4. Human Health

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Human health is naturally linked to the environment. As such, impacts of climate change will likely create a significant and emerging threat to human health in many ways, both directly and indirectly (see Figure 1). For example:

- Extreme temperatures, more frequent wildfires, and other severe weather events will likely increase the risks of heat-related illness, respiratory disease, and vector-borne diseases.
- Drought, flooding, and storm damage will likely alter drinking water supply and water quality conditions.
- Changes in water, air, food quality and quantity, ecosystems, agriculture, and the economy also indirectly expose humans to climate change impacts.

Vector: An organism or vehicle that carries pathogens from one host to another.

Climate change can affect human health in ways that affect families and the workforce, such as premature death and increased sick days, leaves of absence, health care costs, and insurance claims. These impacts also impair quality of life. The populations at greatest risk include children, the elderly, individuals suffering from respiratory and cardiovascular disease, and economically disadvantaged people.

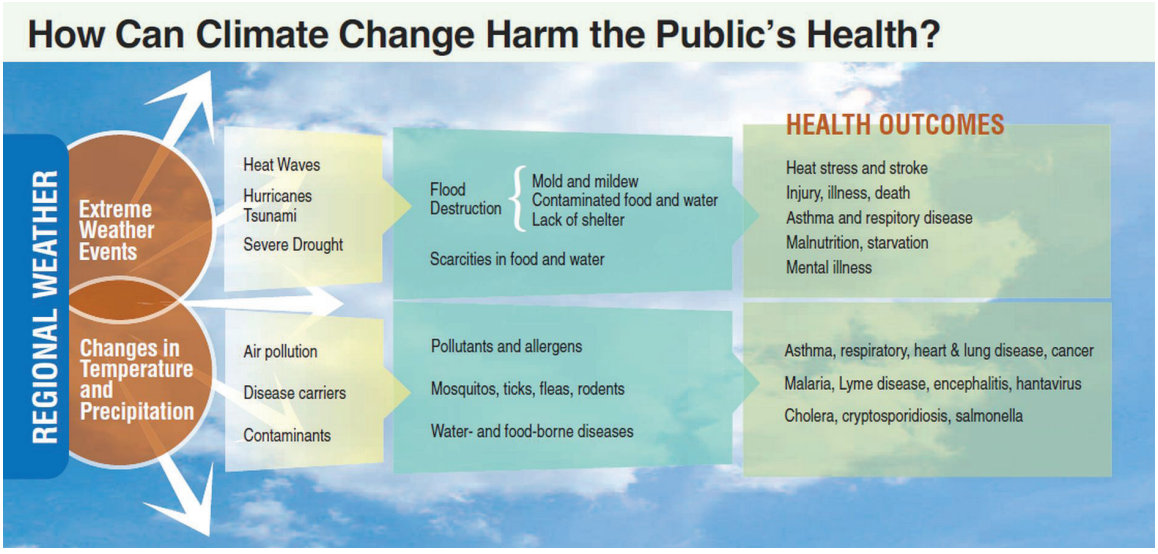

Figure 1. How climate change can harm human health[65]

[65] American Public Health Association citing U.S. Global Change Research Program

Much of the work to address and prepare for climate change effects on human health will happen in local communities and public health agencies, with focus on the adverse effects on vulnerable populations and sensitive communities.

Keeping the people of Washington healthy is of paramount importance. The challenge of adapting to the health impacts of climate change comes at a time when the entire public health system is examining and reshaping its approach to service. Local and state funding for public health is also rapidly eroding. For example, the loss of trained public health professionals ranges from as much as 25 to 40 percent in some jurisdictions.

The following sections describe the scientific understanding of the impacts of climate change on Washington's citizens and outline key strategies to support state and local efforts to protect human health and lower risks to our communities.

Impacts of Climate Change on Human Health

Climate change is expected to affect human health in at least five key ways:

- The risk of illness and death from extreme heat will increase.
- Asthma and respiratory problems will increase due to increasing levels of smog (ground-level ozone) and potential increases in other air pollutants.
- Diseases transmitted by food, water, and insects will increase.
- Illness, injury, and mental health problems from storms will increase.
- Drinking water supplies will change, and water quality could decline.

1 Illness and deaths from heat waves

Climate change is expected to increase the frequency, intensity, and duration of extreme heat events in Washington State. Excessive heat can lead to heat stress, heat stroke, and other health complications such as heart attack, stroke, respiratory illness, and death. Elderly people and people with existing health conditions are especially susceptible to heat-related illness.

Since extreme heat days are uncommon in the Puget Sound region, most homes lack cooling systems. Most people are not well prepared and do not take the necessary precautions. In the Seattle area, the number of heat-related deaths for people age 65 and older is projected to increase. In eastern Washington, increasing numbers of hot days (over 100°F) are expected to cause more heat-related illness, and agricultural workers are particularly exposed.[66]

[66] Jackson *et al.* (2010).

