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Scientific Certainty in a Time of Uncertainty: Predicting Vulnerability of Canada's First Nations to Pandemic H1N1/09

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Scientific Certainty in a Time of Uncertainty: Predicting Vulnerability of Canada's First Nations to Pandemic H1N1/09

Abstract

On June 11, 2009, the Director General of the World Health Organization, Dr. Margaret Chan, announced that the scientific evidence indicated that the criteria for an influenza pandemic had been met: pandemic H1N1/09 virus, the first in nearly 40 years, was officially upon us. The World Health Organization has estimated that as many as 2 billion or between 15 and 45 percent of the population globally will be infected by the H1N1/09 virus. Scientists and governments have been careful to walk a line between causing mass public fear and ensuring people take the risks seriously. The latest information indicates that the majority of individuals infected with the H1N1/09 virus thus far have suffered mild illness, although very severe and fatal illness have been observed in a small number of cases, even in young and healthy people (World Health Organization 2009c). There is no evidence to date that the virus has mutated to a more virulent or lethal form; however, as we enter the second wave of the pandemic, a significant number of people in countries across the world are susceptible to infection. Most importantly, certain subgroups have been categorized as high risk given the clinical evidence to date. One of these subgroups is Indigenous populations (World Health Organization 2009c).

Keywords

pandemic H1N1/09 virus, swine-origin influenza, access to care, Indigenous population, health

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Introduction

On June 11, 2009, the Director General of the World Health Organization, Dr. Margaret Chan, announced that the scientific evidence indicated that the criteria for an influenza pandemic had been met: pandemic H1N1/09 virus, the first in nearly 40 years, was officially upon us.

The World Health Organization has estimated that as many as 2 billion or between 15 and 45 percent of the population globally will be infected by the H1N1/09 virus. Scientists and governments have been careful to walk a line between causing mass public fear and ensuring people take the risks seriously. The latest information indicates that the majority of individuals infected with the H1N1/09 virus thus far have suffered mild illness, although very severe and fatal illness have been observed in a small number of cases, even in young and healthy people (World Health Organization 2009c).ⁱ There is no evidence to date that the virus has mutated to a more virulentⁱⁱ or lethal form; however, as we enter the second wave of the pandemic, a significant number of people in countries across the world are susceptible to infection. Most importantly, certain subgroups have been categorized as high risk given the clinical evidence to date. One of these subgroups is Indigenous populations (World Health Organization 2009c).

In Canada, one of the world's best countries to live, a nation with great health care, an educated populace, and a high standard of living, pandemic H1N1/09 has made its mark already. Poor outcomes have been observed disproportionately in the Aboriginal population. The events that transpired over the last few months in St. Theresa Point and Garden Hill, both remote communities in Northern Manitoba, where H1N1/09 virus outbreaks occurred, reminded us once again of the plight of our First People.

At the national level, the Public Health Agency of Canada (2009b) released the most recent data to date on the pandemic H1N1/09 for the week ending August 22, 2009, illustrating

the disproportionate impact of the pandemic. Aboriginals constitute 3 percent of the national population yet they represent 12.6 percent of confirmed cases of the H1N1/09 virus, 17 percent of associated hospitalizations and 14 percent of cases admitted to ICU (Public Health Agency of Canada 2009b). The rate of infection among Aboriginals has not gone unnoticed. The related decisions of policy makers have been subject to much debate and scrutiny over the last few months, where major breakdowns in the provision of service by the government, including a shortage of pandemic supplies, inadequate health care, and insufficient training, were experienced. Dr. Kim Barker, the Public Health Physician with the Assembly of First Nations warns, “We’re talking about a handful of communities right now...If they can’t shift a few masks onto an airplane right now, what will it be like when we’re dealing with dozens and dozens of First Nations communities this fall and winter?” (White 2009b). Overall, a survey of the coverage on this issue has centered on a recurring theme for those versed in Aboriginal issues, including the social determinants of health (access to health care, water, socioeconomic status, and housing). Of pressing concern is how Aboriginal peoples will fare as we enter the second wave of pandemic H1N1/09?ⁱⁱⁱ

On May 8, 2009, Dr. Margaret Chan, Director General of the World Health Organization, was quoted as saying, “This is a time of great uncertainty for all countries, and great pressure on ministers and ministries of health. The only certain thing that can be said about influenza viruses is that their behavior is entirely unpredictable. No one can say how the current situation will evolve” (World Health Organization 2009f). Although we know more than back in May, we are still in a state of uncertainty in many respects as we enter the fall flu season. As scientists, our main objective is to bring attention to this matter and develop ways to assist in mitigating the effects of the pandemic.

Our work starts with a review of the factors most likely to increase susceptibility to H1N1/09 infection, with the goal of understanding the vulnerability of Aboriginal people while focusing on First Nations in Canada.^{iv} Next, we outline some of the main issues that have surfaced since the initial H1N1/09 virus outbreak earlier this spring and, in light of these events, we suggest a model for predicting outbreaks in First Nations communities, identifying those communities lacking the capacity to adequately deal with the burden of a pandemic. In a time of fiscal restraint such information is important in allocating resources strategically. The World Health Organization warns that capacity will be tested as countries face outbreaks and tough decisions are forced to be made (World Health Organization 2009a).

Background: The Context of Susceptibility

Let us begin by exploring what we currently know about the pandemic H1N1/09. The virus responsible for the pandemic is novel swine-origin influenza virus 2009 A(H1N1).^v It is deemed novel due to its never-before-seen physical characteristics acquired by a reassortment of genes with swine, avian, and human viruses (Chang et al., 2009; Maines et al., 2009). However, this is not the only novel aspect of this H1N1 virus. Its infection patterns are proving to be quite interesting and unexpected as well. As Dr. Donald Low, Chief Microbiologist at Mount Sinai Hospital in Toronto, says, “This thing has not followed any of the rules. It obviously didn’t read the pandemic plan that we had formulated” (Alphonso and Galloway 2009). Specifically interesting about this virus is how it targets young persons, pregnant women, and Aboriginal populations (Dawood et al., 2009; Jamieson et al., 2009; Kermod-Scott 2009). All of these warrant further investigation, but the focus here is on Aboriginals. The implications for this group are easy to see when one considers that although Aboriginal people compose one tenth of the population in Manitoba, they make up approximately one third of all documented cases of the

H1N1/09 virus in the province (Barber 2009a). Why? We will show that this disproportionate burden of infection can most likely be explained by the social characteristics of the Aboriginal population that is “at risk.”

This task is perhaps more difficult than it seems as the virus’s recent emergence means that data on at risk populations is still in the collection stage (Chang et al., 2009). A solution to this shortcoming is to look at data from seasonal influenza and past pandemics, specifically the 1918 influenza pandemic. Comparison to seasonal influenza is not an oversimplification as it has been shown that although the H1N1/09 virus has produced elevated respiratory disease compared with seasonal influenza viruses, it had less efficient respiratory droplet transmission while efficient direct contact transmission was retained (Maines et al., 2009). Thus, it can be reasonably expected that those most at risk for seasonal influenza will also be at risk for contracting pandemic influenza (Chang et al., 2009). Moreover, observations and lessons learned from the 1918 Spanish influenza pandemic can be applied to pandemic H1N1/09, as there are many similarities between the two viruses. That being said, there are many more mechanisms to mitigate the disastrous outcomes associated with the 1918 pandemic, which killed 20-50 million people worldwide and decimated Indigenous communities. Our comparison is not unique; the pandemic H1N1/09 has been compared to the 1918 pandemic by others. Dr. Ethan Rubinstein, a Professor of Infectious Diseases at the University of Manitoba, argues that the H1N1/09 virus will follow the pattern of the 1918 pandemic and the spread of the disease will likely be similar (Skerritt 2009b). These similarities are fairly complex and are deserving of their own review, but to put it very briefly, both viruses are novel influenza A(H1N1) viruses with high transmission rates (Reid and Taubenberger 2003).

