Zika virus

A case study for Canada's role in emerging infectious disease prevention

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ABSTRACT

Before 2015, few people outside the infectious disease community had heard of Zika virus. However, this virus is now the centre of global conscience. Pictures of newborns with microcephaly have been widely circulated and misinformation abounded. This piece explores and examines the evolution of infectious disease outbreaks, in addition to the historical public health responses. This investigation serves to garner lessons which can be applied to the current Zika outbreak. The virus' role as a pathogen is introduced, and current public health responses and their impacts are also examined. Finally, we posit what Canada's role should be in the midst of this outbreak.

THE EVOLUTION OF DISEASE PREVENTION

Past major viral disease outbreaks and corresponding measures taken must be examined to better understand current government and public health responses to the Zika outbreak. In 1918, the Spanish Influenza peaked in Spain, eventually killing an estimated 50 million to 100 million people, making it one of the deadliest outbreaks in history.¹ At the time, civil authorities attempted to achieve control by prohibiting mass gatherings. Theatres, churches, trains, baggage and even the mail were all subjected to disinfection by phenolic oil. Nonetheless, these preventive measures proved ineffective and the Spanish health system was quickly overrun.¹ While an event of the past, these fruitless attempts by Spanish authorities highlight the importance of appropriate public health responses to achieve disease control.

There are often limitations to governmental intervention. In such cases, citizens have taken measures into their own hands. The severe acute respiratory syndrome (SARS) outbreak in Hong Kong and China, for instance, prompted travelers to adopt their own disease prevention strategies. In a Hong Kong study, 34.5% of male respondents and 25.9% of female respondents reported wearing masks when in public. 79% of those surveyed reported they would not travel to mainland China, an area more afflicted by SARS.² This disease outbreak brought public health into the forefront of international media where infectious diseases had been previously relegated to the domain of officials and physicians.

Despite increased public awareness, emerging infectious diseases still cripple public health agencies and entire countries. More recently, the 2014 Ebola outbreak in West Africa had the medical community reeling. Both local and international responses to Ebola highlighted the tardiness and the limited preparedness. The World Health Organization (WHO) did not release its Ebola response plan until 5 months into the outbreak, by which point the

virus had spread to neighboring countries. During the outbreak, foreign aid was distributed to the affected countries in the form of personal protective equipment, medical workers and humanitarian assistance. Domestically, public health authorities responded by screening travelers from affected countries, instilling strict quarantine protocols. Canada even illegally closed its borders to affected countries. Many public health officials called loudly for improved international detection and reporting/response systems before the outbreak of the next pathogen.³

Emerging infectious diseases in the 21st century do not grow in a social vacuum. Technologies influence disease outbreaks. Social media and in particular Twitter proves to be a salient example. The recent Ebola outbreak reminded the world the role that social media can play in public health. In Nigeria, health care workers inadvertently tweeted common misconceptions, forcing the government to take to Twitter, in an attempt to correct the misinformation. For months, #ebola became a globally trending hashtag.³ While the Ebola outbreak highlighted the fear and misconceptions that can be propagated with ease by social media, it also showed the potential that social media can play in distributing correct and current information during an outbreak.

THE ZIKA VIRUS AS A PATHOGEN

Zika virus was first isolated in 1947 from the blood of a rhesus monkey found in the Zika forest in Uganda.⁴ It wasn't until 1952, however, that the first human-infected cases were detected.⁵ Recently, a surge in locally transmitted cases were reported, escalating concerns about the global threat it poses. These cases have been reported in Brazil, Colombia, El Salvador, Guatemala, Mexico, Paraguay, Puerto Rico and Venezuela.⁶ While individuals infected with Zika virus may often be asymptomatic or only mildly symptomatic, there is increasing evidence the virus is linked to severe neurological complications. In January 2016, Brazil reported a 20-fold increase of newborn babies with microcephaly.⁵ Additionally, Zika virus has been associated with an increased frequency of Guillain-Barre syndrome.⁷

The Zika virus itself is a mosquito-borne flavivirus from the Flaviviridae family.⁵ This family includes more widely-recognized Dengue, Yellow fever and West Nile viruses. Transmission of Zika virus is mainly achieved via the *Aedes aegypti* mosquito, though many species of *Aedes* mosquitos have also been reported to transmit the virus. Infections almost always occur following the bite of a carrier mosquito. However, transmission is not limited to the insect vector. Zika has also been identified in urine, breast milk, saliva and semen; the human-human transmission through semen has now been reported.⁵ Once inside its host, the virus invades and compro-

mises epidermal keratinocytes and immature dendritic cells. Neural cells are also susceptible to the virus, consistent with its neurological complications.⁵

