

# Physicians for Social Responsibility

## Climate Change & Health Webinar Series

### Webinar #3: Vector-borne and Water-Borne Diseases

**Slide 10:** Climatic changes that are spurred by climate change – notably higher temperatures and greater humidity – increase the development, reproduction, and survival rates of vectors, or disease-bearing insects. These climate-related factors will also alter behavior of the vectors, influencing them to bite more often. Higher temperatures can also speed up pathogen development within vectors, and higher temperature and increased precipitation may also shift vectors' geographic range or result in their expansion both pole-ward and to higher elevations.

**Slide 11:** Likewise, climatic factors such as temperature, humidity, and rainfall can determine where malaria exists. Typically, Malaria is found and transmitted in tropical and subtropical areas, where temperatures are warm and there is enough rainfall for breeding sites. In these areas, mosquitoes can survive and multiply and malaria parasites can grow in the mosquitoes. As global average surface temperatures rise and precipitation patterns change – in other words, as climate change advances -- the conditions that are necessary for the growth of the vector and the disease are expanding.

According to the Center for Disease Control, approximately 3.3 billion people live in areas at risk of malaria transmission. 91% of the deaths due to Malaria occur in Africa, according to a 2010 estimate. Globally, 86% of the deaths caused by Malaria were children. While Malaria is not prevalent in the United States, there is still some risk: An average of 1500 cases are reported in the United States each year. However, these cases may have resulted from transmission in another country. There are three species of mosquitoes that were responsible for malaria transmission prior to its elimination; they are still widely prevalent in the U.S. , so there is the risk that malaria could be reintroduced in the United States.

Sources:

WHO. "Malaria." World Health Organization.

<http://www.who.int/mediacentre/factsheets/fs094/en/>

CDC. "Malaria Facts" Center for Disease Control. <http://www.cdc.gov/malaria/about/>

St. Louis M. and Hess J. "Climate Change: Impacts on and Implications for Global Health." *Am J Prev Med* 2008;35(5). August 2008.

**Slide 12** Infection with malaria parasites may result in a wide variety of symptoms. These symptoms range from very mild symptoms to severe disease and even death. Typically, Malaria is categorized as uncomplicated or complicated, uncomplicated being the least severe. If diagnosed and treated, malaria can be cured. However, if Malaria is left untreated, it can quickly become life-threatening, leading to acute respiratory distress syndrome and death.

Sources:

CDC. "Disease." Center for Disease Control. <http://www.cdc.gov/malaria/about/disease.html>  
WHO. "Malaria." World Health Organization.  
<http://www.who.int/mediacentre/factsheets/fs094/en/>

**Slide 13** The global incidence of dengue has grown dramatically in recent decades. Dengue is usually found in tropical and sub-tropical climates worldwide, mostly in urban and semi-urban areas. According to the World Health Organization, about half of the world's population is now at risk. It is transmitted by the Asian tiger mosquito, which has become well-established in the United States. As we said earlier, mosquitoes are responsive to heat and moisture, so as climate change continues to intensify, more areas in the U.S. (as well as other countries) become hospitable to mosquitoes and thus potentially to dengue.

There are now an estimated 100 million cases of dengue worldwide each year. In countries in Asia and Latin America, Dengue Haemorrhagic Fever (DHF) is a leading cause of serious illness and death among children. DHF is a more severe form of dengue infection and if not treated promptly and correctly, it can be fatal. (CDC) If treated, fatality rates fall below 1%.

Sources:

CDC. "Frequently Asked Questions". Center for Disease Control.  
<http://www.cdc.gov/dengue/fAQFacts/index.html>  
WHO. "Dengue and Severe Dengue". World Health Organization.  
<http://www.who.int/mediacentre/factsheets/fs117/en/index.html>

**Slide 14** The principal symptoms of dengue fever are high fever, severe headache, severe pain behind the eyes, joint pain, muscle and bone pain, rash, and mild bleeding. Generally, younger children and those with their first dengue infection have a milder illness than older children and adults. (CDC)

The case-fatality rate of its more serious form, dengue hemorrhagic fever (DHF), is about 5%, mostly among children and young adults. Dengue hemorrhagic fever is characterized by a fever that lasts from 2 to 7 days, with symptoms consistent with dengue fever: vomiting, severe abdominal pain, muscle and bone pain, and difficulty breathing. If not treated, those infected may experience circulatory system failure and shock, followed by death.

