air quality impacts such as ozone, smoke and dust exposure related to heat, wildfires and drought. Impacts include complications for asthma, COPD and other respiratory disease. • Elderly patients with limited mobility and/or social connections are at increased risk of injury, illness and death related to extreme weather events.	• Educate patients about their risks of heat illness and how to prevent it • Inform patients about the risks of some medications and heat. ○ Some medications increase the risk of heat illness, while others lose their potency or result in adverse side effects related to heat: https://www.polkcountyiowa.gov/media/189984/medication-handout.pdf • Educate patients on how to avoid climate related triggers for respiratory disease: keep home and car windows closed on days with bad air related to wildfires, high pollen counts, dusty drought conditions; set home and car air conditioners to recirculate (close air intake) and use HEPA air filters if available to decrease indoor air pollution. • Educate and refer patients to the Low Income Home Energy Assistance Program (LIHEAP) to facilitate assistance with energy costs. • Educate patients about indoor mold exposure; provide information about how to get help with home clean-up after flooding.	• Monitor patients closely during periods of extreme heat or poor air quality, particularly those on heat-sensitive medications, those with limited mobility, cognitive impairment, or chronic illness such as diabetes, cardiovascular, renal, or respiratory disease. • Coordinate with public health nurses to integrate climate and health considerations into geriatric and home assessments, including screening for air conditioning, ventilation, shade, and whether they have an emergency plan and make referrals accordingly. • Coordinate with senior living and activity centers to develop heat and air quality protocols related to activity, nutrition, hydration, and medication management and safety checks with elderly patients.

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Young Children *(See Section 6.1—Maternal Health)*		
Climate-health risk	Climate-relevant patient education	Care management and coordination
• Increased risk of heat illness due to rising temperatures and extreme heat events • Increased risk of asthma and asthma exacerbation related to: ◦ Higher ozone levels associated with rising temperatures. ◦ Exposure to wildfire smoke. ◦ Exposure to dust associated with drought. ◦ Exposure to mold associated with storms, floods and increasing precipitation. ◦ Sensitivity to longer, stronger pollen seasons. • Increased risk of infectious disease from food, water, air and vector borne pathogens. • Increased risk of PTSD, anxiety, and learning and behavioral issues related to trauma and/or displacement associated with extreme weather events. • Increased risk of malnutrition related to climate-associated food insecurity.	• Educate children and caregivers on climate risks and safety measures ◦ Heat: Never leave children alone in a hot car or home; keep children hydrated by pushing fluids, or increasing breastfeeding frequency; modify or limit outdoor play; seek shade or cooling centers; dress children in loose, light clothing and do not swaddle infants in heat. ◦ Air quality, including ozone, smoke, pollen, mold and dust: check the Air Quality Index (advise on interpretation and activity guidance); keep home and car windows and doors closed and recirculate air on bad air days or when traveling under wildfire or drought conditions; modify or limit outdoor play; assess and advise on any changes or modifications to asthma management plans for bad air days; signs of indoor mold and resources for mold remediation.	• Ensure adequate vaccine storage and transport during heat events. • Monitor children with asthma closely during heat events and bad air days, assess and modify asthma management plans accordingly. • Monitor children closely during extreme heat events. Assess access to clean water, nutrition support, air conditioning or cooling centers. • Monitor children closely after extreme weather events and assess for symptoms of PTSD, learning or behavior difficulties. Coordinate with school, public health nurses and community health workers to provide mental health support and resources • Coordinate with community health workers, public health nurse and schools, camps or childcare providers to create heat and air quality protocols, and to integrate heat and air quality considerations into asthma management plans.

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Young Children *(See Section 6.1—Maternal Health)*		
Climate-health risk	Climate-relevant patient education	Care management and coordination
	○ Infectious disease: provide information on water safety alerts (harmful algal blooms, waterborne pathogens) for recreational water sources or during storms and floods; dress appropriately and use insect repellent when playing near heavily wooded or brush areas; emphasize good sanitation and food safety practices. ○ Extreme events: advise families to create an emergency response plan, with special consideration for reunification; advise parents on signs and symptoms of PTSD, learning or behavior issues related to trauma from extreme events and provide resources for support. ○ Nutrition: Advise and promote strong nutritional standards; provide resources for nutrition support (WIC, SNAP). • Educate and refer patients to the Low Income Home Energy Assistance Program (LIHEAP) to facilitate assistance with energy costs.	