Ground-level ozone, or smog, is an air pollutant with harmful effects. Exposure to smog is linked to premature death, asthma, bronchitis, heart attack, and other cardiopulmonary problems.

2 Air quality and respiratory and cardiovascular disease

Climate change is expected to increase exposure to ground-level ozone and make it more difficult to meet the air quality standards necessary to protect public health.[67] In King County, average summer ozone concentrations are projected to increase 28 percent by the 2050s. In Spokane County, ozone concentrations are projected to increase by 17 percent by the 2050s.[68]

Larger and more frequent wildfires could also significantly affect air quality in Washington and increase concentrations of tiny atmospheric particles, which degrades air quality. Climate change could worsen our current challenges with asthma, increase pollen production, and prolong the pollen season.

Tiny Particles in the Air: Aerosols or Particulates

When you look up at the sky, you are looking at more than just air. Billions of tiny bits of solid and liquid are floating in the atmosphere. Those tiny floating particles are called **aerosols** or **particulates**.

The aerosols that are from air pollution are hazardous to human health. When these small particles go deep into a person's lungs, it can make him or her very ill.

3 Infectious disease

Climate change is expected to increase some diseases transmitted by food, water, and insects. Increasing temperature, precipitation, and extreme weather events can affect the replication, survival, persistence, habitat range, and transmission of disease-causing agents, worsening the following health concerns.

Tick-related disease. Longer, drier summers and changing distribution patterns of animal hosts could increase the distribution range of Dermacentor ticks, which are can carry Rocky Mountain spotted fever, tularemia, and Q fever, as well as cause tick paralysis. Milder winters in western Washington could cause an increase of Ixodes pacificus tick populations, which is the Lyme disease carrier in the western United States.[69]

[67] U.S. Environmental Protection Agency (2009).
[68] Jackson *et al.* (2010)
[69] Personal communication with Elizabeth Dykstra, DOH Public Health Entomologist, 2011.

Mosquito-borne diseases. The introduction of foreign mosquito-borne diseases remains a concern. The recently introduced species Ochlerotatus japonicus is a known carrier of filariasis and has been shown to transmit West Nile virus in the laboratory. Other types of diseases like western equine encephalitis and St. Louis encephalitis have occurred in Washington State and may be sensitive to climate change, though no cases have been reported since 1988.[70]

Waterborne illnesses. Outbreaks of waterborne diseases frequently follow heavy precipitation[71] and flooding.[72] Surface water used for drinking may be at greater risk of contamination.[73]

Harmful Algal Blooms (HABs). HABs are blooms of algae that can produce natural toxins with harmful effects, including illness and death. Humans are exposed to HABs through consumption of fish or shellfish, inhalation, or skin contact with contaminated water. Climate change may be contributing to the conditions that allow these algal blooms to flourish.

Rodent-related disease. Increased forest damages and losses due to beetle infestations and increasing risk of severe forest fires will alter the habitat and distribution of rodent populations. Loss of forest habitat may send more rodents into residential areas, increasing the risk of human exposure to the diseases rodents can carry, such as hantavirus.[74]

Food-borne illnesses. Research shows a significant correlation between food-borne illnesses and ambient temperature. Depending on the type of food-borne illness, for every degree centigrade (ºC) rise in temperature, the risk of food-borne illness can increase 2.5 to 6 percent.[75]

Washingtonians may also face higher risks from diseases originating in other parts of the world.

[70] Washington State Department of Health (2008).
[71] Curriero *et al*. (2001); Thomas *et al*. (2006).
[72] Wade *et al*. (2004).
[73] Rose *et al*. (2000).
[74] Personal communication with Elizabeth Dykstra, DOH Public Health Entomologist, 2011.
[75] Portier et al. (2010).

4 Injury and mental health problems from severe storms

More frequent and severe weather events such as storms and flooding are expected to result in injuries, illness, and deaths. These health problems include carbon monoxide poisoning from people using generators or barbeques indoors for cooking and alternative sources of heat during power outages.

Extreme weather events also result in more short- and long-term emotional trauma and mental health problems, including:

- Post-traumatic stress disorder.
- Depression.
- Sleep difficulties.
- Social avoidance.
- Drug or alcohol abuse.

The severity of the problems that come after an extreme climate event depend on how much support is available, both during and after, to the person affected by the event. During the recovery period, mental health problems and stress-related disorders can come from:

- Geographic displacement.
- Unemployment.
- Loss of property.
- Death or injury of loved ones.