This map indicates the areas in the United States that are potentially vulnerable to Dengue Fever. Areas in red have reported at least one dengue vector species as of 2005. Fortunately for us, that is not the same as the presence of the disease.

Sources:

CDC. "Frequently Asked Questions". Center for Disease Control.  
<http://www.cdc.gov/dengue/fAQFacts/index.html>  
WHO. "Dengue and Severe Dengue". World Health Organization.  
<http://www.who.int/mediacentre/factsheets/fs117/en/index.html>

**Slide 15** West Nile virus is an arthropod-borne virus most commonly spread by infected mosquitoes. West Nile virus can cause febrile illness, encephalitis or meningitis. West Nile virus was first detected in North America in 1999, and rapidly spread across the continental United States and Canada. (CDC)

Human infection is most often the result of bites from infected mosquitoes... so as you now know, the increases in heat and humidity associated with climate change in many parts of the U.S. contribute to the expansion of appropriate habitat, increase mosquito biting activity, and accelerate pathogen development.

The areas in dark green on the map are the states that have reported WNV human infections, and the areas in light green are states that have reported non-human WNV activity, this year.

Sources:

CDC. "West Nile virus disease cases and deaths reported to CDC by year and clinical presentation, 1999-2012" Center for Disease Control.  
[http://www.cdc.gov/westnile/resources/pdfs/cummulative/99\\_2012\\_CasesAndDeathsClinicalPresentationHumanCases.pdf](http://www.cdc.gov/westnile/resources/pdfs/cummulative/99_2012_CasesAndDeathsClinicalPresentationHumanCases.pdf)

CDC. "FAQ: General Questions About West Nile Virus". Center for Disease Control.  
<http://www.cdc.gov/westnile/faq/genQuestions.html>

WHO. "West Nile Virus" World Health Organization.  
<http://www.who.int/mediacentre/factsheets/fs354/en/>

**Slide 16** Most people who are infected with WNV do not show any symptoms. However, 20% of those who are infected can develop a range of symptoms including fever, headache, tiredness, and body aches, nausea, vomiting, occasionally a skin rash, and swollen lymph glands. Others experience more serious symptoms including headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, and paralysis. A small percent of those who are affected – less than 1% - may develop very serious symptoms, including encephalitis, meningitis, coma and paralysis.

CDC. "FAQ: General Questions About West Nile Virus". Center for Disease Control.  
<http://www.cdc.gov/westnile/faq/genQuestions.html>

WHO. "West Nile Virus" World Health Organization.  
<http://www.who.int/mediacentre/factsheets/fs354/en/>

**Slide 17** Plague is a bacterial disease which primarily affects wild rodents. The plague is spread from one rodent to another by fleas carrying the disease. When humans are bitten by an infected flea, they usually develop a bubonic form of plague, which is characterized by a swollen lymph node known as a bubo.

The Plague was introduced into the United States in 1900; steamships carrying infected rats caused epidemics in port cities. The plague was transmitted to other rat species, and spread to other areas of the western United States. In the U.S., most human cases in the United States

occur in two regions: northern New Mexico, northern Arizona, and southern Colorado; and California, southern Oregon, and far western Nevada.

A study shows that an increase in springtime temperatures by 1.8F could increase the number of rodents infected with the plague by 50%.

It's noteworthy that, as temperatures have warmed, cases in the US have shifted northward.

Sources:

Nakazawa Y, Williams R, Peterson AT, Mead P, Staples E, Gage KL. Climate change effects on plague and tularemia in the United States. *Vector Borne Zoonotic Dis* 2007;7:529–40.

Parker, CL., Shapiro, SM. *Climate Chaos Your Health At Risk What You Can Do to Protect Yourself and Your Family*. Westport, Connecticut: Praeger, 2008.

CDC. "Frequently Asked Questions". Center for Disease Control. <http://www.cdc.gov/plague/faq/index.html>

**Slide 18** Patients develop sudden onset of fever, headache, chills, and weakness and one or more swollen, tender and painful lymph nodes (called buboes). The bacteria multiply in the lymph node closest to where the bacteria entered the human body. If the patient is not treated with the appropriate antibiotics, the bacteria can spread to other parts of the body.

If diagnosed early, bubonic plague can be successfully treated with antibiotics. Another form of the plague, pneumonic plague, is one of the most deadly infectious diseases; patients can die 24 hours after infection. In this form, the mortality rate is high.

