

on the impact of the 2009 H1N1 influenza pandemic on First Nations, Inuit and Métis peoples in Canada and highlight gaps in knowledge in the epidemiological research.

Methodology

The review is one of three based on a larger review of literature on the 2009 H1N1 influenza pandemic and its impact on Indigenous people in Canada published from the start of the pandemic in 2009 to October 2014. Literature for this larger review was identified first through the use of PubMed, Medline, and Google Scholar. Additional literature was identified from the bibliographies of retrieved publications. The search strategy combined any of the terms ‘Aboriginal,’ ‘First Nations,’ ‘Inuit,’ ‘Metis,’ or ‘Métis’ together with the term ‘H1N1.’ Publications could be either peer or non-peer reviewed, based on original research or a review of the literature, be policy related or advocate for a solution to a challenge associated with the public health response to the pandemic. Publications were selected for review if they:

- focused exclusively on Indigenous peoples (First Nations, Inuit and/or Métis) and their experiences with the H1N1 virus;
- focused on the general population but included Indigenous ethnicity as a variable and undertook some analysis at this level;
- were case studies involving primarily Indigenous patients; and

- focused on lessons learned from Indigenous experiences during the pandemic that could inform public health responses to influenza pandemics in the future.

Publications were excluded if they simply presented the number of Indigenous patients within a sample but provided no analysis for this population. They were also excluded if their focus was primarily on other types of influenza. Of the 116 publications which met the search criteria, 44 fit the criteria for the larger review and 26 of these covered the epidemiology of the 2009 H1N1 pandemic with respect to First Nations, Inuit and/or Métis populations. Evidence derived from the 26 papers informed this review paper. These publications generally utilized data from laboratory confirmed cases, hospital admissions or ICU admissions to determine patient presentation, risk factors, or patient outcomes. This fact sheet will summarize key findings and knowledge gaps in this body of literature.

Epidemiology

Canada experienced two waves of the 2009 H1N1 influenza pandemic. The first occurred from April to August 2009 and the second, which resulted in four to five times more hospitalizations and deaths, occurred from the end of August to January of 2010 (Stoops, 2012). Of the 26 studies identified in this literature search, most (17) focused on the general Canadian context but undertook some limited analysis for

Indigenous populations, while nine focused exclusively on Indigenous (First Nations, Inuit, and/or Métis populations). Of these nine studies, seven included analysis for First Nations, one included analysis for Inuit, and two included analysis for Indigenous populations collectively.³ The geographic scale and type of community at which these studies undertook analysis is indicated in Table 1. As can be seen, the geographic scope was most often national or regional, and there is a clear under-representation of urban Indigenous people or those living off-reserve in the literature. The epidemiological studies identified in this literature search included a focus on all or some of the following:ILI, laboratory-confirmed cases, hospital admissions, critical/severe illness, and mortality. These studies included comparisons by geography, ethnicity, age, gender, stage of the pandemic, pregnancy, pre-existing health conditions, clinical presentation, complications, treatment interventions, or length of time from symptom to treatment, as well as comparisons with seasonal influenzas. The proportion of Indigenous people among clinical cases in these studies varied widely.

The information presented here should be interpreted with caution. Most of the research related to the epidemiology of the H1N1 influenza pandemic was focused on the population in general, with Indigenous ethnicity as simply one variable analyzed. Of the Indigenous-specific research, most studies focused on on-reserve and rural/remote populations,

³ Since studies could include analysis for multiple Indigenous populations, the number of First Nations, Inuit and Indigenous studies will not add to nine.

highlighting the acute infection rates among those living in isolated communities. Consequently, their focus was primarily on First Nations populations, with few studies providing detailed information about Inuit and/or Métis populations. The over-representation of First Nations in the literature should be kept in mind when interpreting the evidence on the impact of the H1N1 influenza pandemic on Indigenous populations in general. There is also a need to consider some common limitations of these epidemiological studies, including inconsistent reporting on ethnicity and certain clinical details, and a tendency to focus on the most severe cases. As a result, there was likely a significant under-reporting of H1N1 cases.