Impacts of climate change on U.S. national security

According to the National Intelligence Council, global climate change will have wide-ranging implications for U.S. national security interests in the coming decades. Climate change could increase instability and conflict in vulnerable regions as a result of:

- Increasing drought and conflicts over water.
- Declining food security.
- Increased health problems.
- Increased displacement from flooding and rising sea levels.

These climate-driven impacts will worsen existing problems, such as poverty, social tensions, environmental degradation, and weakening of national governments.

For more information:

www.dni.gov/nic/special_climate2030.html

5 Drinking water supply and water quality

Climate change may affect the sustainability of water supplies in parts of the state in the coming decades. As temperatures rise, declining snowpack and changes in precipitation will affect streamflow timing and volume. These changes in streamflow could increase the risk of water shortages in many basins and also impair water quality. Sea level rise could cause increased saltwater intrusion into coastal aquifers. Expert opinion suggests that sea level rise will have only a minor effect on coastal aquifers, however, and the amount of freshwater available is not expected to change for coastal areas.

Vulnerable populations will bear the burden

For projected impacts of climate change on human health, the most vulnerable populations are children, the elderly, and people with existing respiratory, cardiovascular, or other chronic diseases.[76] People who work or exercise outdoors are also more exposed to the effects of heat.

Poor and disadvantaged people are particularly at risk from the impacts of climate change. Low-income individuals, people of color, and those that speak English as a second language often experience higher rates of chronic stress and have poorer health outcomes, regardless of the stressor. These individuals also may experience:

- Poorer existing health conditions.
- More barriers to health care.
- Unstable employment.
- Lower-quality housing.

In addition, the poor are more likely to:

- Have little or no access to healthy food.
- Have fewer transportation options.
- Live in neighborhoods with less social and financial capital, higher crime rates, and more safety concerns.

As a result, the impacts of climate change may further reduce the ability and capacity of low-income individuals and communities to adapt and to improve their quality of life.

[76] U.S. EPA (2010a).

Recommended Adaptation Strategies and Actions—Human Health

Much of the work to address and prepare for climate change effects will happen in local communities and public health agencies. The public health community has programs that reach across various populations and locations. Public health leaders have a key role to play in preparing communities to cope with the urgent consequences of climate change.

The following section describes five recommended strategies, along with accompanying actions. These strategies and actions are intended to help Washingtonians understand, respond, and adapt to the impacts of climate change. The strategies are not expected to introduce entirely new fields of work to public health but rather to bolster existing systems. By integrating climate adaptation strategies into the emerging public health system, the strategies:

- Help communities' most vulnerable populations.
- Communicate the health impacts of climate change.
- Enhance public readiness to take actions.
- Prioritize and implement operational changes that allow public agencies and communities to prepare for climate change.

Strategy A-1. Protect the communities that are most vulnerable to impacts of climate change.

Actions:

1. Identify people, communities, regions, infrastructure, and local economies that are most vulnerable to climate impacts. Provide tools that local health departments and communities can use to conduct community-wide assessments. Provide financial and technical support for local communities to develop and implement appropriate adaptation strategies to respond to current and future threats.

2. Enhance the capacity of state and local health organizations and communities to implement preventive actions that reduce public health risks related to climate change. The focus will be on ensuring efficient organizational structure, effective policies and programs, and adequate funding.

3. Work collaboratively with local health departments, community-based organizations, state and local planning organizations, and transportation agencies to:
   - *Improve community planning and design to support and promote healthy built environments and healthy living.*
   - *Expand and protect urban vegetation and open space.*
   - *Prevent construction of new critical infrastructure in vulnerable areas.*

4. Work with state and local agencies and organizations to:
   - *Enhance efforts to develop transportation options and evacuation routes to ensure safety of vulnerable people.*
   - *Develop and publicize shelters and responses to heat and flooding extremes.*
   - *Increase access to health care for at-risk populations.*
   - *Prepare for aftermath of extreme events.*
   - *Enhance preparedness for disease prevention of vector-borne and water-borne diseases following floods and storms.*

Strategy A-2. Enhance surveillance and reporting systems to monitor and support early detection of climate-related risks and swift responses to emerging health threats associated with climate change.

The ongoing and systematic collection of data is critical for monitoring changes in the magnitude of current public health threats and early detection of new or emerging threats. The following are the three areas where surveillance systems are critically important to public health preparation and adaptation:

- Zoonotic disease (diseases transmitted from animals to humans).
- Air quality monitoring.
- Notifiable conditions, a public health surveillance of those conditions that legally require reporting to local and state health departments.

Actions:

1. Maintain, rebuild, and increase overall efficiency of current surveillance systems—at the state level and in local health departments and health care organizations—to monitor and identify outbreaks of climate-related health diseases and illnesses.

2. Continue development of the Department of Health's Environmental Public Health Tracking network, and focus future efforts on expanding data and health indicators linked to climate change and healthy communities.