Impairment of Host Defense

Any characteristic of a population or community that impairs the ability of people to produce a sufficient immune response will result in an elevated infection rate. One such characteristic would be high malnutrition rates. Deficiencies in micronutrients, such as vitamin E or selenium, have been tied to compromised immune response and increased susceptibility to infection (Louria 2007). High rates of smoking will also exaggerate the infection rate as smokers are more likely to contract influenza than non-smokers (Arcavi and Benowitz 2004). Particularly relevant to today's pandemic is a strain of influenza A(H1N1) that circulated in the 1980s and was shown to infect smokers more often than non-smokers (Kark, Lebiush, and Rannon 1982). Furthermore, existing chronic disease impairs immune functioning, resulting in an increased likelihood of influenza infection and an elevated mortality rate (Barker and Mullooly 1982; Szucs 1999). Therefore, it can be assumed that populations with increased incidence of chronic disease will have an increased risk of infection.

Exposure to Virus

Factors that increase exposure to any form of influenza will also result in elevated infection rates of the H1N1/09 virus. An obvious contributor to this is housing conditions. Overcrowding of households not only increases frequency of exposure but also causes larger doses of infecting virus (Mathews et al., 2009). Larger virus dose is associated with increased illness severity and infection rate (Conenello et al., 2007), as it overwhelms the immune system before it can produce an immune response (Mathews et al., 2009). Education has also been shown to be associated with the rate of respiratory infection. In fact, the respiratory infection rate in children of mothers with primary and vocational education was more than twice that of those in children of mothers with university education, even when economic variables were held

constant (Pawlinska-Chmara and Wronka 2007). Presumably, these mothers, in comparison to mothers with higher education, were deficient in teaching proper techniques to avoid exposure to illness (such as hand washing) and less likely to seek out proper medical care. Thus, individuals with less education can be expected to be at higher risk of contracting influenza.

Access to Care

Inadequate access to quality care will no doubt influence complications associated with contracting the H1N1/09 virus, particularly in severe cases. Isolated rural communities are particularly vulnerable as, in general, they: have “local health care systems” that are smaller; a greater distance from patients; and, are under-resourced in comparison to those in urban areas (Rowland and Lyons 1989). Furthermore, children from low income families have limited access to care, as shown by the increased likelihood of having unmet health care needs, no regular health care provider, and less prescription medicine use as compared to their high socioeconomic status counterparts (Larson and Halfon 2009).

Compounded Effects

It is important to note that the above categories are not mutually exclusive or exhaustive. Many factors have compounded effects that make the population possessing these characteristics even more vulnerable to the H1N1/09 virus. Take for instance overcrowded housing conditions. Under normal circumstances, isolation or reduced contact with those individuals who are severely ill and possess a highly virulent strain of a virus can have a negative selection effect on the viral genes, as fitness and transmission of the genes are decreased. However, in overcrowded conditions where exposure to the virus cannot be mitigated, there is no environmental or behavioral negative selection process at work, which means that any mutation resulting in

increased reproduction will have a selective advantage that may be more virulent in nature as well (Mathews et al., 2009).

Isolation, discussed earlier in its effects on access to care, also plays a very important role in immunity. New variants arise from, and subsequently replace, ancestor strains (Nelson and Holmes 2007). This relatedness results in significant cross-immunity between variants with a specific subtype, such as within H1N1 types (Ferguson, Galvani, and Bush 2003). Thus, those populations in isolation, with no past exposure to many forms of influenza are not protected by any prior immunity; in other words, they are immunologically naïve, which likely results in higher viral multiplication, burden and transmitted dose as well as increased virulence (Mathews et al., 2009).

Even malnutrition has further effects other than its impairment of host defense. In fact, it has been shown that malnutrition causes genomic changes in the virus that make it more virulent although the exact mechanism is unknown (Louria 2007).

Socioeconomic Status

It should be noted that the overarching cause of many of the problems mentioned is low socioeconomic status. Not only is it responsible for creating these conditions through material/social deprivation, but low relative socioeconomic status has been associated with a greater likelihood of influenza infection as well (Cohen et al., 2008).

Deviation from Seasonal Influenza

Many individuals have compared the seasonal influenza to the H1N1/09 virus. According to the World Health Organization (2009d), there are four major differences between the H1N1/09 virus and seasonal influenza based on observations to date: a) H1N1/09 virus infects more people in affected areas; b) seasonal influenza infects people of all ages, but the vast

majority of H1N1/09 virus cases have been under the age of 50; c) seasonal influenza is most likely to cause severe illness in the very young and elderly, but the H1N1/09 virus has caused such symptoms in healthy people between 25 and 44. In seasonal influenza, the elderly are more likely to contract respiratory infections due to a weakening immune system (Meyer 2001). However, during pandemic influenza, as seen in the 1918 pandemic, the elderly may display partial immunity having been exposed to a previous related virus at some point in their lives and very young children are still protected by innate immunity (Ahmed, Oldstone, and Palese 2007; Mathews et al., 2009). These factors mean that the burden of disease falls on young adults (Murray et al., 2006). This phenomenon is being observed once again in Canada where the median infection age is 21 years of age (Alphonso and Galloway 2009); d) Unlike the seasonal flu, 40-50% of cases with the H1N1/09 virus have suffered from diarrhea.^{vi}

Are Aboriginals “At Risk?”

Having identified the conditions or variables which may increase susceptibility to the H1N1/09 virus, we provide a brief overview of the distribution of these variables among Aboriginals and the general Canadian population, in order to assess the relative risk of the former. Always keep in mind that influenza pandemics develop based on three sets of factors: the characteristics of the virus; the characteristics of the population under attack; and, the environment.

The 2002/2003 First Nations Regional Longitudinal Health Survey revealed that First Nations adults have four times the Canadian diabetes rate and 40 percent are overweight, suggesting malnutrition and inadequate physical activity (Assembly of First Nations 2007). Furthermore, nearly half of all individuals who are First Nations are daily smokers and adults have a higher frequency of various chronic diseases, when compared to the general Canadian

population (Assembly of First Nations 2007). In 2006, the number of First Nations living in overcrowded conditions was four times greater than the rate for all of Canada (Macaulay 2009). The First Nations Regional Longitudinal Health Survey also reported socioeconomic conditions: over 50 percent of First Nations adults living in First Nations communities did not graduate high school, compared to just one third in the Canadian population (Assembly of First Nations 2007; White et al., 2009); approximately 50 percent of First Nations adults reported working for pay compared to 57 percent of the Canadian population (Assembly of First Nations 2007). In terms of geography, just over half of First Nations people live either on reserves or in rural non-reserve areas (Assembly of First Nations 2007), whereas approximately only 20 percent of the general Canadian population resides in rural areas (Statistics Canada 2005). According to the First Nations Regional Longitudinal Health Survey, access to care was associated with residing in reserve and rural non-reserve areas, with one in five adults reporting having no doctor or nurse available in his or her area (Assembly of First Nations 2007).