Generally, the literature shows evidence of a disproportionate representation of Indigenous peoples affected by the 2009 H1N1 influenza pandemic. These studies generally showed an over-representation of Indigenous people among those hospitalized with influenza (H1N1) when both waves of the pandemic are combined (Helferty et al., 2010; Rolland-Harris et al., 2012; Tran et al., 2012; Wilkinson et al., 2012). However, the proportion of Indigenous people with confirmed H1N1 influenza was not evenly distributed across both waves. Although more Indigenous people were admitted to hospital during the second wave than the first, proportionally they accounted for

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more H1N1 cases during the first wave of the pandemic compared to the second (Helferty et al., 2010; Rolland-Harris et al., 2012; Wilkinson et al., 2012). Representing approximately 4.3% of Canada’s population (Statistics Canada, 2013), Indigenous people accounted for 27.8% of all hospital admissions reported to PHAC during the first wave, but only 6.1% of hospital admissions during the second wave (Helferty et al., 2010). Indigenous women also accounted for 37.3% of hospitalized pregnant women during the first wave but only 9.8% during the second (Rolland-Harris et al., 2012). These findings are supported by regional studies (see for example, Mostaçõ-Guidolin, Towers, Buckeridge, & Moghadas, 2013; Zarychanski et al., 2012).

There is general consensus that Indigenous peoples were especially vulnerable to severe manifestations of H1N1 influenza. Seven studies utilizing data from hospitals across Canada found Indigenous people

TABLE 1: ADDITIONAL CHARACTERISTICS OF STUDIES

Geographic scale	Number of studies
National	11
Regional	9 ⁴
Specific community	5
International	1
Type of community	Number of studies
On-reserve	8
Rural/remote	8
Urban	4
Off-reserve	4
Undefined	14

*N does not equal 26 since analysis within studies may occur at multiple levels.

⁴ Seven studies were in Manitoba, one in Ontario and one in Nunavut/Manitoba.



The research shows a fairly strong association between severe manifestations of H1N1 influenza and the geographic isolation of Indigenous communities.

were over-represented among patients admitted to ICU and in fatalities attributed to H1N1 influenza (Campbell et al., 2010; Helferty et al., 2010; Jouvet et al., 2010; Kumar et al., 2009; Rolland-Harris et al., 2012; Tran et al., 2012; Wilkinson et al., 2012). For example, Indigenous people accounted for 25.6% of critically ill patients from 39 ICUs across Canada during the first wave (Kumar et al., 2009); 20.9% of patients from 12 pediatric ICUs during both waves of the pandemic combined (Tran et al., 2012), and 18.2% of all pregnant cases reported to PHAC during both waves (Rolland-Harris et al., 2012). Indigenous people also accounted for 17.6% of deaths reported to PHAC during the first wave and 8.9% of deaths during the second wave (Helferty et al., 2010). As with the case counts, these findings are supported by regional studies (Green et al., 2013; Oluyomi-Obi et al., 2009;

Zarychanski et al., 2012). Fatality rates were, however, low among children in general (Bettinger et al., 2010; Tran et al., 2012). There is also some evidence to suggest that once hospitalized, Indigenous people were not considered at elevated risk for admission to ICU (Jouvet et al., 2010; Campbell et al., 2010). Campbell et al. (2010) suggest this may be attributed to Indigenous patients being more likely to be admitted with milder forms of the illness.⁵

Five studies compared seasonal influenza with pandemic H1N1 influenza using clinical data from the general Canadian population. Three of these focused on pediatric cases (Fanella et al., 2011; Tran et al., 2012; Bettinger et al., 2010), one focused on the general population (Green et al., 2013), and one focused on pregnant women (Rolland-Harris et al., 2012). Collectively, findings from these studies are

generally mixed. Most studies agree that hospital admissions and severe outcomes occurred in a much younger Canadian population than is typically seen for seasonal influenzas (Bettinger et al., 2010; Campbell et al., 2010; Helferty et al., 2010; Kumar et al., 2009; Spence & White, 2010). Several authors also suggest there were no differences between H1N1 and seasonal influenzas in terms of mortality or intensive care admission (see for example Bettinger et al., 2010; Tran et al., 2012). However, there is more divergence of opinion in terms of whether seasonal influenza differed from H1N1 influenza in terms of risk factors, patient presentation, treatment protocols and patient outcomes.

