Climate and Health: Some General Observations for the IACC Project

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Because human communities and individuals are part of both local and global ecosystems, health conditions within them are influenced to a significant degree by climatic fluctuation. Changes in microbial ecosystems, the source of disease among human and animal populations, are often the direct result of variability of water. This discussion will consider three aspects of the interaction between water, disease, and human populations. They are, temperature, in particular the significant warming of the past decades, drought, and overabundance of water. The three variables are intimately related and, as with any other aspects of ecosystems, cannot be easily separated from one another.

Warming

The past two decades have seen a significant, if not unprecedented, rise in global temperatures. The most significant epidemiological consequence of this trend has been the spread of what once were considered tropical diseases to areas of higher latitude. Because pathogens and the animals that serve as their vectors to humans are largely dependent on water for their development, increased temperatures serve to nurture pathogens that would otherwise not be able to survive. Diseases that were almost unknown in northern North America a decade ago are now serious health threats to human populations on the prairies. The introduction of diseases to previously uninfected areas is the result of increased global trade and communications but also of shifts within environmental conditions of newly infected areas.

In Saskatchewan one of the most significant health consequences of recent warming had been the rapid spread of a disease of African origin, the West Nile Virus. The disease is carried by mosquitoes and transmitted to both bird and human populations. As both summer and winter temperatures increase, greater numbers of mosquitoes survive and breed, spreading infection within the insect population. The virus is then transmitted to birds who spread the disease to uninfected mosquitoes and eventually to humans. The virus is a threat even during dry periods, as insect populations that prey on mosquitoes are diminished and birds are forced to congregate at dwindling sources of water. Infection is increased as mosquitoes infect the concentrated bird population. As birds become increasingly infected, they in turn spread the virus to other uninfected mosquitoes and eventually to humans.

West Nile virus was discovered for the first time in North America in 2000 (Epstein 2000). Five years later, it has been identified in every province and has because so ubiquitous, that the Canadian Blood Service has begun to test all blood donations for the virus in the months when the pathogen is viable. The southwestern Canadian prairies are particularly vulnerable. West Nile infection rates near Moose Jaw were some of the highest reported in North America over the past few years. Considered as harbingers of serious West Nile virus

infection, dead birds are now reported to local authorities. The interrelationship between West Nile infection and climate is clear. In the warm years since the arrival of the pathogen the infection spread quickly westward, spreading serious illness and even death. The cool summer experienced in 2004 served to mitigate the spread of the virus to the human population. As temperatures increase, public health officials will have to deal with West Nile as an increasingly significant issue. The general population has already gone through a shift with regard to the disease. Standing water on private property is now often seen as a potential threat. The application of insect repellant is now becoming as common as the use of sun screen.

Other emerging pathogens are spreading as a result of warming. Hantavirus Pulmonary Syndrome, a highly lethal infection of the lungs, is passed to humans through the inhalation of the virus from secretions and excretions of rodents (Epstein 2000: 54). In the South Saskatchewan River Basin (SSRB), deer mice are the main source of Hanta virus transmission. Rodent populations often increase during drought and the threat to human population increases when they seek food in areas of human occupation. Although urban populations are a risk, farms are particularly vulnerable to the spread of the disease.

Hanta virus has spread quickly since its introduction from Asia to the southern United States in shipping container filled with used tires. By the early 1990s, the disease was being spread through the rodent population of inner cities of the U.S. and the dry country of the American southwest. In 1993, the first serious outbreak in the American southwest, occurred, on the Four Corners Navajo Reservation and resulted in several deaths. The disease has spread northward into Canada primarily through infection of deer mice and their interaction with humans. Farming communities are at particular risk as infected mice soil grain storage areas. Deaths have been reported in the prairies from the infection. The interaction of increasingly warm and dry conditions will serve to increase the risk of Hantavirus Respiratory Syndrome in human communities.

Other pathogens have been spreading from the tropics to higher latitudes. As temperatures in areas of temperature climates become increasingly warm. Although not a threat to Canada, the virus responsible for Dengue fever had been spreading southward from the tropical regions of South America in the past decades. The virus is transmitted though mosquitoes to humans and became a serious threat to public health in the urban slums of South America after its arrival in Latin America in the 1960s (Garrett: 1995:258). Buenos Aires experienced an outbreak of the disease in the late 1990s. Infections have been reported at elevations as high as one mile in Taxco, Mexico (high elevations were considered to be relatively free of such diseases in the past because of their cooler climates). Because no effective drug treatment has been developed for Dengue, the pathogen may pose a serious threat to infected areas. As temperatures and the population of mosquitoes that carry the virus increase, the disease will spread to previously uninfected areas.

Other diseases will become increasingly significant threats as temperatures increase. Malaria, a water-borne disease spread by mosquitoes has greatly expanded its range of infection since the 1990s. Heat waves have increased the risk even further. Outbreaks of the disease have been reported throughout the southern United States and even into Michigan and Toronto (Epstein 2000: 53). As summer heat waves become more intense, conditions for malaria and other tropical diseases will spread, providing pathogens with an ever expanding range of susceptible populations.