All these characteristics would contribute to increased risk of H1N1/09 virus infection rates in First Nations. However, First Nations people have additional unique characteristics beyond the conditions just mentioned that make them particularly vulnerable. For example, demographically one fifth of First Nations are under the age of nineteen, double the proportion of Canadians in that age group, as well as having higher fertility rates, indicating high pregnancy rates (Assembly of First Nations 2007). As discussed earlier, pandemic influenza targets young adults and pregnant women which would, once again, result in a disproportionately high infection rate among this relatively young group with high fertility rates.

In assessing risk, it is important to note the drawbacks of the research. First of all, homogeneity of Aboriginals and Canadians is typically assumed, when in fact these populations

are incredibly varied (Groom et al., 2009). Although the comparison of pandemic H1N1/09 and seasonal influenza viruses is well recognized, deviation has been noted earlier in this paper. This raises the issue of whether further deviations will be observed. At this point, it can be concluded that the elevated risk of infection among First Nations can be attributed, at least partially, to poor social conditions.

Out of necessity, most studies we looked at related either to what makes a population vulnerable to infection or to the current state of First Nations conditions. References used in this review were, for the most part, not a direct investigation of the effects of social conditions in First Nation populations on pandemic influenza susceptibility and transmission. In fact, despite its importance, there is a limited body of research investigating the direct effect of social conditions on pandemic influenza transmission in Aboriginal and non-Aboriginal communities. Although it will never be argued that efforts should not be focused on reducing the negative effects of current pandemics, we must remember that future pandemics are not a question of if, but when (Reid and Taubenberger 2003). In order to best prepare for this pandemic and the inevitable ones in the future, especially among vulnerable populations, studies must be developed that will fill the existing void in the literature. Only then, with a better understanding of the importance of social determinants in the control of the spread of infectious disease, can certain social health issues be prioritized and brought to the forefront of public policy to better the health of vulnerable populations and the world as a whole.

Indigenous Populations at Risk: Patterns Across the Globe

What is the global picture? International data on the links between Indigenous socioeconomic conditions and health are noteworthy given the global nature of pandemic H1N1/09. As seen in Table 1, there is a pattern of inequality between Indigenous peoples and the

respective general populations of different countries. The correspondence between low socioeconomic conditions and health is beyond shocking.

The *relative* standard of living of the Indigenous segment of the populations across the world, including Australia, Canada, New Zealand, and the United States is well below what we would expect in these highly developed countries. For example, in an adaptation^{vii} of the United Nations Human Development Index (HDI) to measure Aboriginal conditions in Canada in 2000/2001, it was found that as a country, Canada scored near the top of the international HDI rankings, but Registered Indians living on-reserve ranked at the 54th level in the world, with significantly lower income, education, and life expectancy (Cooke et al., 2007).

Congruent with this data, reports of Indigenous populations being infected with the pandemic H1N1/09 virus at a much higher rate than the general population have been documented globally. For example, in Australia, as of late July, the highest per capita H1N1/09 flu outbreak had occurred in the Northern Territory where 30 per cent of the population is Indigenous. Furthermore, it has been reported that the Indigenous people are five times more likely to be hospitalized than the general population when infected with the H1N1/09 virus (Ryan 2009). Dr. Paul Bauert, who serves as the president of the NT branch of the Australian Medical Association explains that “Many (indigenous people) are living in conditions of poverty and there is a lot of crowding in houses so that this infection, which is spread very easily, tends to run very quickly” (Ryan 2009). Sadly, this is the norm worldwide.

Another issue has arisen in South America, where reports have confirmed that members of the Matsigenka ethnic group in the Peruvian Amazon have tested positive for the H1N1/09 virus. The tribe makes its home along the Urubamba River, near a reserve set aside for so-called uncontacted tribes. Human rights groups fear the H1N1/09 virus could spread to the more

isolated people. There is some worry that some Indigenous communities living in voluntary isolation have historically been vulnerable to diseases brought by outsiders, with Indigenous populations in the Americas having suffered centuries of losses after Europeans arrived (Cuthand 2009). As mentioned earlier, these immunologically naive populations are at risk of high attack rates and mortality (Mathews et al., 2009). World Health Organization senior influenza expert Dr. Keji Fukuda commented in early June that reports from Manitoba on the Aboriginal population were troubling since these vulnerable populations have been struck quite heavily during previous pandemics (Skerritt 2009a). For example, the Spanish flu pandemic of 1918 decimated Aboriginal populations, with the death rate up to 600 per 1000 population in remote areas of Alaska, and 42 per 1000 population for the Maori in New Zealand. To put these figures into perspective, worldwide the approximate deaths per 1000 population was 2-25 (Mathews et al., 2009). Health authorities have attributed this to the social conditions of this population. The infection of Indigenous people is particularly troubling in poorer countries, lacking the capacity to adequately care for the majority of the population, much less the relatively impoverished Indigenous peoples (World Health Organization 2009a).

	Australia Non-Aboriginal	Aboriginal and Torres Strait Islander	Aboriginal-Non-Aboriginal Gap
Life Expectancy	82.8	59.6	23.2
Median Income (2000 PPP\$)	21767	12268	9499
Education*	0.69	0.31	0.38
HDI Rank	4	104	100
	Canada Non-Aboriginal	Canadian Registered Indian	Gap
Life Expectancy	78.7	72.9	5.8
Median Income (2000 PPP\$)	27617	14824	12793
Education^T	0.79	0.44	0.35
HDI Rank	8	54	46
	New Zealand Non- Aboriginal	Maori	Gap
Life Expectancy	79.6	71.1	8.5
Income (2000 PPP\$)	29756	23024	6732
Education^L	0.63	0.37	0.27
HDI Rank	20	74	54
	United States Non- Aboriginal	American Indian and Alaska Native	Gap
Life Expectancy	76.6	70.6	6.0

Income (2000 PPP\$)	21050	16000	5050
Education^R	0.75	0.67	0.08
HDI Rank	7	31	24

*Proportion 18-24 still in school or with highest educational qualification year 12 or equivalent

^T Proportion 18-24 with secondary school certificate, some college, trades or technical, or university

^L Proportion 18-24 with sixth form or higher qualification

^RProportion 18-24 with high school graduation, GED, or higher educational attainment

Table 1: 2000/2001 International Comparison of Human Development Indicators For Indigenous and General Populations Across Four Countries (Adapted from Cooke et al., 2007)

Early Outbreaks of Pandemic H1N1/09 in Manitoba, Canada: A Sign of Things to Come?

With growing public concern about the H1N1 virus in Canada, Prime Minister Stephen Harper was quoted on April 30, 2009 as saying, “I think we are doing everything that is necessary to respond to this situation at this time” (CBC News 2009). This reassurance was far from comforting given the events that would eventually transpire in First Nations communities in northern Manitoba.