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Pregnant Women and Infants *(See Section 6.1—Maternal Health)*

Climate-health risk	Climate-relevant patient education	Care management and coordination
Heat and drought • Increased risk of heat illness, dehydration, renal failure and infectious disease • Increased risk of preterm birth, poor fetal growth, low birth weight, and infant mortality • Air quality: wildfire smoke, higher ozone levels • Increased risk of preterm birth, low birth weight **Floods and storms** • Increased risk for waterborne disease • Increased risk of anemia, eclampsia, spontaneous abortion, preterm birth, low birth weight • Increased susceptibility to mold and environmental toxins.	• Advise patients about the risks of extreme heat for pregnancy and how to stay safe, including information on hydration, exertion, cooling centers, and social support. • Educate and refer patients to the Low Income Home Energy Assistance Program (LIHEAP) to facilitate assistance with energy costs. • Advise patients to check the Air Quality Index (AQI) http://airnow.gov/index.cfm?action=aqibasics.aqi for unsafe ozone and particulate levels during hot days and in event of wildfires. Even if pregnant women live far from wildfire sites, smoke plumes can travel thousands of miles, so they should monitor air quality closely. • Advise and assist patients to create an emergency response plan in case of need to evacuate, for example, in event of flood, wildfire, extreme weather or other emergent climate threat. For more information and guidance, visit the CDC site for emergency preparedness for pregnant women and infants. • Advise patients on the risks of illness from food, water and vector borne pathogens and to take appropriate precautions against illness:	• Closely monitor pregnant patients during extreme heat events, on bad air days, during or after extreme weather events and assess for relevant climate-health risks. • Coordinate with WIC, Black Infant Health, and public health nurses to integrate climate and health considerations into pregnancy and home assessments, including screening for air conditioning, ventilation, shade, window screens, vector habitat near the home, and whether they have an emergency plan. Make referrals accordingly.

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Pregnant Women and Infants *(See Section 6.1—Maternal Health)*		
Climate-health risk	Climate-relevant patient education	Care management and coordination
	○ Prepare all food with safe, clean water. ○ Wear protective garments and insect repellent when outdoors near mosquito and tick habitats. Use screens on windows and doors at home to keep insects out. ○ Recognize the symptoms of Lyme disease and Dengue. ○ CDC Lyme Disease and pregnancy fact sheet: http://www.cdc.gov/lyme/resources/toolkit/factsheets/10_508_lyme-disease_pregnantwoman_factsheet.pdf ○ CDC Dengue and pregnancy factsheet: http://www.cdc.gov/dengue/resources/educationMaterials_pdfs/15_261427-A_Seda_508_Update_Prevent_dengue_during_pregnancy508.pdf • Zika virus ○ Avoid travel to areas where there have been outbreaks of Zika virus: http://wwwnc.cdc.gov/travel/page/zika-travel-information ○ CDC Zika and pregnancy site for patients: http://www.cdc.gov/zika/pregnancy/question-answers.html ○ For physicians: Doctor's Visit Checklist for Pregnant Women who Traveled to an Area with Zika: http://www.cdc.gov/zika/pdfs/docvisit-checklist-travelpreg.pdf	

Appendix 6: Personal Actions to Confront Climate Change

Table A6.1 PERSONAL ACTIONS TO CONFRONT CLIMATE CHANGE IN TRANSPORTATION, ENERGY, FOOD AND HOME

Transportation

- When possible, walk or bike instead of driving.
- Drive low or no-carbon vehicles.
- Carpool with coworkers to work and meetings.
- Ensure your car tires are fully inflated and service your car regularly.
- Advocate for walking and biking infrastructure and public transit.

Energy

- Purchase renewable energy if you can.
- Upgrade your appliances, electronics, and light bulbs to energy efficient models.
- Use power strips in your home and office, especially for large machines (i.e. home entertainment system, computers) to reduce phantom loads.
- Use programmable thermostats to reduce heating and cooling energy usage.
- Advocate for policies that support renewable energy.

Food

- Eat less meat, especially beef.
- Eat fewer processed foods.
- Buy locally sourced, organic produce if you can.
- Support local farmer's markets and other local community food events.
- Reduce food waste in your home and when you eat out.
- Compost food scraps.
- Advocate for policies that support local, healthy, sustainable food systems.

Home

- Wash clothes in cold water.
- Hang-dry clothes.
- Ensure your home is airtight with appropriate measures to prevent indoor air pollution.
- Recycle.
- Buy fewer items and products overall.

For More Information

- *The Environmental Research Letter*, "The climate mitigation gap: Education and government recommendations miss the most effective individual actions"[23]
- Union of Concerned Scientist's Ten Personal Solutions to Global Warming[231]
- NRDC's How You Can Help Fight Climate Change[232]

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