Epidemiological research examining differences among First Nations, Inuit and Métis populations is extremely limited. Only two publications that compared any or all

⁵ It is important to remember that in this study, Indigenous status was reported in only 24% of patients.

of these three populations could be found (Helferty et al., 2010; Fanella et al., 2011). The more comprehensive of the two (which drew from hospital admissions and severe outcomes across Canada during both phases of the pandemic), revealed some interesting differences among the three Indigenous groups (Helferty et al., 2010). The 2011 National Household Survey reported that First Nations account for approximately 61% of all Indigenous people, Inuit account for 4%, and Métis account for 32% (Statistics Canada, 2013). Given these proportions, Helferty et al. (2010) found that Inuit were particularly over-represented during the first wave of the pandemic, First Nations were more over-represented during the second wave, and Métis were consistently under-represented in both waves. Of the 299 Indigenous hospital admissions across the country reported to PHAC during the first wave, approximately 63% were First Nations, 30% were Inuit, and only 6% were Métis. Of the 308 Indigenous hospital admissions during the second wave, 80% were First Nations, 7% were Inuit, and 10% were Métis. Helferty et al. remind us, however, that under-reporting challenges remain, with Indigenous ethnicity reported in only 62% of the clinical cases. Fanella et al. (2011) limited their study to a single urban community and found that of the 71% of patients admitted to the Winnipeg Children's Hospital in the early stages of the pandemic, 55% were from Indigenous communities and 16% were from Inuit communities. No studies assessing differences in patient characteristics, clinical profile or outcomes among First Nations, Inuit or Métis beyond these proportions reported were found in

the literature. The lack of research on the experiences of Inuit and Métis populations represents a considerable gap in knowledge.

The research shows a fairly strong association between severe manifestations of H1N1 influenza and the geographic isolation of Indigenous communities. More than 30% of the publications retrieved in this literature search reported on either rural and remote Indigenous contexts or on-reserve communities. Six studies undertook some comparisons between remote and isolated communities and those that were not (Green et al., 2013; Mostaço-Guidolin et al., 2011, 2012; Morrison, Buckeridge, Xiao, & Moghadas, 2014; Janjua et al., 2012, 2012). While the scope of these studies is limited to specific regions or communities, the findings from this research seem to suggest that rural/remote and on-reserve communities may have unique characteristics that increase the risk of severe manifestations from H1N1 influenza, including: a greater likelihood to report comorbidity or greater household crowding (Janjua et al., 2012); limited access to healthcare (Mostaço-Guidolin et al., 2011); delays in time-to-hospitalization (Morrison et al., 2014); lower socio-economic status (Green et al., 2013); and younger demographic profile (Green et al., 2013). However, none of these studies undertook any in-depth exploration of the associations between these unique characteristics and the incidence and severity of the H1N1 influenza in Indigenous communities, representing another gap in knowledge.

Two studies also compared H1N1 influenza rates across Canada (Helferty et al., 2010; Green et al., 2013). Helferty et al. (2010) found considerable regional variation in rates of H1N1 influenza among Indigenous peoples, especially across the two waves. While Manitoba and Nunavut were the most severely impacted during the first wave, during the second wave most hospital admissions involving Indigenous people came from other provinces, particularly Alberta. They also noted that generally, Quebec reported the most hospital admissions while Ontario reported the most deaths. Different levels of preparedness within communities and provinces and the development of herd immunity within particular places likely contributed to the differences between the two waves (Thompson et al., 2012; Daghofer, 2012). Green et al. (2013), however, found that once baseline differences (such as demographic and socio-economic status) were accounted for, "the relative increase in risk of hospitalization for pH1N1 for those living on a First Nations reserve was similar across provinces [BC, Ontario and Manitoba] at about 45%" (p. 6). They note that Manitoba had the highest rates of hospitalization, but also had the youngest and poorest First Nations reserve populations, which likely made them more vulnerable to the spread of influenza.

The age of H1N1 influenza patients is assessed in a number of studies. Most of these studies focused on the general Canadian population, with only one study focusing on age differences between First Nations and non-Indigenous populations (see Mostaço-Guidolin et al., 2013).