The end of the flu season tends to coincide with early spring; however, the H1N1/09 virus had begun wreaking havoc over the summer months, with Aboriginal communities being afflicted at a disproportionate rate than the general population (Canwest News Service 2009). Most notably, in Manitoba, by mid July, while Aboriginals constituted 14 percent of the population, they accounted for one third of all cases and two thirds of the cases in intensive care for the H1N1/09 virus (Alphonso 2009a, 2009b; Lang 2009).^{viii} Two reserve communities in the Island Lake area (St. Theresa Point and Garden Hill), approximately 600 km northeast of Winnipeg, accessible by plane only, were hit hard.^{ix}

First Nations leaders in Manitoba have stated that reserves do not possess the capacity to handle large scale outbreaks given the social conditions of their communities, which include inadequate access to quality health care and safe drinking water as well as overcrowded and poor housing conditions (Skerritt 2009a). Indeed, reports of inadequate basic medical resources and treatment as well as delays in responding to the situation in First Nations communities have been documented (Godbout 2009; White 2009a). For example, nursing stations were inadequate in treating cases in many cases with patients having to be medivaced to hospitals in urban centers such as Winnipeg (Godbout 2009). The effects on the health care system had been a cause of

concern with reported strains on emergency rooms and intensive care units (Canwest News Service 2009).

In the midst of an outbreak, in mid June, Chief David Harper of the Garden Hill First Nation indicated that the band had spent \$15,000 for basic pandemic supplies, such as hand sanitizers, surgical masks and other medical supplies which were supposed to be supplied by the federal government as per the Canadian Pandemic Influenza Plan (Canadian Newspapers 2009; White 2009a, 2009b). The money came from the community's education fund which was going to be used for laptops and rewarding students with perfect school attendance (Engelhart 2009). Antiviral medication was pretty much absent from Garden Hill and St. Theresa Point; and, chiefs have expressed doubts regarding its availability in the near future (Santin 2009a; Skerritt and Santin 2009). The situation had become so severe that community leaders from the Island Lake area requested a personal meeting with federal Health Minister Aglukkaq and Indian Affairs Minister Strahl to outline the serious concerns of their communities. They made calls for an emergency field hospital in the Island Lake region to provide surrounding communities with a more appropriate level of care. This proposal was rejected on the basis that it would slow down efforts to prevent the outbreak in their respective communities (Barrera 2009a, 2009b).

Federal health officials have stated that they are committed to protecting the health and well-being of First Nations across the country but critics, such as senators, Aboriginal leaders, and opposition politicians, have expressed deep concerns with the response by the federal government. For example, NDP MP Niki Ashton has argued that the pandemic plan is full of paper but thin on resources (Barrera 2009b). In a similar vein, Manitoba Senator Sharon Carstairs described the situation as not gaining the attention it deserves given the lack of

planning before the outbreak, including medivac flights with improper infection control in place, a lack of hand sanitizers, and inadequate pandemic training of chiefs (Rabson 2009c).

The situation in the Canadian province of Manitoba showed that the provincial and federal governments have had their share of problems during the earlier stages of the crisis. This is evidenced by some of the issues that have arisen: (1) Health Canada and the province of Manitoba have not reached an agreement on how to deal with pandemics on reserves. Provincial Health Minister Theresa Oswald expressed frustration with jurisdictional issues preventing the province from contributing more in response to the H1N1/09 virus. Concretely, the federal government turned down the province of Manitoba's offer to assist Ottawa with pandemic planning on First Nations thirteen times over a four week period this last spring until the flu outbreak had occurred in St. Theresa Point (three confirmed cases of the H1N1/09 virus and hundreds more reporting flu like symptoms as of early June); and, (2) a lack of leadership in disseminating key information on pandemics to First Nations, including communication issues related to provincial privacy laws, which were prohibiting authorities from sharing confirmed or suspected cases on reserves with Aboriginal leaders (Huber and Rabson 2009; Rabson and Kusch 2009).

In June 2009, a Senate probe of the federal government's response to the H1N1/09 virus outbreak on remote reserves in Manitoba was conducted. It was revealed that the government had made several controversial decisions, including delaying sending hand sanitizers to communities in the early stages of the outbreak reportedly because of fears that individuals would ingest the high alcohol based gel. Masks, respirators and hand sanitizers were not delivered to the region even as conditions had deteriorated. The federal government eventually delivered 2500 bottles of alcohol based sanitizer to Garden Hill First Nation as the community

waited for two and a half weeks despite community leaders pleading with officials in Ottawa for these supplies (Kirbyson 2009; White 2009a). This was a problem since nearly 4000 people in the community do not have running water and are unable to wash their hands frequently. Critics have called the reason cited for inaction paternalistic, racist, and ignorant, given the small number of individuals who might abuse such substances in the entire community (Fitzpatrick 2009). Essentially, while the government discussed the merits of alcohol based sanitizer, major outbreaks were occurring. It was also disclosed that some communities requested alcohol free hand sanitizer given the “dry” policy of the reserves but the government did not have any, according to Deputy Minister Anne-Marie Robinson of the First Nations and Inuit Branch of Health Canada (Goar 2009).

By late June, Aboriginal leaders around Manitoba declared states of emergency, which would facilitate freeing funds for federal assistance (Barber 2009b). The private sector has rushed in to help fill gaps by the government, with CIBC donating \$10,000 to the Assembly of Manitoba Chiefs to assist in purchasing 15,000 swine flu kits for northern communities, which have been impacted greatly by pandemic H1N1/09. The Assembly of Manitoba Chiefs hopes to raise \$1.5 million to cover the costs of the kits (Welch 2009). By mid-August, the province of Manitoba announced that it would provide outstanding funds for the kits, with the federal government refusing involvement and even problematizing some aspects of the kits (Preprost 2009; Rabson 2009a).

We draw attention to these problems not to be critical of the government, but to clearly point out that Canada is a country that is not fully prepared for the pandemic, and we have structural jurisdictional, resource, and planning problems.

In sum, it appears that the \$1 billion Canadian Pandemic Influenza Plan has failed in the early stages of the outbreak in protecting one of our most vulnerable groups in society—Aboriginals. Inaction, a lack of coordination and planning/readiness, a failure to translate policy into reality and, particularly, preexisting poor socioeconomic conditions contributed to the events observed. Have we learned our lesson? Only time will tell.

Things may end up getting worse as there have been reports that medical stations in remote communities of northern Manitoba may have to close, because Health Canada is having problems recruiting and retaining nurses to work in isolated areas (Puxley 2009). There is, however, hope as some mistakes have already been identified and corrected. For example, in Ontario, an outbreak in the isolated reserve community Sandy Lake, three weeks after the outbreaks in Manitoba reserve communities, resulted in an aggressive response by the government resulting in hundreds of doses of antiviral medication being brought into the community, with 160 patients administered the drugs. As a result, no residents had to be flown out of the community for treatment (Santin 2009b). According to Manitoba's and Ontario's Chief Medical Officers of Health, if an outbreak occurs again in the fall, any Aboriginal showing flu like symptoms will be prescribed the antiviral drugs (Santin 2009b). We will later propose a model which may be a policy planning tool to aid in preventing further negative outcomes associated with pandemic H1N1/09.

As evidenced by the events over the summer in Manitoba, Canada, the ability to provide acute health care service to Aboriginals in remote communities is essential given their vulnerability during this pandemic; however, this is a difficult task, given the very high associated costs. Many infected individuals may end up being transported to larger centers; social support networks, which have been associated with positive health outcomes will be

disrupted; and, absenteeism from work and productive endeavors could severely cripple these impoverished communities.

The World Health Organization warns that a high proportion of people becoming infected could put serious strains on health care systems, increasing demands on emergency rooms and ICUs. This could result in a diminished capacity to treat other serious health ailments (World Health Organization 2009a). In Canada, we certainly saw this in the province of Manitoba. Dr. Bruce Martin, a doctor sent to lead up work in St. Teresa Point, put it clearly: “Just keeping the building open under this kind of workload is very difficult,” and the 50 cases that came out of the small 2000 person community had an overwhelming effect on the large modern Winnipeg hospital system (Patterson 2009).

