



## Health Implications of Global Warming: Vector-borne and Water-borne Diseases

Global warming is acknowledged by scientists around the world to be a reality and to be caused primarily by human activity, especially the burning of fossil fuels. As the earth warms, the delicate balance of climate, weather events and life is disrupted. Consequences emerge that threaten human health and, ultimately, survival.

This is one of several fact sheets produced by Physicians for Social Responsibility that examine recent scientific evidence of global warming's impact on health.

### Vector-borne diseases

#### Vectors carry and transmit disease

- Vectors are insects (mosquitoes, ticks, fleas, black flies and sandflies) that carry infectious agents such as protozoa, bacteria and viruses.
- They carry and transmit numerous diseases to humans: parasitic vector-borne diseases such as malaria, leishmaniasis, and Chagas disease; arboviral diseases such as dengue fever, yellow fever, West Nile Virus, Rift Valley fever, and tickborne encephalitis; and bacterial and rickettsial diseases such as Lyme borreliosis, tularemia and plague.

#### Global warming impacts vector-borne diseases

- Vector organisms and the infectious agents they carry are cold-blooded, so changes in temperature will affect their development, reproduction, behavior and survival rates.
- Changing temperature and precipitation may shift the geographic range in which they can live and the seasonal period of disease risk.
- Temperature also can affect pathogen development within vectors, precipitation can influence the availability of breeding sites, and climatic variables can affect the distribution and abundance of their vertebrate host species.<sup>i, ii</sup>

**Global warming and mosquitoes:** Mosquitoes are highly sensitive to temperature. Higher temperatures:

- boost their reproductive rate, lengthen their breeding season, and make them bite more frequently;
- shorten the time it takes for the pathogens they carry to mature to an infectious state;
- can expand the mosquitoes' range to higher elevations and more northern latitudes, potentially putting previously unexposed populations at risk.

Storms, hurricanes and floods can contribute to the spread of malaria, as they leave behind vector breeding sites.

**The threat to health:** Mosquitoes can carry malaria and dengue fever, among other diseases.

- Malaria: Some 350 to 500 million cases of malaria occur annually, resulting in the deaths of an estimated one to three million people, mostly young children. Worldwide, malaria has the largest disease burden (illnesses, deaths, financial costs and other indicators) of any vector-borne disease.<sup>iii</sup>

- Dengue fever: It is estimated that there are over 100 million cases of dengue worldwide each year. The case-fatality rate of its more serious form, dengue haemorrhagic fever (DHF), is about 5%, mostly among children and young adults.<sup>iv</sup> The disease is now endemic in many countries of the Americas; there is a small risk for dengue outbreaks in the continental United States.<sup>v</sup>

### **Global warming and ticks**

- Ticks maintain multiple and diverse disease agents (including bacteria, viruses, and parasites) and serve as bridging vectors between animal reservoirs of the disease and humans.
- Changing weather patterns associated with climate change have induced shifts in the distribution of vector ticks carrying Lyme disease. Modeling indicates that in the future, the tick that carries Lyme disease will expand into Canada.<sup>vi</sup>

### **Global warming and fleas**

- Fleas are best known as vectors of the causative agent of plague. Plague has caused millions of human deaths, especially during the Black Death of the Middle Ages.
- Plague is still with us, notably in New Mexico, where its prevalence seems to correlate with the timing and amount of precipitation.<sup>vii,viii</sup>
- Recently, studies of plague transmission in the U.S. found that the pattern of human plague cases has shifted northward as temperatures have warmed. It is predicted that some northward expansion of the disease could occur from New Mexico into Wyoming and Idaho.<sup>ix</sup>