CURRENT GOVERNMENTAL AND PUBLIC HEALTH RESPONSES TO ZIKA VIRUS

In sharp contrast to Ebola, the WHO responded quickly to the Zika outbreak, officially declaring it a public health emergency, and swiftly released their Global Emergency Response plan. As part of this program, the Regional Office for the Americas was deployed to aid local health ministries track and contain Zika virus, advise on clinical management and investigate its disease associations. Funding was also quickly distributed to aid the cause; \$25 million USD to the WHO-based response and \$31 million USD to key partners.⁸

In February 2016, President Obama asked the United States Congress for \$1.8 billion USD in emergency funding to combat Zika and prevent its spread to the North. This money would be allocated to mosquito control, vaccine research and health care for low-income pregnant women (most susceptible). More precisely, \$355 million USD would be directed as foreign aid to countries where Zika is most rapidly spreading. Prevention in the States, infectious disease experts argue, should be targeted to low-income areas along the Gulf of Mexico, which are historically hardest hit by mosquito-borne disease. The National Institutes of Health has also streamlined a Zika vaccine trial; expediting the process from 3 years to 1 year.⁹

The threat of Zika is geographically closer to the United States, but this doesn't leave Canada risk-free. The WHO has noted that Zika is unlikely to spread to Canada. Consequently, the government's response has been mainly limited to awareness campaigns. In February 2016, the Canadian government issued a public health notice targeting travelers to affected countries, specifically warning those who are pregnant or potentially pregnant. It also noted that the National Microbiology Laboratory in Winnipeg, Manitoba is now equipped to test for Zika virus should travelers experience symptoms.¹⁰

As part of Canada's preventive measures, research is being conducted to determine whether *Aedes albopictus*, another mosquito species identified as Zika carriers, could be driven into Canada by climate change. Researchers are also attempting to determine whether *Aedes culex*, a mosquito native to Canada and known to transmit flaviviruses, could pose a public health threat.¹¹

WHAT SHOULD CANADA'S ROLE BE IN THE FIGHT AGAINST ZIKA?

As exemplified with Ebola, one of the greatest barriers to thwarting Zika is lack of knowledge. Canadian research facilities are well-equipped and well positioned to study Zika.¹¹ Canadians made significant contributions in Ebola vaccine development,¹¹ and now is a good time again put this research capacity to the test. The countries currently struggling with Zika are among the world's poorest, lacking surveillance, laboratory and epidemiological capacities. Public health officials and physicians have called for

Canada to dispatch humanitarian efforts in the form of expertise to address the spread of Zika and to simultaneously strengthen the capacities of these affected countries.

As has been highlighted with Ebola, social media should also be utilized to combat the virus. Instead of letting misinformation and common misconception spread and "go viral", the Canadian government and public health agencies should harness its power as a platform to spread evidence-based, public health information readily accessible to Canadians and Zika-afflicted populations around the world. Finally, as it has been shown numerous times, prevention is more effective than treatment in terms of both cost and measurable outcomes.¹² For instance, it is more cost-effective to vaccinate against an infectious agent than to treat those infected. Public perceptions around disease prevention have also been shifting.¹² Historically, because of its perceived urgency, treatment was viewed more favourably amongst the public. However, this is no longer the case. The notion that it "is better to prevent than to cure" seems to have caught on.

Clearly now is the time to act, not when it proves too late, leading to a historical repeat of ill-timed responses by governments and public health agencies. The lessons learned from past emerging diseases must be carried forward and applied to Zika.¹³ Where the responses to Ebola were retroactive and treatment-based, the responses to Zika need to be characterized by proactivity and prompt prevention measures.

CONCLUDING REMARKS

The recent spike in reported cases of microcephaly and Guillain-Barré have brought Zika to the forefront of the global health community. The valuable and oftentimes difficult lessons learned during previous infectious outbreaks need to be applied vigilantly and quickly to combat Zika. Canada, as a global health leader, has a responsibility contributing to disease prevention efforts. Initiatives should be undertaken at first possibility, so that in the future, physicians and public health officials will not have to reflect on Zika and lament "hindsight is 20-20".

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