Prevention: Vaccination

In Canada we are fortunate that the issue is not whether we will have enough vaccines for everyone, it is how quickly everyone will be get vaccinated (Public Health Agency of Canada 2009a).

As we enter the second wave of the pandemic in coming months, questions surrounding the availability of the vaccine have been receiving much attention. An editorial appearing in the Canadian Medical Association Journal (CMAJ) on August 31 was highly critical of Health Canada’s vaccination plan. Essentially, Health Canada was criticized for its plan to use an adjuvant vaccine.^x CMAJ suggested that this decision would delay the introduction of the vaccine to the public by about one month (beginning in mid November) due to the greater regulatory guidelines. They reasoned that the virus is not highly virulent for most of the population; therefore, vaccinating high risk groups with the non-adjuvanated vaccine before the epidemic season peaks would be the best strategy, while the rest of the population at lower risk

waits for the adjuvant vaccine (Hebert and MacDonald 2009). This claim was quickly disregarded by Health Canada, which stated that adjuvanted and non-adjuvanted vaccine would be received at about the same time.^{xi} It was suggested that any delays in receiving the vaccine compared to other countries, such as the United States and Australia, was a product of Canada placing their order at a later date (White and Alphonso 2009). Of concern are the gaps in communication being observed. If the largest association of medical doctors is unclear of the government's plans, how will ordinary citizens, particularly the vulnerable, including First Nations, fare? Interestingly, as of September 2, 2009, in a news release by the Public Health Agency of Canada (2009a), the Government of Canada had yet to identify those people who should receive the vaccine first although news reports indicate that Aboriginals will be one of those groups.

Moving Forward: A Predictive Model

In discussing the risk on reserves, Dr. David Butler Jones, Canada's Chief Public Health Officer, commented any influenza outbreak will affect some communities more than others. He further stated on June 12, 2009, "We've never been able to understand why that is...To make conclusions based on a couple of communities...it's way too early" (Rabson 2009b). While Dr. Butler-Jones was trying not to be alarmist and was being cautious based on the observations at that time, *we argue that the literature does indicate that the social determinants of health, including poverty, a lack of capacity, and access to health resources would be a powerful predictor of vulnerability, regardless of the health issue in question.* As indicated earlier, there is a body of research suggesting that those populations with poor socioeconomic outcomes are most vulnerable to the seasonal influenza and pandemic H1N1/09. We suggest an implementation of this information to predict vulnerability would be useful.

In addressing the complexity of the situation, Dr. Margaret Chan, Director General, World Health Organization remarks, “The emergence of the H1N1 virus creates great pressure on governments, ministries of health, and World Health Organization to make the right decisions and take the right actions at a time of great scientific uncertainty” (World Health Organization 2009a). With this in mind, we remind readers that researchers and policy makers have a social responsibility to mitigate potential harm and catastrophe. How can this be accomplished?

- 1) Removing as much uncertainty from the situation as possible; and,
- 2) Policy and planning based on informed decision making.

Although there are debates on the projected severity of pandemic H1N1/09, few experts doubt that vulnerable communities, particularly First Nations, will be impacted most by the pandemic. This begs the question, which communities are vulnerable? In Canada, we have a potential model. Work originating from the work of researchers attached to the Aboriginal Policy Research Consortium (International), housed at the University of Western Ontario, and the Strategic Research and Analysis Directorate, Indian Affairs Canada, has produced and refined the Community Well-Being (CWB) Index. The CWB Index measures well-being at the community level using data from the Census of Canada. It is composed of four variables identified in the literature as key social determinants of health: income, housing, education, labor force status.^{xii} It assesses differences between First Nations communities themselves and between First Nations communities and other Canadian communities over time. No doubt, on average, First Nations communities fare worse than other Canadian communities; for example, only 1 of the top 100 Canadian communities is a First Nation, and 92 of the lowest scoring communities are First Nations (O’Sullivan and McHardy 2007). Perhaps less well known is the differences between First Nations communities are great; in some cases the intra First Nations

differences are larger than between First Nations and the Canadian population (O'Sullivan and McHardy 2007; Spence 2007).^{xiii} This coincides with many news reports which have found that some communities have been hit much harder than others by the H1N1/09 virus.

We have been unable to secure data to examine the relationship between the CWB Index and pandemic H1N1/09 outbreaks across Canada's First Nations communities. However, the CWB Index is probably the best tool for predicting those communities which will be at greatest risk of being affected by pandemic H1N1. We do not wish to over state the effectiveness of the CWB Index's predictive power. However, in the absence of extensive empirical testing, the sites of early H1N1/09 virus outbreaks, St. Theresa Point, Garden Hill and Sandy Lake, all have relatively low CWB Index scores. *St Theresa Point and Garden Hill are in the bottom 10% among First Nations communities and Sandy Lake around the 25th percentile.* Increased surveillance and resource allocation are considerations given this data.

The impact of H1N1/09 virus will be seen in coming months. The manner in which the story of this pandemic will play out will be a product of decisions and (in)actions of key stakeholders. Targeted use of interventions will be important.

This pandemic has centered attention on the inequalities First Nations experience in Canada. Given the importance of the social determinants of health (World Health Organization 2008), health outcomes are inseparable from the inequality we observe across all domains of the social sphere, including education, housing, income, and labor force participation. One feature of pandemics is that they strive to survive; we, as humans, must work to ensure we do the same.

Conclusion

We are defined by how we deal with adversity. The coming months will test policy makers and citizens worldwide, and the future will challenge researchers and policy workers to

become more effective. How will the story of pandemic H1N1/09 play out? We know Indigenous populations across the globe will face a disproportionate degree of illness, suffering, and devastation, just as they have in the past from first contact through the spring 2009 outbreaks. Efforts to mitigate the impact of the pandemic are underway; however, many of these solutions, while noteworthy given the current crisis, fail to address the underlying social factors, which leave many communities “at risk.” Until these social factors are ameliorated, we will continue to witness disastrous outcomes with many faces for years to come.

The international data captures the systematic inequality of Indigenous peoples worldwide. International reports have indicated that Indigenous people will continue to endure an inordinate amount of anguish resulting from this pandemic. We have proposed a model for predicting the differential vulnerability of First Nations communities in Canada. We believe the CWB Index could also be very useful as a tool in other countries.^{xiv} The main strength of the CWB Index is that it is a theoretically rooted measure, composed of basic social determinants of health. We see the CWB Index approach as a potentially useful tool for identifying the state of Aboriginal communities along the continuum of disadvantage, allowing policy makers to plan accordingly. While two of the three communities we examined that had outbreaks in the spring fell in the bottom 10% of First Nations communities, and the third fell in the bottom 25%, we would likely say that the bottom one third of any measured communities would be at greatest risk. This is a working hypothesis at this point. Overall, we wish to continue our investigations on this important issue as we feel it a duty incumbent upon us to contribute to understanding during this time of great scientific uncertainty.

Endnotes

ⁱ The severity of a pandemic is typically assessed based on two criteria: 1) the “attack rate,” which is the proportion of people who become ill over the course of the pandemic; and, 2) the “mortality rate,” which is the proportion of the people who die over the course of the pandemic (Mathews et al., 2009).

ⁱⁱ Virulence is defined as a quantitative measure of the degree of pathogenicity (i.e., the ability to inflict damage) of a parasite; it is usually measured as the dose or cell number that will produce a pathological response over a given time period (Brock et al., 1994).

