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.

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

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]

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.

    o 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.

Climate Change Impacts on Children's Health

EXTREME WEATHER: Climate change increases the amount and severity of storms. Extreme weather can impact sanitation and sewer systems. This increases the risk of water-re lated and gastrointestinal illnesses. Children are especially susceptible to such conditions due to their developing im mune systems. Injury and mental health impacts are also common among children exposed to extreme weather.

EXTREME HEAT: Climate change is increasing the frequency and intensity of extreme heat events. Children are less able than adults to regulate their body temperature. Thus, they are more vulnerable to changes in temperature. Compared to adults, extreme tempera tures have led to more heat-related illnesses and deaths among children, especially infants.

VECTOR-BORNE DISEASE: Insects and rodents that carry viruses respond quickly to changes in temperature and moisture, which can increase their growth and duration. Children are at risk for vector-borne illnesses due to their increased outdoor activity. They are also susceptible due to their developing immune systems. Lyme disease, hantavirus, dengue fever, and Zika virus are among the climate-related vector-borne diseases that pose a heavy health burden on children.

POOR AIR QUALITY: Climate change extends the warm season and lengthens pollen season. It also increases the amount of airborne pollutants in the environment. Pollutants and pollen can have chronic impacts on children's respiratory health, triggering allergies and asthma.

FOOD INSECURITY: Given changes in the weather due to climate change, crops will be affected by droughts and flooding. Climate change also alters the nutrient quality of food. Together, these impacts could reduce access to food and nutrients. Poor nutrition can result in devel opmental delays and adverse health outcomes for infants and children.

Stunted Growth
Malnutrition
Dehydration
Lyme Disease
Hantavirus
Zika Virus
Gastrointestinal
Disorders
Starvation
Asthma
Allergies

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.

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]

- Engage in recovery planning to promote rebuilding that supports families and child health and development, e.g. active transportation, parks, and complete neighborhoods.

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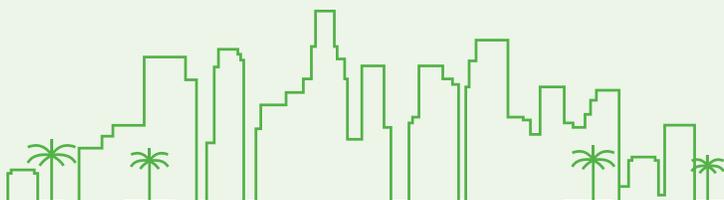
"We talked to a lot of staff who saw climate change as an issue but at first had a harder time connecting it to health. Once we started the conversation, they were totally on board with looking at the health co-benefits and integrated messaging."

