COMMENTARY

Potential Impacts of Global Warming and Climate Change on the Epidemiology of Zoonotic Diseases in Canada

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Global climate change may add to the risk of infectious diseases faced by Canadians. A warmer climate may permit the northward expansion of certain disease reservoir animal hosts and vectors increasing the risk to Canadians from zoonotic diseases, i.e., diseases that are transmissible between animals and humans. A shorter, less severe winter would prolong the transmission season for many existing Canadian zoonoses, and could allow previously exotic zoonoses that enter Canada to become established. Significant challenges to epidemiological forecasting arise from complex interactions among climatic factors, zoonotic disease agents, other infectious agents, underlying human health and immunity, socio-economic factors, and ecological parameters. Public health officials and health care providers need to be kept informed of the changing nature of zoonotic disease risk in order to be vigilant in the early detection of disease, and to plan to respond to new or increased health risks. Surveillance and public education will also help protect Canadians from any additional zoonotic health risks of climate change.

Global warming and climate change

Global warming and associated climate change will be important determinants of future Canadian public health.[1] The International Panel on Climate Change (IPCC) accepts projections of a 1.4 to 5.8ºC increase in mean global temperature by 2100 as a result of the accumulation of greenhouse gases (carbon dioxide, ozone, methane, nitrous oxide, and water vapour) in the atmosphere. Achievement of Kyoto emissions reduction targets will reduce the rate of warming but will not prevent it.[2] Climate changes in Canada may include increased temperature over most of Canada, especially in winter and at night; reduced soil moisture and summer drought; increased frequency of extreme precipitation events; more severe weather; and an 11 to 77 cm sea-level rise, by 2100.[2] The greatest changes may affect the Arctic.[2,3]

Vectorborne zoonoses

Climate change may increase the risk to Canadians from vectorborne diseases (caused by pathogens with an invertebrate vector), including arboviral encephalitis, rickettsial diseases, and Lyme borreliosis. Forecasts under conditions of global warming suggest an increase in arboviral encephalitis in the US.[4] Increased temperatures and longer summers may extend the survival of vectors in Canada, and allow the northward expansion of the ranges of other vectors.[5] Sporadic human cases of arboviral encephalitis in Canada have been caused by Western Equine Encephalitis (WEE), Powassan virus and viruses of the California serogroup (including Snowshoe Hare virus). There have also been outbreaks of Eastern Equine Encephalitis (EEE) in horses.[6,7] Outbreaks of St. Louis Encephalitis (SLE) are common in the US[8] and there are American reports of sporadic outbreaks of others, including West Nile Virus (WNV).[9] West Nile Virus has been found in bird carcasses from southern Ontario.[10]

Rocky Mountain Spotted fever,[9] Lyme borreliosis,[11,12] and ehrlichiosis[13] are tickborne diseases that may have increased incidence in Canada given milder winters and increased spring precipitation. Warmer temperatures could accelerate pathogen development within the tick,[12] and populations of reservoir mice and deer could expand due to increased food availability and decreased winter die-off. Longer summers might increase the risk of human recreational exposure.

Foodborne and waterborne zoonoses

Every year in Canada, foodborne infections cause significant morbidity and mortality.[14] Many, including *Salmonella* and *Escherichia coli* O157:H7, have known food animal or wildlife reservoirs.[14-17] Climate change has been tentatively linked to increased foodborne disease incidence in the UK.[18] Elevated temperatures in North America may exacerbate food contamination during livestock rearing, food processing, and food preparation. Outbreaks of zoonotic diarrhea in heat-stressed livestock may contribute to this contamination.

Contamination of drinking water in Canada by zoonotic pathogens from livestock has been documented.[19] Linkages between water contamination and precipitation events have been noted in the US,[20] and proposed in Canada.[19] Several debilitating outbreaks of waterborne zoonotic diseases have been reported.[19-22] Under conditions of climate change, heavy rain or snowmelt would increase the risk of fecal contamination of surface and ground water, leading to drinking water contamination. In the US, over half the enteric disease outbreaks from 1944 to 1994 were reportedly preceded by an extreme precipitation event.[23]

Other zoonoses

Changing climate will affect the ecology of wild animals, many of which are reservoirs

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of diseases infectious to humans. Longer, warmer summers and milder winters will prolong rodent breeding seasons and reduce mortality. Increased small mammal populations may foster animal epidemics of diseases such as Hantavirus infection.[24] Outbreaks of rabies, tuberculosis, and brucellosis, for example, may occur in wild ungulates. If a consistently warmer climate allows more northern agricultural land use, there will be risk of disease spread to livestock and people. Increased recreational activities during longer summers may also bring more Canadians into contact with infected wildlife. Plague is established in rodent populations in several areas in the US, and two areas in southern British Columbia and Alberta.[9] Under climate conditions favourable to rodent populations, the likelihood of animal epidemics of plague would increase, and increase the risk of human cases.[25] Climate change will likely result in changes to wildlife habitat, range and ecology, changing the risk of human and livestock exposure to zoonoses.[26]

CONCLUSION

Canadians face new health threats from zoonotic disease from global climate change. Changes are expected in the epidemiology of both existing and exotic infectious diseases. Changes in human behaviour associated with warmer weather and longer summers may increase exposure to infectious diseases, and to zoonoses in particular. Canada's North may face new risks from zoonoses given the degree of climate change expected there, the presence of wildlife reservoirs, the potential for vectors to become established, and the potential for the eventual northward expansion of agriculture. The warming projected for southern Canada will result in rapid and complex changes to ecosystems and to the landscape, bringing unforeseen changes in the ecology of infectious diseases. Surveillance, including animal sentinels, will be key in the early detection of emerging zoonotic disease threats under global climate change. Physicians, other healthcare providers, public health workers, indeed, all Canadians need to be made aware of potential zoonotic risks related to climate change to allow for the detection of early cases of unusual or unexpected disease, and to protect Canadian public health. An exhaustive review of the potential impact of global climate change on infectious disease risk to people and animals in Ontario is in preparation for the Ontario Ministry of Natural Resources and the Agricultural Research Institute of Ontario.

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