ⁱⁱⁱ According to the World Health Organization (World Health Organization 2009b), the historical record of influenza pandemics indicates that they strike in two and sometimes three waves. During the previous century, the 1918 pandemic, the most deadly of them all, began with a mild wave and then returned in a far more deadly one. In fact, the first wave was so mild that its significance as a warning signal was missed.

^{iv} We focus on First Nations and their communities for three reasons: 1) the first true test of pandemic preparedness occurred in Canada’s First Nations communities; 2) we argue that First Nations communities are unique social spaces given their historical, cultural, political, and socioeconomic attributes. They are geographically meaningful places in which First Nations people live. Reserves can be host to a variety of initiatives and policies that impact on the day-to-day lives of its constituents, for example, building of schools, and the creation of health projects. These social spaces are historically important locations for First Nations of Canada. There is a distinct set of social networks, norms, and attitudes, which are formed within these geographical spaces (Mignone 2003; White, Spence, and Maxim 2005). A similar argument was put forth by the Royal Commission on Aboriginal People (Royal Commission on Aboriginal Peoples 1996), which suggested that an understanding of community norms and broad social conditions is necessary for positive outcomes to occur; de facto crime, alcoholism, sexual abuse, and suicide are merely symptoms of a structural problem. The importance of this context is also strategic given the demographic characteristics of the communities. According to the 2001 Census data (Statistics Canada 2004), there were about 1.32 million people who self-identified as having Aboriginal ancestry. According to departmental data from Indian Affairs, the Registered Indian population is numbered at 703,800 in over 600 Bands, with approximately 419,800 (60%) on-reserve (Indian and Northern Affairs Canada 2004). If the migration assumption is correct, the proportion of Registered Indians living on-reserve is projected to increase from an estimated 60% in 2001 to 75% in 2021.

Thus, our understanding of the dynamics surrounding Aboriginals and their communities would be profitable as the future on-reserve population increases substantially (Indian and Northern Affairs Canada 2004) and we try to curb the threat of potential disasters in the future, including pandemics; 3) First Nations, living “on reserve” (in home communities), are the most disadvantaged subgroup of Aboriginals in Canada; and, 4) there is an application to other countries where Indigenous peoples live in their own communities and have measurable disadvantage.

^v We have adopted the World Health Organization’s terminology of the pandemic virus: H1N1/09.

^{vi} If virus shedding is detected in fecal matter, this would introduce an additional route of transmission (World Health Organization 2009a). The significance could be especially great in areas with inadequate sanitation, such as some First Nation communities in Canada and some Indigenous communities worldwide.

^{vii} See White, Beavon and Spence (2007) for a description of the development and importance of the First Nations Human Development Index.

^{viii} The disproportionate rates of illness have not gone unnoticed by other residents. In early June, residents from St. Theresa Point First Nation, where a few cases had been documented, staying at a Winnipeg hotel for health checks unrelated to influenza were asked to leave the hotel for fear they had H1N1/09 given their home community (Godbout, Kusch, and Rollason 2009).

^{ix} The degree of isolation of these communities is troubling given the previous discussion on “immunologically naïve populations.”

^x Adjuvant vaccine allows more vaccine to be produced (dosage sparing) and it provides better cross protection in the case of mutating virus strains; in fact, the World Health Organization advocates use of the adjuvant vaccine based on its merits (Public Health Agency of Canada 2009c; World Health Organization 2009e).

^{xi} In an interview with the Canadian Press, Dr. David Butler-Jones, Chief Public Health Officer, stated that Canada would purchase 1.2 million doses of unadjuvanted vaccine for pregnant women given the lack of data on its use in this demographic. This strategy is meant to improve rates of immunization among pregnant women who typically are less likely to be vaccinated yet are at high risk (Branswell 2009).

^{xii} For extensive coverage of the Community Well-Being Index, methodological issues, and trends across Canada over time, see White, Beavon, and Spence (2007).

^{xiii} All too often, the diversity of Aboriginal people tends to be missed in discussions across a variety of audiences and arenas. This simplification of the Aboriginal condition is sometimes based on pragmatic grounds, but the danger of this process is far from benign. It is imperative to highlight the diversity of histories, cultures, and socio-economic circumstances of the Aboriginal population to adequately address the various needs of these people. Young (Young 2003) states in his review of Aboriginal research that intra group differences are often overlooked, homogenizing the geographic, cultural, socioeconomic, and health status of Aboriginal people. Waldram, Herring, and Young (1995) voice similar concerns in their work:

Beyond the obvious and well-known need to understand the historico-cultural context of health, it is vital to appreciate that the concept of “Aboriginal health” is itself a convenient but ultimately false representation of the problem at hand. It masks the rich diversity of social, economic, and political circumstances that give rise to variation in health problems and healing strategies in Aboriginal communities. If nothing else, this [work] should make it clear that health and health care patterns show extensive variation across the country, despite the tendency for national, regional, and provincial databases to create the impression of widespread trends and homogeneity of experience (258-9).

^{xiv} It should be noted that some work has attempted to capture the relative disadvantage of Indigenous peoples in a number of countries, including Australia, New Zealand, and Australia (e.g., Cooke et al., 2007). Moreover, in the spring of 2009, Aboriginal Policy Research Consortium researchers (Martin Cooke of The University of Waterloo, Erin O’Sullivan of McMaster University, Jerry White of The University of Western Ontario, and Dan Beavon of Indian Affairs and Northern Development) conducted a training institute for scientists and Indigenous peoples from Moscow and Novosibirsk. The delegation was shown how to construct and use the CWB so they could start developing it at home.

References

- Ahmed, R., M. B. Oldstone, and P. Palese. 2007. "Protective immunity and susceptibility to infectious diseases: lessons from the 1918 influenza pandemic." *Nat Immunol* 8(11), 1188-93.
- Alphonso, C. and G. Galloway. 2009. "Swine flu targets youth, figures reveal." *Globe and Mail*, June 18, A1.
- Alphonso, C. 2009a. "Conditions on reserves blamed for greater risk of flu." *Globe and Mail*, July 15, A11.
- . 2009b. "Natives fear ending up last on list for vaccines." *The Globe and Mail*, July 15, A11.
- Arcavi, L. and N. L. Benowitz. 2004. "Cigarette smoking and infection." *Arch Intern Med* 164(20), 2206-16.
- Assembly of First Nations. 2007. *First Nations Regional Longitudinal Health Survey 2002/03*. Ottawa, ON.
- Barber, M. 2009a. "Aboriginal populations vulnerable to H1N1: report." *Edmonton Journal*, June 6.
- Barber, M. 2009b. "Indigenous people at risk." *Leader Post*, July 3, A8.
- Barker, W. H. and J. P. Mullooly. 1982. "Pneumonia and influenza deaths during epidemics: implications for prevention." *Arch Intern Med* 142(1), 85-9.
- Barrera, J. 2009a. "First Nations field hospital for flu rejected." *Edmonton Journal*, June 18, A7.
- . 2009b. "Natives demand to meet ministers over swine flu; 'A pending atrocity'." *National Post*, June 17, A10.