3. Enhance surveillance and electronic reporting from laboratories to support our ability to detect emerging health issues rapidly and implement timely and effective community responses.

4. Develop meaningful data sets to better understand changes in zoonotic disease patterns and disease vectors, air quality conditions, and harmful algae blooms. This information will assist our future efforts in preparing for and adapting to climate change-related conditions affecting our health.

5. Develop an early warning system to identify and predict when and where a harmful algae bloom or pathogen event may occur in our marine waters. This initiative will focus on:
   - *Characterizing environmental and biological factors that contribute to biotoxin or bacterial events.*
   - *The public health burden associated with these toxic events.*
   - *Potential policy and scientific solutions and/or information and data needs for mitigating human exposure from recreational, occupational, and seafood-related pathways during such events.*
   - *Increase collaboration between the Health and Agriculture departments on zoonotic disease surveillance improvements.*

Strategy A-3. Incorporate climate adaptation strategies into the Department of Health's *Agenda for Change*, with a focus on prevention, early detection, and swift responses to protect people from diseases and other health threats caused by changing climate conditions.[77]

Actions:

1. Identify, prioritize, and incorporate into health planning and regulations climate change mitigation and adaptation strategies. Include actions that promote healthy living and reduce greenhouse gas emissions and toxic pollutants. Collaboration with local governments can help incorporate healthy living strategies into land use planning and regulations, such as compact development that concentrates growth in compact walkable urban centers to avoid sprawl.

2. Refine existing emergency response and public health preparedness planning to enable local health and emergency response agencies to:

   - *Anticipate impacts of severe heat events, droughts, wildfires, and coastal flooding.*
   - *Develop early warning systems.*
   - *Quickly respond to extreme weather events.*
   - *Help local health departments assess their capacity to respond to health threats and to integrate climate preparedness into their hazard response plans and daily operations.*

[77] Washington State Dept. of Health (2010).

Strategy A-4. Engage and motivate citizens and organizations to take actions to build resilient communities.

Actions:

1. Collaborate with the Northwest Center for Public Health Practice and other academic partnerships to develop a web-based resource hub to provide information and technical resources on public health and climate change preparedness. This website should provide information in several languages to help meet the needs of communities most at risk.

2. Enhance the ability of local organizations to understand climate risks and reach vulnerable populations. Provide vulnerable populations with information on what they need to know and how to prepare for and address the risks of climate change.

3. Pursue partnerships with nonprofit organizations and businesses to develop climate change communication tools, messages, and social support networks that promote active community involvement and raise public awareness about the health problems related to changing climate.

4. Using the medical system, enhance awareness of the projected health problems that come from a changing climate and the services (response strategies) that are available—including the mental health system.

5. Distribute information on how a changing climate can affect human health to doctors, nurses, and emergency response personnel that provide direct services to vulnerable citizens. Expected impacts include increased asthma, heat exhaustion, and potential new diseases transmitted from animals to humans.

6. Pursue opportunities to engage with medical and academic institutions to raise awareness of the overarching mental health problems that come from the social and environmental disruptions related to emergencies. Potential partners include the state's mental health system, the Washington Medical Association, Washington State Department of Social and Health Services, University of Washington Medical School and School of Public Health, and the schools of social work at Washington State University, Portland State University, and Eastern Washington University.

7. Distribute alerts to the service providers of the medical and mental health communities during extreme weather events (and in advance, when possible), so they can be best prepared to serve members of their communities that may be adversely impacted.

8. Encourage the Washington State Public Health Association to dedicate time at the annual Joint Conference on Health to raise awareness and engage the public health and healthcare service providers about the health problems related to a changing climate. This conference also provides an opportunity to raise awareness about the tools and strategies that local communities can use to prepare for health problems associated with climate change.

9. Use existing programs within the Department of Health's Office of Drinking Water to educate and alert public water system operators and their customers about likely impacts of climate change and the need for enhanced emergency preparedness.

Strategy A-5. Build capacity and support to safeguard human health in the face of climate change.

Actions:

1. Expand training and education of health and social services providers, including mental health agencies, to build capacity to respond appropriately to human health risks of climate change.

2. Improve our understanding of human health impacts of climate change and extreme weather through continued interdisciplinary studies at the University of Washington, Washington State University, and with agency scientists. Further work needs to focus on better understanding the risks; identifying the areas and populations at greatest risk; and exploring new methods to address the identified risks.

3. Seek more reliable funding mechanisms that can support more localized forecasting and risk modeling to address the health implications of climate change from extreme heat events, flooding, other extreme weather events, and increased forest fires.

4. Pursue future funding opportunities, such as the Centers for Disease Control and Prevention (CDC) funds, to support the enhancement of critical public health infrastructure needed to promote healthy communities and to address the impacts of climate change.