Sources:

CDC. "Frequently Asked Questions". Center for Disease Control. <http://www.cdc.gov/plague/faq/index.html>

WHO. "Plague". World Health Organization. <http://www.who.int/topics/plague/en/>

**Slide 19** Lyme disease is the most commonly reported tick-borne disease in the United States. According to the CDC, there were more than 22,500 confirmed cases of Lyme disease in 2010. Changing weather patterns associated with climate change have induced shifts in the distribution of vector ticks carrying Lyme disease. In addition, more people may contract Lyme disease as humans expand development into forested areas.

Sources:

Parker, CL., Shapiro, SM. *Climate Chaos Your Health At Risk What You Can Do to Protect Yourself and Your Family*. Westport, Connecticut: Praeger, 2008.

CDC. "Lyme Disease". Center for Disease Control. <http://www.cdc.gov/niosh/topics/lyme/>

WHO. "Lyme Borreliosis (Lyme Disease)". World Health Organization. <http://www.who.int/ith/diseases/lyme/en/>

**Slide 20** After a human is bitten by an infected tick, a “bull’s eye” rash often appears at the site of the tick bite. The rash occurs in approximately 70-80% of infected persons<sup>1</sup> and begins after a delay of 3-30 days (average is about 7 days). The rash gradually expands over a period of several days, and can reach up to 12 inches (30 cm) across. Parts of the rash may clear as it enlarges, resulting in its “bull's-eye” appearance. The rash usually feels warm to the touch but is rarely itchy or painful. (CDC) If left untreated, the infection may spread from the site of the bite to other parts of the body, producing an array of specific symptoms that may come and go, including: Additional Bulls eye rash, facial or Bell's palsy, severe headaches and neck stiffness due to meningitis, pain and swelling in the large joints.

Sources:

CDC. “Signs and Symptoms of Lyme Disease”. Center for Disease Control.  
[http://www.cdc.gov/lyme/signs\\_symptoms/index.html](http://www.cdc.gov/lyme/signs_symptoms/index.html)

**Slide 21** Sources:

Zielinski-Gutierrez, Emily, Wirtz, Robert A., Nasci, Roger S., Brogdon, William G. “**Protection against Mosquitoes, Ticks, & Other Insects & Arthropods**”. Center for Disease Control.  
<http://wwwnc.cdc.gov/travel/yellowbook/2012/chapter-2-the-pre-travel-consultation/protection-against-mosquitoes-ticks-and-other-insects-and-arthropods>

**Slide 23** CDC. “**Global WASH-Related Diseases and Contaminants**”. Center for Disease Control.  
[http://www.cdc.gov/healthywater/wash\\_diseases.html](http://www.cdc.gov/healthywater/wash_diseases.html)

**Slide 24** CDC. “Water-borne Diseases”. Center for Disease Control.  
<http://www.cdc.gov/climateandhealth/effects/waterborne.htm>

**Slide 25** Cholera is a diarrheal illness caused by infection of the intestine. An estimated 3-5 million cases and over 100,000 deaths occur each year around the world. The cholera bacterium can be found in water or food sources that have been contaminated by feces from a person infected with cholera. People living in locations with inadequate water treatment, poor sanitation, and inadequate hygiene are the most likely to become infected. Those factors are multiplied by heavy rainfall, increasing temperatures, and flooding – meaning that climate change is contributing to already severe problems in places like India and Bangladesh.

The map shows the global prevalence of cholera. The areas shaded in yellow are areas that have reported outbreaks of cholera. The black dots represent countries that have reported imported cases of cholera.

Sources:

Miguel Ángel Luque Fernández, Ariane Bauernfein, Julio Díaz Jiménez, Cristina Linares Gil, Nathalie El Omeiria, Dionisio Herrera Guibert. **Influence of temperature and rainfall on the evolution of cholera epidemics in Lusaka, Zambia, 2003-2006: analysis of a time series.**

*Transactions of the Royal Society of Tropical Medicine and Hygiene*, 2009; 103 (2): 137 DOI: [10.1016/j.trstmh.2008.07.017](https://doi.org/10.1016/j.trstmh.2008.07.017)

CDC. "General Information". Center for Disease Control.  
<http://www.cdc.gov/cholera/general/index.html>

WHO. "Cholera". World Health Organization.  
<http://www.who.int/topics/cholera/about/en/index.html>

**Slide 26** Cholera infection is often mild or without symptoms, but can sometimes be severe. For those who develop symptoms, most have mild or moderate symptoms, while around 20% develop acute diarrhea with severe dehydration. Approximately one in 20 (5%) infected persons will have severe disease characterized by diarrhea, vomiting, and leg cramps. These people become dehydrated and can go into shock due to loss of fluids. If proper treatment is not administered quickly, death can occur within hours.