- Branswell, H. 2009. "Protecting those pregnant a priority: Canada will purchase 1.2 millions doses of unadjuvanted vaccine." *The Canadian Press*, September 5.
- Brock, T., M. Madigan, J. Martinko, and J. Parker. 1994. *Biology of Microorganisms (Seventh Edition)*. Englewood Cliffs: Prentice Hall.
- Canadian Newspapers. 2009. "Third World status tested." *Winnipeg Free Press*, June 22, A15.
- Canwest News Service. 2009. "Swine flu overwhelms reserves." *Edmonton Journal*, June 4, A5.
- CBC News. 2009. "Canada doing all that's needed to respond to swine flu: PM." CBC News, April 30 2009. Retrieved August 28 2009. (<http://www.cbc.ca/canada/story/2009/04/30/swine-flu-harper030.html>).
- Chang, L. Y., S. R. Shih, P. L. Shao, D. T. Huang, and L. M. Huang. 2009. "Novel Swine-origin Influenza Virus A (H1N1): The First Pandemic of the 21st Century." *J Formos Med Assoc* 108(7), 526-32.
- Cohen, S., C. M. Alper, W. J. Doyle, N. Adler, J. J. Treanor, and R. B. Turner. 2008. "Objective and subjective socioeconomic status and susceptibility to the common cold." *Health Psychol* 27(2), 268-74.
- Conenello, G. M., D. Zamarin, L. A. Perrone, T. Tumpey, and P. Palese. 2007. "A single mutation in the PB1-F2 of H5N1 (HK/97) and 1918 influenza A viruses contributes to increased virulence." *PLoS Pathog* 3(10), 1414-21.
- Cooke, M., F. Mitrou, D. Lawrence, E. Guimond, and D. Beavon. 2007. "Aboriginal Well-being in Four Countries: An Application of the UNDP's Human Development Index to Aboriginal Peoples in Australia, Canada, New Zealand, and the United States." Pp. 87-109 in *Aboriginal Well-Being: Canada's Continuing Challenge*, edited by J. White, D. Beavon and N. Spence. Toronto: Thompson Educational Publishing.

-
- Cuthand, D. 2009. "First Nations only too familiar with pandemics." *Saskatoon Star-Phoenix*, May 1, A11.
- Dawood, F. S., S. Jain, L. Finelli, M. W. Shaw, S. Lindstrom, R. J. Garten, L. V. Gubareva, X. Xu, C. B. Bridges, and T. M. Uyeki. 2009. "Emergence of a novel swine-origin influenza A (H1N1) virus in humans." *N Engl J Med* 360(25), 2605-15.
- Engelhart, K. 2009. "The unseen costs of swine flu." *Macleans.ca*, June 26, Retrieved August 20, 2009. <http://www2.macleans.ca/2009/06/26/the-unseen-costs-of-swine-flu/>.
- Ferguson, N. M., A. P. Galvani, and R. M. Bush. 2003. "Ecological and immunological determinants of influenza evolution." *Nature* 422(6930), 428-33.
- Fitzpatrick, M. 2009. "Chiefs demand swine-flu action." *The Province*, June 25, A33.
- Goar, C. 2009. "Hand sanitizer outcry masks deeper problems." *Toronto Star*, June 26, A23.
- Godbout, A. 2009. "'We're in a war zone': chief." *Winnipeg Free Press*, June 11, A3.
- Godbout, A., L. Kusch, and K. Rollason. 2009. "Reserve residents aren't welcome at inn: chief." *Winnipeg Free Press*, June 5, A3.
- Groom, A., C. Jim, M. Laroque, C. Mason, J. McLaughlin, L. Neel, T. Powell, T. Weiser, and R. T. Bryan. 2009. "Pandemic Influenza Preparedness and Vulnerable Populations in Tribal Communities." *Am J Public Health*.
- Hebert, P.C. and N. MacDonald. 2009. "The H1N1 vaccine race: Can we beat the pandemic?" *CMAJ*.
- Huber, J. and M. Rabson. 2009. "Ministers clash over swine flu response." *Leader Post*, June 6, B8.

Indian and Northern Affairs Canada. 2004. *Basic Departmental Data, 2003*. Ottawa: First Nations and Northern Statistics Section Corporate Information Management Directorate Information Management Branch.

Jamieson, D. J., M. A. Honein, S. A. Rasmussen, J. L. Williams, D. L. Swerdlow, M. S. Biggerstaff, S. Lindstrom, J. K. Louie, C. M. Christ, S. R. Bohm, V. P. Fonseca, K. A. Ritger, D. J. Kuhles, P. Eggers, H. Bruce, H. A. Davidson, E. Lutterloh, M. L. Harris, C. Burke, N. Cocoros, L. Finelli, K. F. Macfarlane, B. Shu, and S. J. Olsen. 2009. "H1N1 2009 influenza virus infection during pregnancy in the USA." *Lancet*.

Kark, J. D., M. Lebiush, and L. Rannon. 1982. "Cigarette smoking as a risk factor for epidemic A(H1N1) influenza in young men." *N Engl J Med* 307 (17), 1042-6.

Kermode-Scott, B. 2009. "Canada has world's highest rate of confirmed cases of A/H1N1, with Aboriginal people hardest hit." *BMJ* 339, b2746.

Kirbyson, G. 2009. "H1N1 crisis deepens." *Winnipeg Free Press*, June 25, A3.

Lang, M. 2009. "Natives want vaccine priority; Two-thirds of Alta. flu deaths are Aboriginals." *Calgary Herald*, July 21, B1.

Larson, K., and N. Halfon. 2009. "Family Income Gradients in the Health and Health Care Access of US Children." *Matern Child Health J*.

Louria, D. B. 2007. "Undernutrition can affect the invading microorganism." *Clin Infect Dis* 45(4), 470-4.

Macaulay, A. C. 2009. "Improving aboriginal health: How can health care professionals contribute?" *Can Fam Physician* 55(4), 334-9.

Maines, T. R., A. Jayaraman, J. A. Belser, D. A. Wadford, C. Pappas, H. Zeng, K. M. Gustin, M. B. Pearce, K. Viswanathan, Z. H. Shriver, R. Raman, N. J. Cox, R. Sasisekharan, J. M.

-
- Katz, and T. M. Tumpey. 2009. "Transmission and pathogenesis of swine-origin 2009 A(H1N1) influenza viruses in ferrets and mice." *Science* 325(5939), 484-7.
- Mathews, J. D., J. M. Chesson, J. M. McCaw, and J. McVernon. 2009. "Understanding influenza transmission, immunity and pandemic threats." *Influenza Other Respi Viruses* 3(4), 143-9.
- Meyer, K. C. 2001. "The role of immunity in susceptibility to respiratory infection in the aging lung." *Respir Physiol* 128 (1), 23-31.
- Mignone, J. 2003. "Social Capital in First Nations Communities: Conceptual Development and Instrument Validation." PhD dissertation, Department of Community Health Sciences, University of Manitoba, Winnipeg.
- Murray, C. J., A. D. Lopez, B. Chin, D. Feehan, and K. H. Hill. 2006. "Estimation of potential global pandemic influenza mortality on the basis of vital registry data from the 1918-20 pandemic: a quantitative analysis." *Lancet* 368 (9554), 2211-8.
- Nelson, M. I., and E. C. Holmes. 2007. "The evolution of epidemic influenza." *Nat Rev Genet* 8(3), 196-205.
- O'Sullivan, E. and M. McHardy. 2007. "The Community Well-being Index (CWB): Well-being in First Nations Communities, Present, Past, and Future." Pp. 111-148 in *Aboriginal Well-Being: Canada's Continuing Challenge*, edited by J. White, D. Beavon and N. Spence. Toronto: Thompson Educational Publishing.
- Patterson, K. 2009. "Influenza has a cure - it's affluence." *The Globe and Mail*, September 5, F1.