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

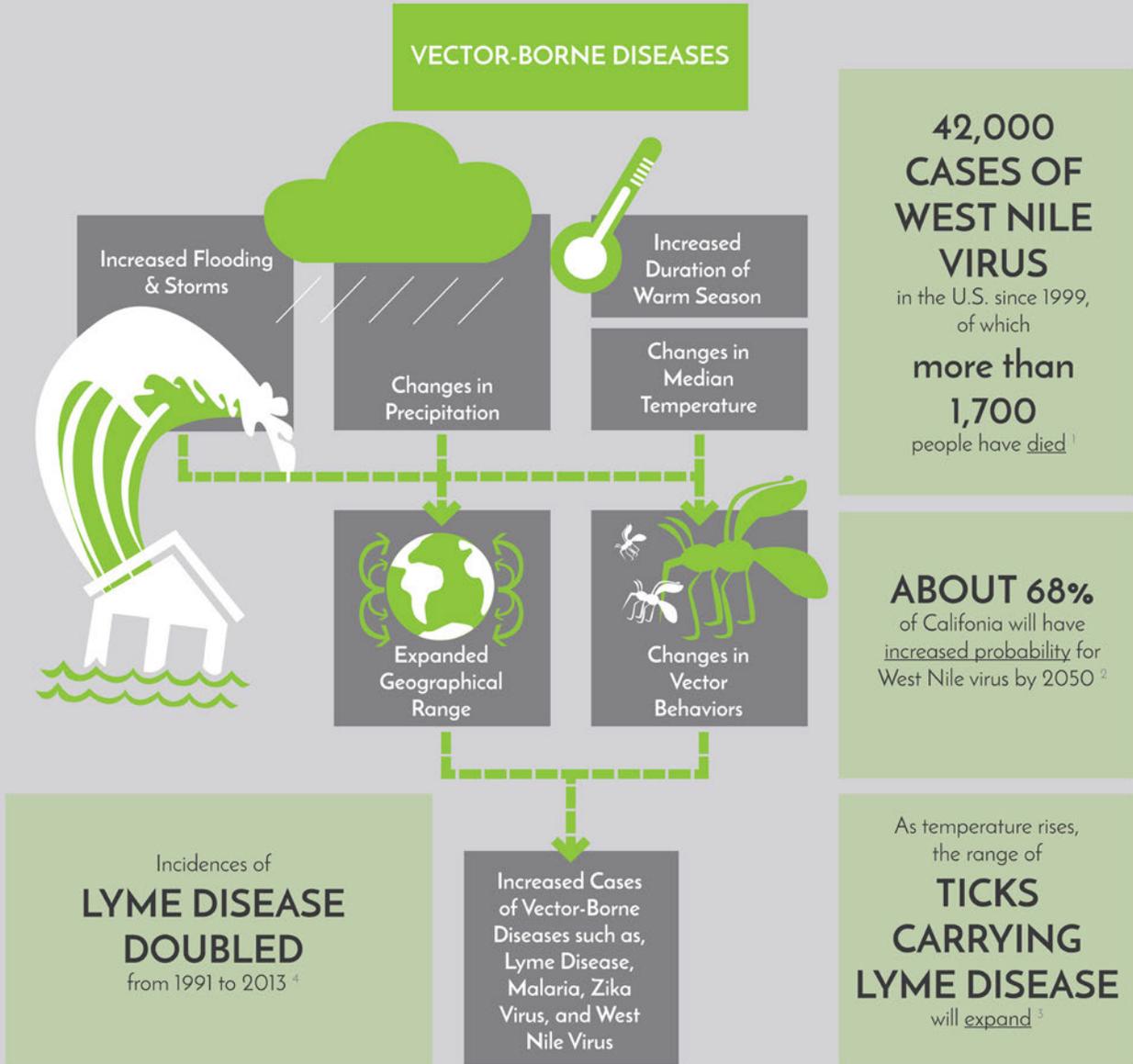### Why Infectious and Communicable Disease Control Should Care

- 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.

HOW CLIMATE CHANGE AFFECTS YOUR HEALTH

VECTOR-BORNE DISEASES

Increased Flooding & Storms

Changes in Precipitation

Increased Duration of Warm Season

Changes in Median Temperature

Expanded Geographical Range

Changes in Vector Behaviors

Incidences of **LYME DISEASE DOUBLED** from 1991 to 2013 [4]

Increased Cases of Vector-Borne Diseases such as, Lyme Disease, Malaria, Zika Virus, and West Nile Virus

42,000 **CASES OF WEST NILE VIRUS** in the U.S. since 1999, of which **more than 1,700** people have died [1]

ABOUT 68% of Califonia will have increased probability for West Nile virus by 2050 [2]

As temperature rises, the range of **TICKS CARRYING LYME DISEASE** will expand [3]

1. http://www.cdc.gov/features/westnilevirus/
2. http://onlinelibrary.wiley.com/doi/10.1111/gcb.12534/pdf
3. https://www3.epa.gov/climatechange/impacts/health.html
4. https://www.epa.gov/climatechange/science/indicators/health-society/lyme.html

climatenexus

APHA
AMERICAN PUBLIC HEALTH ASSOCIATION
For science. For action. For health.

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.

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.

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

- 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…*

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.

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

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]

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]

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]

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]

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 Mental Health

IMMEDIATE IMPACTS
Natural disasters are sudden in their onset and include destructive storms, floods, wildfires, and extreme heat.

Natural disasters may cause posttraumatic stress disorder (PTSD), anxiety, depression, and stress. Self-harm, including substance abuse and suicidal ideation, may also occur.
READINESS: Seek education about what to expect and how to prepare for future climate events.

GRADUAL IMPACTS
Slowly progressing, long-term conditions associated with climate change include rising temperatures, elevated sea levels, and changing precipitation patterns.

Chronic stress can result from the gradual impacts of climate change. For example infectious diseases, chronic diseases (asthma and allergies), nutritional deficiencies, and injuries can contribute to stress.
MONITORING: Know your health, and determine whether you are stressed (signs include low energy, tension, and headaches). Seek treatment and/or support if needed.