Sources:

CDC. "General Information". Center for Disease Control.  
<http://www.cdc.gov/cholera/general/index.html>

WHO. "Cholera". World Health Organization.  
<http://www.who.int/topics/cholera/about/en/index.html>

**Slide 27** Norovirus is the most common cause of acute gastroenteritis in the United States, causing approximately 21 million illnesses, 70,000 hospitalizations and 800 deaths each year. Norovirus is also the most common cause of food-borne disease outbreaks in the United States. Norovirus is a very contagious virus, and is transmitted in a number of ways. One of these is via contaminated water, which is why we include it in this discussion of climate change.

Sources:

CDC. "Overview". Center for Disease Control.  
<http://www.cdc.gov/norovirus/about/overview.html>

**Slide 28** People with norovirus feel extremely ill and throw up or have diarrhea many times a day. This can lead to dehydration, especially in young children, older adults, and people with other illnesses. Fortunately, most people with norovirus illness get better within 1 to 3 days.

Sources:

CDC. "Symptoms". Center for Disease Control.  
<http://www.cdc.gov/norovirus/about/symptoms.html>

**Slide 29** A large outbreak of norovirus took place in the aftermath of Hurricane Katrina. 1,169 people who had been evacuated to Houston, TX reported symptoms of acute gastroenteritis. Most of

these people were under the age of 18. While the number of hospitalizations is unknown, no deaths were reported.

Sources:

CDC. “**Norovirus Outbreak Among Evacuees from Hurricane Katrina --- Houston, Texas, September 2005**”. Center for Disease Control.  
<http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5440a3.htm>

**Slide 30** *Naegleria fowleri* is found around the world. In the United States, the majority of infections have been caused by *Naegleria fowleri* from freshwater sources (lakes, rivers, hot springs, poorly maintained swimming pools) located in southern-tier states, but has also been observed in locations farther north, potentially due to warmer temperatures associated with climate change. While infections with *Naegleria fowleri* are rare, they occur mainly during the summer months when temperatures are warm.

*Naegleria fowleri* infects people when water containing the ameba enters the body through the nose. This typically occurs when people go swimming or diving in warm freshwater places, like lakes and rivers.

Sources:

CDC. “General Information”. Center for Disease Control.  
<http://www.cdc.gov/parasites/naegleria/>

**Slide 31** Once the ameba enters the nose, it travels to the brain and is usually fatal. *Naegleria fowleri* causes primary amebic meningoencephalitis (PAM), which is an infection that destroys brain tissue. The symptoms of PAM begin about 5 days after infection. The initial symptoms may include headache, fever, nausea, or vomiting. As the disease progresses, those infected experience stiff neck, confusion, lack of attention to people and surroundings, loss of balance, seizures, and hallucinations. Once the symptoms begin, the disease progresses rapidly and usually causes death within about 5 days. The fatality rate is over 99%.

Sources:

CDC. “General Information”. Center for Disease Control.  
<http://www.cdc.gov/parasites/naegleria/general.html>

**Slide 32** Clin Infect Dis. 2012 Mar;54(6):805-9. doi: 10.1093/cid/cir961. Epub 2012 Jan 11.

**Fatal *Naegleria fowleri* infection acquired in Minnesota: possible expanded range of a deadly thermophilic organism.**

Kemble SK, Lynfield R, DeVries AS, Drehner DM, Pomputius WF 3rd, Beach MJ, Visvesvara GS, da Silva AJ, Hill VR, Yoder JS, Xiao L, Smith KE, Danila R.

**Slide 33** IRC. **How to promote measures to prevent water-borne diseases?** IRC International Water and Sanitation Centre. <http://www.irc.nl/page/8904>

**Slide 40** Finally, work with Physicians for Social Responsibility to help slow, stop and eventually reverse climate change. PSR is made up of citizens and health professionals who work for a safe and healthy energy policy. If you're interested in joining, go to our website or call the phone number shown on the slide.