-
- Pawlinska-Chmara, R. and I. Wronka. 2007. "Assessment of the effect of socioeconomic factors on the prevalence of respiratory disorders in children." *J Physiol Pharmacol* 58 Suppl 5 (Pt 2), 523-9.
- Preprost, M. 2009. "Flu supplies for First Nations." *Winnipeg Free Press*, August 19, A3.
- Public Health Agency of Canada. 2009a. "Canada well-positioned to provide flu vaccines on time." Public Health Agency of Canada, September 2, Retrieved September 2, 2009. (http://www.phac-aspc.gc.ca/media/nr-rp/2009/2009_0902-eng.php).
- . 2009b. "Flu Watch August 16, 2009 to August 22, 2009 (Week 33)." Public Health Agency of Canada, August 28, Retrieved August 28, 2009. (http://www.phac-aspc.gc.ca/fluwatch/08-09/w34_09/pdf/fw2009-34-eng.pdf).
- . 2009c. "Frequently Asked Questions H1N1 Flu Virus." Public Health Agency of Canada. Retrieved August 20, 2009. (http://www.phac-aspc.gc.ca/alert-alerte/h1n1/faq_rg_h1n1-eng.php#vac).
- Puxley, C. 2009. "Ottawa may close clinics at centre of flu outbreak." *Telegraph-Journal*, June 12, A8.
- Rabson, M. 2009a. "Feds likely won't pay to send kits to reserves." *Winnipeg Free Press*, August 20, A4.
- . 2009b. "Official downplays risk on reserves." *Winnipeg Free Press*, June 12, A3.
- . 2009c. "Senators to probe H1N1 outbreak." *Winnipeg Free Press*, June 23, A5.
- Rabson, M. and L. Kusch. 2009. "Feds ignored flu offers: Oswald." *Winnipeg Free Press*, June 5, A3.
- Reid, A. H. and J. K. Taubenberger. 2003. "The origin of the 1918 pandemic influenza virus: a continuing enigma." *J Gen Virol* 84 (Pt 9), 2285-92.

- Rowland, D., and B. Lyons. 1989. "Triple jeopardy: rural, poor, and uninsured." *Health Serv Res* 23(6), 975-1004.
- Royal Commission on Aboriginal Peoples. 1996. *Report of the Royal Commission on Aboriginal Peoples*. Ottawa: The Royal Commission on Aboriginal Peoples.
- Ryan, S. 2009. "Indigenous at more risk of swine flu." *The Australian*, August 10.
- Santin, A. 2009a. "H1N1 drugs available to First Nations, official says." *Winnipeg Free Press*, August 5, A5.
- . 2009b. "Officials bolster H1N1 strategy for First Nations." *Winnipeg Free Press*, August 8, A3.
- Skerritt, J. 2009a. "Flu catches WHO's attention." *Winnipeg Free Press*, June 10, A3.
- . 2009b. "Researchers fear second wave of deadly virus; More illnesses reported in Manitoba first nations communities, following pattern of 1918 pandemic." *The Vancouver Sun*, June 11, B3.
- Skerritt, J. and A. Santin. 2009. "Manitoba First Nations aren't ready for swine flu." *The Ottawa Citizen*, August 5, A3.
- Spence, N. 2007. "New Vistas on the Income Inequality-Health Debate: The Case of Canada's First Nations Reserve Population." PhD dissertation, Department of Sociology, The University of Western Ontario, London, ON.
- Statistics Canada. 2004. *Aboriginal Peoples of Canada, 2001 Census. Selected Demographic and Cultural Characteristics, Registered Indian Status, Age Groups, Sex and Area of Residence for Population, for Canada, Provinces and Territories, 2001 Census - 20% Sample Data*. Ottawa: Statistics Canada,.
- . 2005. *Population urban and rural, by province and territory*. Ottawa: Statistics Canada.

- Szucs, T. 1999. "The socio-economic burden of influenza." *J Antimicrob Chemother* 44 Suppl B:11-5.
- Waldram, J, A Herring, and T. Young. 1995. *Aboriginal Health in Canada: Historical, Cultural, and Epidemiological Perspectives*. Toronto: University of Toronto Press.
- Welch, M. A. 2009. "Chief wary of donor money." *Winnipeg Free Press*, July 17, A8.
- White, J., D. Beavon, J. Peters, and N. Spence, editors. 2009. *Aboriginal education: current crisis and future alternatives* Thompson Educational Publishing.
- White, J., D. Beavon, and N. Spence, editors. 2007. *Aboriginal Well-Being: Canada's Continuing Challenge*. Toronto: Thompson Educational Publishing.
- White, J., N. Spence, and P. Maxim. 2005. "Social capital and educational attainment among Aboriginal peoples: Canada, Australia and New Zealand." Pp. 66-81 in *Policy Research Initiative Social Capital Project Series, Social Capital in Action: Thematic Studies*, edited by Policy Research Initiative. Ottawa: Policy Research Initiative, Government of Canada.
- White, P. 2009a. "Alcohol fears led Ottawa to withhold hand sanitizers from flu-ravaged reserves." *The Globe and Mail*, June 24, A1.
- . 2009b. "A global pandemic, a local failure: flu outbreak sweeps reserves." *The Globe and Mail*, June 12, A1.
- White, P. and C. Alphonso. 2009. "Doctors, Ottawa clash over flu vaccine." *The Globe and Mail*, September 2.
- World Health Organization. 2008. *Closing the gap in a generation: Health equity through action on the social determinants of health. Final Report of the Commission on Social Determinants of Health*. World Health Organization: Geneva.

-
- . 2009a. "Concern over flu pandemic justified." World Health Organization, May 18, Retrieved August 10, 2009. (http://www.who.int/dg/speeches/2009/62nd_assembly_address_20090518/en/).
- . 2009b. "H1N1 influenza situation." World Health Organization, May 4, Retrieved August 15, 2009. (http://www.who.int/dg/speeches/2009/influenza_a_h1n1_situation_20090504/en/).
- . 2009c. "Pandemic (H1N1) 2009 briefing note 9 Preparing for the second wave: lessons from current outbreaks." World Health Organization, August 28 Retrieved September 3, 2009. (http://www.who.int/csr/disease/swineflu/notes/h1n1_second_wave_20090828/en/index.html).
- . 2009d. "Questions and Answers: The Virus." World Health Organization, Retrieved August 20, 2009. (<http://www.wpro.who.int/NR/rdonlyres/4221DAEE-B15C-4455-B628-B63D5D14157B/0/InflAH1N1FAQformedia.pdf>).
- . 2009e. "WHO Virtual Press Conference of 6 August 2009 with Dr. Marie-Paule Kieny, Director of the Initiative for Vaccine Research at WHO Headquarters and Gregory Hartl, Spokesperson for H1N1." World Health Organization, August 6, Retrieved August 10, 2009. (http://terrance.who.int/mediacentre/audio/press_briefings/VPC_06AUG2009_Influenza_A_H1N1.mp3)
- . 2009f. "World is better prepared for influenza pandemic." World Health Organization, May 8, Retrieved August 20, 2009. (http://www.who.int/dg/speeches/2009/asean_influenza_ah1n1_20090508/en/index.html).
- Young, T K. 2003. "Review of research on Aboriginal populations in Canada: relevance to their health needs." *BMJ* 327, 419-422.