Diseases once though to be under control may also increase as a consequence of warming. Although not a threat to human populations with adequate medical care, tuberculosis infection poses a serious threat to under serviced or poor communities such as isolated villages (in South America) as harvests diminish and communities are displaced. Tuberculosis remains a primary cause of sickness and death in the Third World and will undoubtedly increase as climate change increases displacement of large populations in the Third World. Other pathogens considered little more than a nuisance in the developed world greatly increase their virulence in malnourished populations. If warming leads to large scale displacement of farming populations in areas with inadequate infrastructure to provide food relief, diseases such as measles can become fatal (Morley 1980:124-125). The recent severity of a measles outbreak among the refugee population in Darfur, Sudan, is an example of the threat posed by pathogens in immune compromised populations.

Drought

Drought is largely considered to be the most significant consequence of the warming trend experienced in the last decades. Droughts, however, are not simply a result of increased heat. In the Canadian plains, the most severe drought period of the past five hundred years, from 1790-1801 occurred during the climatic period known as the Little Ice Age, when temperatures were significantly cooler (1˚ C) than they are at present. Even without the warming normally associated with droughts in the modern period, the depletion of water supplies pose a risk to health. During the severe drought episode at the end of the 18th century, at least two severe outbreaks occurred as a consequence of the protracted dry period. An outbreak of the bacterial disease, Tularemia, resulted from the contamination of water which was probably at severely low levels. Rodent populations across the Canadian west suffered high rates of mortality. The disease was transferred to humans and a serious outbreak of the disease ensued. The burgeoning of the rodent population that resulted from the drought also acted to spread a serious lung disease to humans and resulted in many fatalities.

Preliminary studies have been made on the health impact of drought on contemporary populations in the Canadian plains (Smoyer-Tomic, et.al 2004;

Klaver 2002). Although further investigation is required, they have identified numerous health consequences of drought. The first is psychological. As crops fail and political and market forces place increased strain on farmers, stress and even suicide become increasing significant.

As dry conditions increase the levels of dust (as measured in total suspended particulates or TSPs), particularly during the spring and fall, when farming operations are at their peak. Organic dust includes pollens, molds, fungi, mites etc., and will contribute to increased respiratory inflammation, bronchitis and asthma. Although these conditions are not usually fatal, they will contribute to an increase in illness particularly among the sick and aged.

Another regional outcome of drought on the Canadian prairies is the increased risk of air pollution from fires. Although local fires from the burning of crops is an ongoing problem, smoke from major fires can cause respiratory inflammation in populations long distances away. In 1997, the smoke from major forest fires in Sulawesi, Indonesia, created serious lung problems for residents of major cites hundreds of miles away from fire zones. The major fires in 2004 in Yukon and British Columbia undoubtedly exacerbated respiratory illnesses ion the plains. Smoke also contributed to eye diseases such as conjunctivitis from inflammation.

As mentioned above, rodent populations often explode during periods of protracted drought. Mice often serve to transmit pathogens to humans. Diseases that increase in frequency during dry periods include Hanta, Rocky Mountain Spotted Fever (transmitted from ticks to rodent to other mammals), Western Equine Encephalitis and Lyme disease. As water levels decrease during droughts both pathogen and toxins concentrations increase. Contamination from livestock to human population becomes an increasingly important threat. There may be a bigger threat to human populations from these pollutants following the end of droughts, as contaminated water is spread into an expanded area of watersheds as levels increase. Water-borne pathogens such as *Cryptosporidium, Giardia, and E. Coli*, can be particularly dangerous in drought or post-drought environments.

Flooding and High Water

As stated above, the main threat during times of high water and flooding is the spread of organic or chemical contamination to human populations. Although Cholera outbreaks on the North American plains have been rare, the disease may pose a greater threat as temperatures increase. In the tropics, Cholera poses a serious threat. During the 1990s, an algal bloom in the Pacific created a “Red Tide” which brought the disease to the coast of Peru. Pre-empting an outbreak of the disease was a central component of the relief operation in the wake of the recent Tsunami in the Indian Ocean. Although measures taken appear to have been largely successful, the infection of drinking water supplies

from outside infection during floods remains a serious concern of public health authorities.

On the Canadian prairies, the interaction of fertilizer contamination from intensive agriculture and sewage could create blooms of potentially harmful algae, including those that cause diseases such as Typhoid or Cholera.

The interaction of the variables of warming, drought, and eventual flooding have, and will continue to have, serious implications for public health. Though bacterial infections can be treated in the short term by the use of antibiotics, many pathogens are becoming increasingly resistant to their use. Human populations generally will have to act to diminish the collective threat to pathogens if long term solutions to these impending disasters are to be successful.

References:

Epstein, Paul R. “Is Global Warming Harmful to Health?” *Scientific American*, vol. 283 (August 2000):50-57.

Laurie Garrett, *The Coming Plague: Newly Emerging Diseases in a World Out of Balance.* Harmondsworth: Penguin Books, 1995.

Klaver, Justine D.A. “Climate Change and Human Health: A Canadian Prairie Perspective.” M.A., Medical Sciences-Public Health Sciences, University of Alberta, 2002.

Morley, David. “Severe Measles.” In *Changing Disease Patterns and Human Behaviour*. Eds. N.F. Stanley and R.A. Joske, 115-128. London: Academic Press, 1980.

Smoyer-Tomic, Karen E., Justine D.A. Kavner and Donald W. Spady “Health Consequences of Drought on the Prairies.” *Ecohealth* (Online Journal) November 2004.