

Infectious Disease, Climate Change and Health



FAST FACT:

In the U.S., more than 50% of waterborne disease outbreaks are associated with extreme rainfall.

Climate change is increasing the risk of infectious diseases, including vector, food, and water-borne diseases, through multiple pathways. In this brief, we focus on the impacts of climate change on infectious diseases in California and the U.S.

Vector-borne disease and climate change

- Climate change is causing warmer temperatures and changes in precipitation that impact the habitat distribution and mating cycles of disease-carrying mosquitos and ticks, increasing the risks of exposure to disease in some areas.
- In the U.S., mosquito-borne West Nile Virus and tick-borne Lyme Disease are the two most commonly occurring vector-borne diseases.
 - Since it first appeared in the U.S. in 1999 and in the state in 2002, California has reported more than 4800 cases of West Nile Virus, the highest of any state in the union. The annual number of reported cases has been rising steadily in the state since 2010,¹ and cases more than doubled between 2013 and 2014.^{2,3}
- The *Aedes aegyptii* mosquito that transmits dengue, yellow fever, and Zika virus is now found in 28 U.S. states⁴. This “yellow fever mosquito” was not found in California until 2013 but is now present in 56 counties.⁵
 - Currently, more than 125 countries are considered endemic for Dengue, with global incidences ranging from 50 to 200 million cases.⁶
- Although 90% of Lyme Disease cases occur in the Eastern and Midwestern United States, the western black-legged tick, which transmits the virus, is present throughout California.

Water-borne disease and climate change

- There are an estimated 12 to 19 million endemic cases of water-borne illness in the U.S. each year.⁷
- The frequency and intensity of extreme precipitation and flooding is increasing with climate change.
 - In the U.S., more than 50% of water-borne disease outbreaks are associated with extreme rainfall.⁸
 - Flooding of water and sewage treatment facilities increases the risk of waterborne disease.
 - In areas with “combined” sewer systems that collect sewage and storm water runoff, heavy rainfalls can overwhelm the systems. Sometimes municipalities release untreated waste into water bodies to prevent back-up of untreated wastewater into homes. This “combined sewer overflow” can increase risk of water-borne gastrointestinal disease if people come into contact with contaminated water bodies.⁹



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Since it first appeared in the U.S. in 1999 and in the state in 2002, California has reported more than 4800 cases of West Nile Virus, the highest of any state in the union.

- Warmer water temperatures, in both ocean and freshwater sources, allow for greater proliferation of microorganisms such as *Vibrio* that cause gastrointestinal and more serious illness, including cholera.
- Warmer water also fosters the growth of harmful algal blooms (HAB), associated with increased risk of exposure to dangerous, potentially fatal, toxins.
 - In summer of 2015, an unprecedented HAB stretched from Alaska to the central California coast, leading to the shutdown of shellfish, salmon, tuna, and anchovy fishing to prevent exposure to domoic acid produced by the algae. Domoic acid can accumulate in shellfish and, if consumed, results in life-threatening Amnesic Shellfish Poisoning.¹⁰

Food-borne disease and climate change

- There are currently an estimated 48 million cases of food-borne illness in the U.S. each year,¹¹ with over 120,000 hospitalizations and nearly 3,000 deaths.¹²
- Higher ambient temperatures increase the replication cycle of food-borne pathogens such as salmonella, campylobacter, or *E.coli*, increasing disease risk.
- As temperatures increase, people may engage in behaviors — such as outdoor picnics — that further amplify the risk of food-borne illness.

Drought and infectious disease

- Increasing drought, as a result of climate change, will also increase the risk for food and waterborne illness, as water becomes more scarce for basic sanitation purposes. See [Drought, Climate Change and Health](#)

Drought and West Nile Virus¹³

Because mosquitoes are known to thrive in tropical conditions, it seems counterintuitive that drought would exacerbate spread of West Nile Virus (WNV). In reality, this is exactly what it does.

- As water sources dry up, mosquitos move toward domestic water sources, such as pools and fountains, thus increasing the likelihood of contact with and transmission of the disease to humans.
- Fewer water sources also increase the likelihood of contact between mosquitos and birds, which serve as amplification hosts for the virus and then spread WNV to other mosquitos when bitten.
- Ample rainfall can help “wash out” underground mosquito populations, for example in sewer pipes; during drought, these wash outs decrease, leaving stagnant pools of water in which mosquito populations thrive.
- Hotter temperatures also have a dramatic effect on increasing WNV by increasing viral replication rate, increasing the frequency of feeds per mosquito, and speeding mosquito development rate, which in turn increases the population size.