INDIRECT IMPACTS
Climate change can affect the way we think about ourselves, each other, and the world.

After a climate event or resulting displacement, people may experience a diminished sense of self, difficulty relating to others, diminished social interaction, and solastalgia (the loss of a sense of place, solace, and security tied to one's physical environment). Community impacts include domestic abuse, child abuse, and violence (e.g., assault and civil conflict). Economic insecurity and physical damage are other potential effects.
COOPERATION: Establish social ties and connections with community members. This will help to withstand changes and encourage adaptation.

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

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]
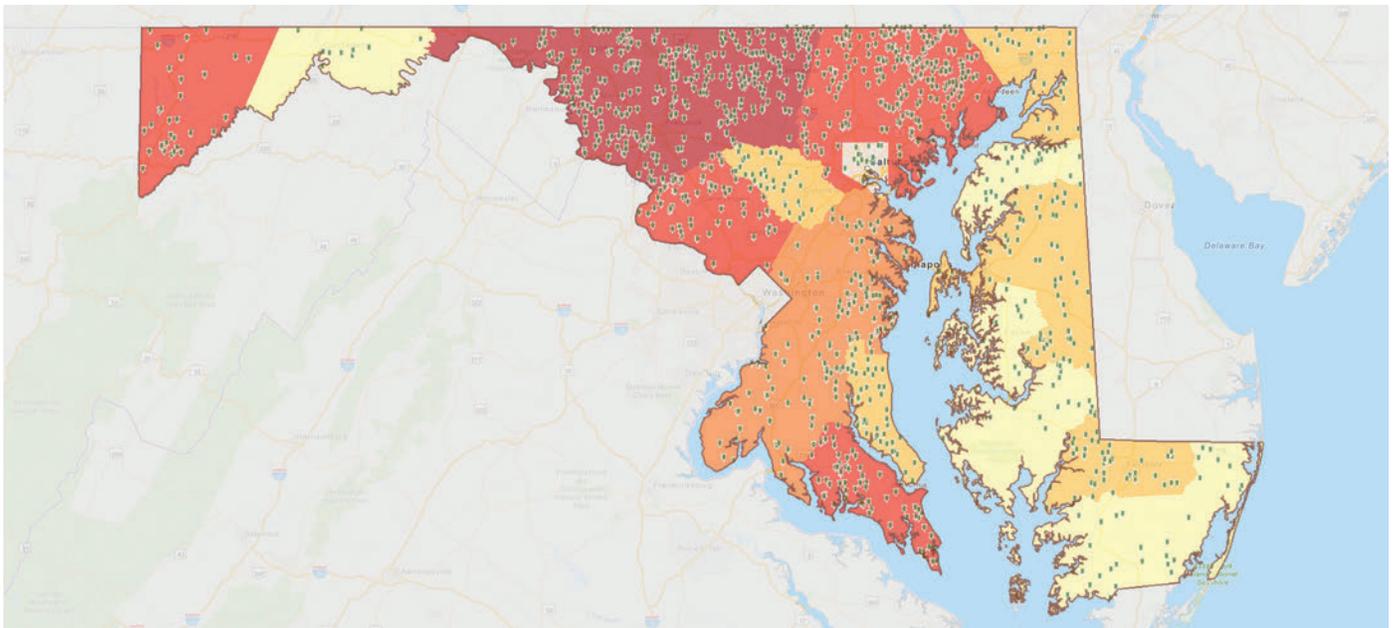
Maryland Food System Map
mdfoodsystemmap.org

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.
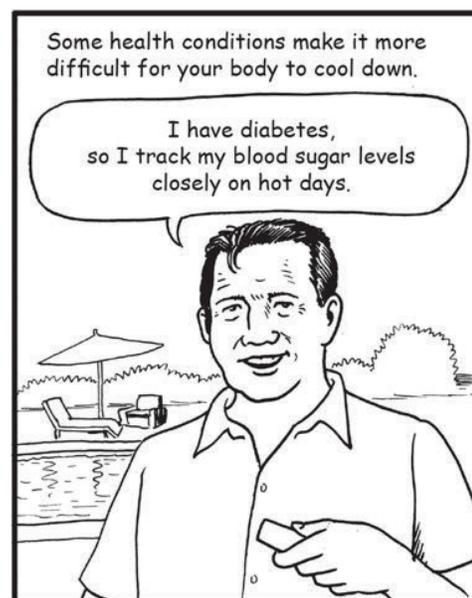
Source: Public Health- Seattle King County