## **Water-borne diseases**

### **Water-borne infectious diseases worsen with global warming**

- Infectious diarrhea is one of the most prevalent of the world's water-borne diseases. It is usually a symptom of gastrointestinal infection, which can be caused by a variety of bacterial, viral and parasitic organisms. Infection is spread through contaminated food or drinking-water, or from person to person as a result of poor hygiene.
- Severe diarrhea leads to fluid loss and may be life-threatening, particularly in young children and people who are malnourished or have impaired immunity. Globally, it is the second-leading cause of mortality in young children.<sup>x</sup>
- This is only expected to worsen with climate change, driven by factors including increased temperatures, flooding, and other changes in the water cycle.<sup>xi</sup>
- Cholera is a diarrheal disease caused by bacteria that occur naturally in rivers, estuaries, and coastal waters. Scientists have observed a relationship between the increase in sea-surface temperature and the onset of cholera epidemics. Strong El Nino cycles and other climate variables provide a predictive capacity for cholera epidemics.<sup>xii</sup>

### **Increased risk of water-borne diseases in the U.S.**

- In countries with reliable sources of potable water, contamination of recreational waters from extreme weather events remains a significant means of disease transmission. Ear, nose, and throat, respiratory, and gastrointestinal illnesses are commonly associated with recreational swimming in fresh and oceanic waters.
- Other, potentially more severe waterborne diseases are also transmitted in recreational waters, although with less frequency, such as hepatitis, giardiasis, and cryptosporidiosis.<sup>xiii</sup>
- A study of water contamination of the Great Lakes projected that as extremely heavy precipitation events become stronger, there will be a resulting greater potential for flooding and sewer overflow, with a corresponding greater potential for waterborne diseases. It stated, "The Great Lakes, which serve as a drinking water source for more than 40 million people, are particularly susceptible to fecal pollution and can become reservoirs for waterborne diseases."<sup>xiv</sup>

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- <sup>i</sup> Gage K. et al. "Climate and Vectorborne Diseases" *Am J Prev Med* 2008; 35(5).
- <sup>ii</sup> Patz et al., Impact of regional climate change on human health. *Nature*, Vol 438, 17 November 2005.
- <sup>iii</sup> St. Louis M. and Hess J. "Climate Change: Impacts on and Implications for Global Health." *Am J Prev Med* 2008;35(5). August 2008.
- <sup>iv</sup> CDC. "Dengue Fever Fact Sheet." Centers for Disease Control and Prevention. <http://www.cdc.gov/ncidod/dvbid/dengue/#current>
- <sup>v</sup> CDC. "Dengue Fact Sheet." Centers for Disease Control and Prevention. <http://www.cdc.gov/ncidod/dvbid/dengue/resources/DengueFactSheet.pdf>
- <sup>vi</sup> Brownstein JS, Holford TR, Fish D. Effect of climate change on Lyme disease risk in North America. *EcoHealth* 2005;2:38–46.
- <sup>vii</sup> Parmenter RR, Yadav EP, Parmenter CA, Ertstad P, Gage KL. Incidence of plague associated with increased winter-spring precipitation in New Mexico. *Am J Trop Med Hyg* 1999;61:814–21.
- <sup>viii</sup> Ensore RE, Biggerstaff BJ, Brown TL, Fulgham RE, Reynolds PJ, Engelthaler DM, et al. Modeling relationships between climate and the frequency of human plague cases in the southwestern United States, 1960–1997. *Am J Trop Med Hyg* 2002;66:186–96.
- <sup>ix</sup> 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.
- <sup>x</sup> Shea K and Committee on Environmental Health. "Global Climate Change and Children's Health." *PEDIATRICS* Volume 120, Number 5, November 2007.
- <sup>xi</sup> St. Louis M. and Hess J. "Climate Change: Impacts on and Implications for Global Health." *Am J Prev Med* 2008;35(5). August 2008.
- <sup>xii</sup> Colwell R. "Global Climate and Health: Predicting Infectious Disease Outbreaks." *Innovations*. Summer 2006, Vol. 1, No. 3, Pages 19-23. Accessed online at <http://www.mitpressjournals.org/doi/pdf/10.1162/itgg.2006.1.3.19?cookieSet=1>
- <sup>xiii</sup> Patz J et al. "Climate Change and Waterborne Disease Risk in the Great Lakes Region of the U.S." *Am J Prev Med* 2008;35(5). August 2008.
- <sup>xiv</sup> Patz J et al. "Climate Change and Waterborne Disease Risk in the Great Lakes Region of the U.S." *Am J Prev Med* 2008;35(5). August 2008.