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Sometimes municipalities release untreated waste into water bodies to prevent back-up of untreated wastewater into homes. This “combined sewer overflow” can increase risk of water-borne gastrointestinal disease if people come into contact with contaminated water bodies.⁹



Valley Fever in California's Changing Climate

- As temperatures and drought increase, soils dry out and dust levels increase. In some arid regions including the U.S. Southwest, the spores of the *Coccidioides immitis* fungus are carried on dust. Inhaling these spores causes Coccidioidomycosis, also known as cocci or “Valley fever.”
- Cases of Valley fever in the U.S. have risen about 15% each year from 1998 to 2011.¹⁴ Valley fever is characterized by coughing, chest pain and fever, as well as headaches, joint pain and rash. If untreated, it may cause pneumonia or complications from the spread of the disease outside the lungs and into other organs.
- California experienced a fivefold increase in Valley fever cases between 2000–2011, with 75% of cases occurring among residents of the San Joaquin Valley. Since 1990, the rates in some counties have increased by thousands of percentage points.¹⁵
- East Porterville, in Tulare County,¹⁶ is experiencing an epidemic of Valley fever with a rate of 39.2 per 100,000 residents. The impacts are especially devastating for this economically disadvantaged town, where nearly one-third of residents are uninsured, 40% do not have an educational level beyond 9th grade, 75% are Latino and over 30% are below the Federal Poverty Level.
- Dozens of workers constructing two solar power-generating facilities in central California contracted Valley fever between 2011–2014.¹⁷

California counties with largest rise in valley fever cases

REPORTED CASES

3,500

3,000

2,500

2,000

1,500

1,000

500

0

'90 '91 '92 '93 '94 '95 '96 '97 '98 '99 '00 '01 '02 '03 '04 '05 '06 '07 '08 '09 '10 '11

YEAR

Rise from 1990 to 2011 / Percent change

KERN — 2,540 / 1,058%

FRESNO — 788 / 11,114%

KINGS — 537 / 10,740%

LOS ANGELES — 247 / 685%

SAN LUIS OBISPO — 238 / 5,950%

Source: California Department of Public Health

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Climate change, infectious disease and health equity

Social and economic inequities, as well as individual characteristics, place some individuals and communities at greater risk than others for climate change-related infectious diseases:

- **Occupation:** Farm workers and other outdoor laborers are at greater risk for exposure to disease vectors and fungus.
- **Housing conditions:** insufficient vector barriers, such as screens on windows and doors, can facilitate disease transmission.
- **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.
- **African-Americans and Filipinos** are at higher risk of illness following exposure to *Coccidioidomycosis*.¹⁸
- **Chronic illness:** those with pre-existing chronic medical conditions are more susceptible to complications from infectious disease as a result of climate change.



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What can physicians do to address climate change and infectious disease?

- Talk with patients about the health risks of infectious diseases and how to stay safe and healthy.
 - Educate patients about mosquito-borne illnesses such as West Nile Virus, Dengue and Zika and ways to avoid transmission, including using insect repellent, clothing and installing door or window screens to keep mosquitos out of homes.
 - West Nile Virus Factsheet: [English](#), [Spanish](#)
 - Dengue Factsheet: [English](#), [Spanish](#)
 - Zika Virus:
 - Avoid travel to areas where there have been outbreaks of Zika virus: <http://wwwnc.cdc.gov/travel/page/zika-travel-information>
 - CDC Zika and pregnancy site for patients: <http://www.cdc.gov/zika/pregnancy/question-answers.html>
 - For physicians: Doctor's Visit Checklist for Pregnant Women who Traveled to an Area with Zika: <http://www.cdc.gov/zika/pdfs/docvisit-checklist-travelpreg.pdf>
 - Educate at-risk patients about Valley Fever and ways to avoid exposure, including avoiding areas and activities with high dust exposure (construction or dusty fields, gardening, etc), staying indoors with windows closed on windy and dusty days, wearing a respirator such as an N95 mask if areas and activities with dust can't be avoided, and ensuring good indoor air filtration.
 - Valley Fever Factsheet: [English](#), [Spanish](#), [For workers](#)



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Cases of Valley Fever in the U.S. have risen about 15% each year from 1998 to 2011.¹⁴

- Educate patients on the importance of good sanitation practices to avoid food and water-borne illness, especially following heavy rainfalls.
 - Information about WASH-related (water, sanitation & hygiene) practices: <http://www.cdc.gov/healthywater/emergency/audience/public.html>
- Educate your colleagues and community on the links between climate change, infectious disease, and what can be done to prevent adverse health impacts
- Promote mitigation and adaptation strategies related to climate change and infectious disease.
 - Work with local water management boards to ensure clean, safe drinking water for all communities, including protection of water systems during extreme storms and contamination prevention during drought, when groundwater sources are more likely to be tapped.
 - Advocate for improved surveillance of insect vectors impacted by climate change.
 - Work with planning departments to strengthen infrastructure related to flooding, including sewer system up-grades and run-off prevention through the use of green infrastructure.
- Support policies and programs in your community and in your health system that authentically engage and partner with community residents in addressing climate and health problems, including the social and economic inequities, for individuals and communities, related to climate change and infectious disease.
 - Advocate that emissions credits and other revenues be invested the hardest-hit communities to improve food and water system infrastructure, vector surveillance and mitigation efforts.



For More Information

- CDC Infectious Disease sites-includes information and resources for patients
 - **Valley Fever**
CDC: <http://www.cdc.gov/fungal/diseases/coccidioidomycosis/>
 - **West Nile Virus**
CDC: <http://www.cdc.gov/westnile/index.html>
 - **Dengue**
CDC: <http://www.cdc.gov/dengue/>
 - **Lyme Disease**
CDC: <http://www.cdc.gov/lyme/>
 - **Zika**
CDC: <https://www.cdc.gov/zika/>

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