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.
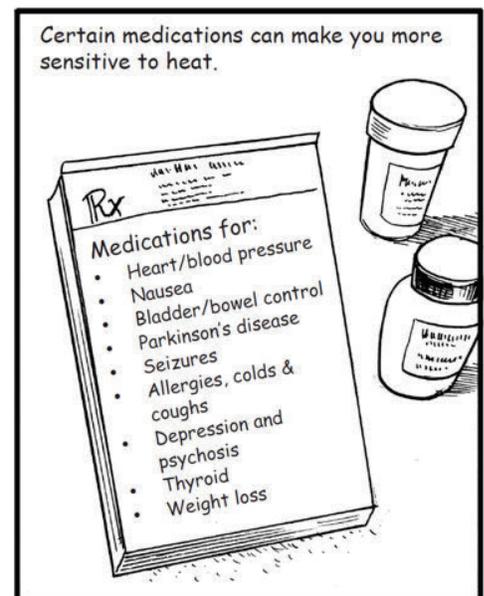
Preparing for Extreme Weather Events and Population Displacement

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]

Certain medications can make you more sensitive to heat.

Medications for:
• Heart/blood pressure
• Nausea
• Bladder/bowel control
• Parkinson's disease
• Seizures
• Allergies, colds & coughs
• Depression and psychosis
• Thyroid
• Weight loss

Source: Public Health- Seattle King County

165

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.

PUBLIC HEALTH PROGRAMS AND CLIMATE CHANGE

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]

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).

East Harlem COAD Leadership Team Members
ioby.org

- 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.
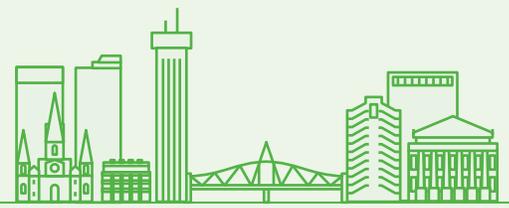
Strengthening Community Networks: New Orleans Health Department

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:

Climate Action
for a Resilient New Orleans
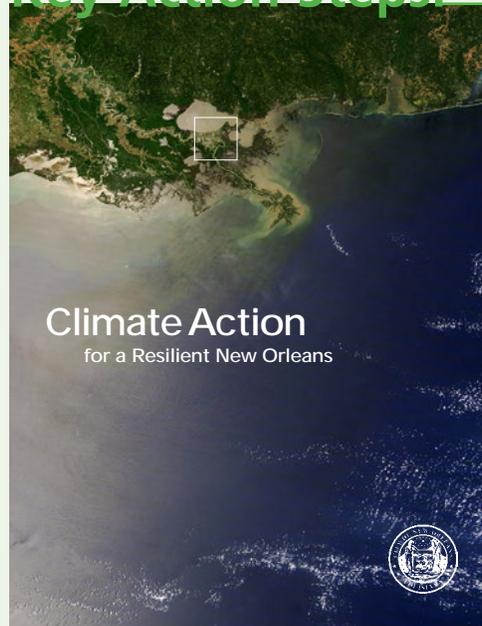
- Work with local and state agencies to compile climate and health data to develop a climate and health vulnerability assessment.

- 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:

  o Inform patients about climate risks, incorporate knowledge of climate impacts into patient care, and make referrals for climate-related services.

  o Integrate climate change into non-profit hospital system Community Health Needs Assessments.

  o Serve as "climate and health champions" to educate community residents and decision makers about climate health impacts and support climate actions with health benefits.

  o Work to reduce the carbon footprint of health care facilities.

  o 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.

Health Provider Role in Climate Change, Health and Equity

Eat less meat
Walk, bike, use transit
Clean energy, energy
efficiency

Green your clinic or hospital
Grand rounds presentation
Policy statement or resolution

Patient education
Care plans and protocols
Home assessments

Write an Op-ed or Letter to the Editor
TV and radio interviews

Community engagement & power
Community presentations
Local healthy communities planning

Legislative visits
Policy testimony

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)

    o 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.

    o 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.

    o 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]

    o 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]