

# Climate Change & Communicable Diseases in the Northwest

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The past generation has seen the emergence of an array of infectious diseases—viral, bacterial, fungal, protozoan, and even parasitic worms. In its 2003 treatise on *Microbial Threats to Health*, the Institute of Medicine identified 13 factors that lead to such emergence, one of which was “climate and weather.”

The effect of this factor is sure to be felt in the Pacific Northwest, where models predict an average increase in temperature of 5°–7°F year-round and, in the winter, a shift from snow to rain. This article illustrates mechanisms and explores potential effects of changes in climate and weather on communicable diseases in the Pacific Northwest.

Climate and weather may influence the emergence and epidemiology of infectious diseases through several mechanisms (see box, opposite page).

## Vector-borne Disease

Many diseases borne by arthropod vectors are caused by pathogens whose reproduction is sensitive to temperature. Among these are “tropical” diseases such as malaria and dengue, but West Nile virus infection is similarly affected by temperature. The West Nile virus appears not to replicate within female *Culex* mosquitoes at temperatures lower than about 57°F. Titers of the virus within infected female *Culex* mosquitoes have been shown to be a function

of time and incubation temperature. There seems to be a threshold viral titer within the mosquito, below which transmission does not occur. The pattern of West Nile infection already exhibits a strong seasonality, with peak transmission in late summer in the Northwest; longer summers and higher temperatures may have a substantial effect on incidence of human West Nile fever and encephalitis.

Image: Idaho Department of Health and Welfare



Idaho Department of Health and Welfare launched a Fight the Bite campaign to alert the public about the dangers of West Nile virus.

## Vibrio Parahemolyticus

*Vibrio parahemolyticus* is a well-known agent of gastrointestinal illness in people who eat raw oysters harvested from sufficiently warm waters. This bacterium may require water temperatures 63°F or higher to proliferate and to reach quantities in oysters sufficient to infect humans. Oysters harvested in Oregon, Washington, and British Columbia during the summer have caused outbreaks of *V. parahemolyticus* infection. In 2004, an outbreak aboard a cruise ship implicated oysters harvested from Prince William Sound, Alaska—more than 600 miles north of the pathogen’s previously recognized northern outpost. Warming waters in the Pacific Northwest are almost certainly likely to lead to higher concentrations of *Vibrio* species in shellfish beds and longer periods of summer risk.

## Zoonotic Diseases

A review of infectious diseases in 2001 identified 175 that were caused by pathogens considered to be “emerging.” Of these diseases, 132 (75 percent) were zoonoses—transmitted to human beings from animals. We should expect that animal host populations for zoonotic pathogens may, for better or worse, be affected by changes in climate.

Pathogenic microbes may be passively transported on air or in water. One concern is *Cryptosporidium parvum*, a protozoan agent of diarrhea that is found in cattle. Predicted increases in rain and flooding, multiplied by rain-on-snow events in the Cascades, may wash *C. parvum* and other animal intestinal dwellers into drinking water reservoirs.

Rivers swollen by spring rains and snow runoff may well have been the cause of contamination of the Milwaukee, Wisconsin, drinking water supply and the massive outbreak of cryptosporidiosis in 1993. A review of waterborne disease outbreaks in the United States from 1948 to 1994 found a significant correlation with an “extreme precipitation event” in the two months before the outbreak. On the other hand, survival of cysts of both *Cryptosporidium* and *Giardia* is shortened by warmer water temperatures.

Environmental changes also can lead to shifts in the population of vector species. For example, the 1993 outbreak of hantavirus pulmonary syndrome in

New Mexico was preceded by increasing densities of *Peromyscus* mice, the definitive host for *Sin Nombre* hantavirus. *Peromyscus* densities were higher in areas where precipitation had increased in 1992 in association with the *El Niño* event of that year. Further studies of precipitation, *Peromyscus* densities, and *Sin Nombre* seropositivity among *Peromyscus* mice in several areas in the Southwest corroborated the association of higher rates of hantavirus pulmonary syndrome with periods of higher-than-usual rainfall, after a lag time that allowed for the mouse reservoir populations to increase and to become infected with *Sin Nombre* virus.

### Fungal Diseases

The fungus *Cryptococcus neoformans* is an environmental saprophyte whose environmental niche is dead or rotting trees. *C. neoformans* has been notorious as a cause of meningitis in patients with organ transplants or AIDS, but one variety has shown a particular ability to infect hosts with intact immune systems. This variety, known as *gattii*, was formerly



Photo: istockphotos.com

Shucking oysters for eating at a market stall.

thought to have been restricted to tropical and subtropical areas. However, the pathogen emerged as the cause of an outbreak on the east coast of Vancouver Island beginning in 1999. Environmental sampling in a provincial park unveiled an ecological berth among several tree species there, notably our beloved Douglas Fir. The researchers hypothesized that the establishment of the fungus in this area may have been due to climatic changes.

### Human Activities

Changes in where people eat, drink, dwell, and recreate will probably have more effect on the epidemiology of infectious diseases than specific changes in climate themselves. Legionnaire's disease has been uncommon in the Northwest, but increased use of air conditioning, should summers become warmer and longer, may lead to higher rates of this infection. Increased flooding or rising sea levels could lead to

displacement and concentrations of populations, with consequent increases in diseases transmitted directly from person to person. In-migration of populations from a hotter and drier US Southwest could lead to increased settlement east of the Cascade mountains, and exposing more people to diseases such as hantavirus pulmonary syndrome or relapsing fever. Likewise, increased housing adjacent to forested areas west of the Cascades could lead to more contact with the *Ixodes* tick vectors of Lyme disease.

### Surveillance

We cannot predict the net effect of climate change on the incidence of communicable diseases. Expected increases in vector-borne and other diseases might be more than offset by reduced incidence of diseases typically associated with cold weather, such as influenza or rotavirus infection. However, given the dynamic interplay among reservoirs, vectors, human hosts, and the environment, changes in communicable disease patterns are inevitable.

The most prudent strategy for protecting the Northwest from these changes are those advocated by the CDC ten years ago to address the problem of emerging infectious diseases: ensuring that we have a robust, sustainable, and influential public health system that can detect changes in disease patterns quickly using public health surveillance, investigate as needed, and mount an appropriate response.

### Authors

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### Further reading

Centers for Disease Control and Prevention. Preventing emerging infectious diseases: a strategy for the 21st century. *MMWR* 1998;47(RR-15).

## Effects of Climate on Infectious Diseases

### Direct Effects

- microbial multiplication rate
- microbial movement
- movement and replication of vectors and animal hosts
- evolutionary biology

### Indirect Effects

- effects operating through ecological changes
- effects operating through changes in human activities