These studies indicate that unlike other seasonal influenzas, where hospital admission rates and severe outcomes are greatest among the elderly, a much younger population was more likely to be hospitalized and experience severe outcomes during the H1N1 influenza pandemic (Zarychanski et al., 2012; Campbell et al., 2010). Zarychanski et al. (2012) reported the mean age of laboratory-confirmed cases for both waves of H1N1 in Manitoba to be 25.3 years, while Rolland-Harris reported it to be 27.5 years for all pregnant women hospitalized with the influenza in Canada. In their study of critically ill patients admitted to ICUs across Canada during the first wave, Kumar et al. (2009) found that severe disease and mortality were concentrated among individuals aged 10 to 60. Similarly, Campbell et al. (2010) found the risk of severe outcomes to be greatest among patients who were 20 years of age or older in their study of disease characteristics and

outcomes among patients admitted to hospital with H1N1 during the first wave. There is less agreement in the literature, however, about whether there were any differences in the average age of patients treated during the first and second waves. While Wilkinson et al. (2012) did not notice any differences in the ages of adult patients hospitalized with H1N1 influenza in 40 hospitals across Canada between the two waves, Helferty et al. (2010) reported considerable age differences between the two waves, with a median age of 23 for hospital admissions, 37 for ICU admissions and 51 for deaths during the first wave and 30 years for hospital admissions, 47 for ICU admissions and 54 for deaths during the second wave. The vulnerability of younger adults to the H1N1 influenza virus, especially during the first wave, is an important finding given the relative youthfulness of the Indigenous population.

Five studies, at a mix of national, regional and local scales, undertook an analysis of sex differences during the H1N1 pandemic (Helferty et al., 2010; Kumar et al., 2009; Sood et al., 2010; Thompson et al., 2012; Zarychanski et al., 2010). All of these studies focused on the general Canadian population. Collectively, their findings show a greater tendency for women to have developed severe H1N1 influenza infection. However, Helferty et al. (2010) do provide evidence that more females were hospitalized, placed in an ICU, or died as a result of H1N1 influenza during the first wave, while slightly more males were hospitalized, placed in an ICU, or died during the second wave. The increased risk of females to severe manifestations of H1N1 influenza may be attributed to a number of factors including a greater exposure to the virus through their increased contact with children (Thompson et al., 2012) and the fact that pregnancy has been identified as a risk factor for severe manifestations of H1N1 influenza (Oluyomi-Obi et al., 2010; Kumar et al., 2009; Green et al., 2013).

Research has shown that the H1N1 influenza virus has the potential to cause severe illness in pregnant patients and adverse perinatal outcomes (Helferty et al., 2010; Rolland-Harris et al., 2012; Oluyomi-Obi et al., 2010; Kumar et al., 2009). In a 2010 report on lessons learned from the H1N1 influenza pandemic, PHAC and Health Canada identified the high rates of pregnancy in isolated and remote First Nations communities as one factor which affected the high rates of influenza seen in these communities. Several studies examined pregnancy as a risk

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factor for H1N1 hospitalization, ICU admission and deaths. Indigenous women were found to be over-represented in cases of pregnant women who were admitted to hospital and ICU with H1N1 influenza (Rolland-Harris et al., 2012; Oluoyomi-Obi et al., 2010). Rolland Harris et al. (2012), for example, found that Indigenous women accounted for 16.2% of hospitalized cases, 18.2% of ICU cases, and 50% of fatalities attributed to H1N1 influenza of those reporting ethnicity across Canada when both waves of the pandemic were combined. In Manitoba, of the six of 30 adult pregnant women admitted to the ICU who tested positive for H1N1, five were Indigenous (Oluoyomi-Obi et al., 2010). Helferty et al. (2010) found that while pregnant women across Canada were at increased risk of severe illness during both waves of the pandemic, they comprised proportionally fewer of all hospital admissions and deaths during the second wave compared to the first. Rolland-Harris et al. (2012) also noted that the fatality rate for

pregnant women in Canada was considerably lower than reported in other countries.

Only one study reported on perinatal outcomes of obstetric patients with 2009 H1N1 influenza (Oluoyomi et al., 2010). This study reported on the experiences of pregnant women in Manitoba who tested positive for the H1N1 influenza and were admitted to ICU during the period from March 1 to August 31, 2009. Thirty women tested positive and six subsequently were admitted to ICU. Of these six, five were Indigenous. The authors found there was a high risk of poor fetal and neonatal outcomes among the six ICU patients, with three having adverse perinatal outcomes, one having a spontaneous abortion, and one having an early preterm delivery. The lack of research on the perinatal outcomes of pregnant women, in particular First Nations, Inuit and Métis women, represents a considerable gap in knowledge.

Finally, while most of the epidemiology studies reported on

differences in the rates of severe outcomes between Indigenous and non-Indigenous Canadians, only one study explored the nature of severe outcomes in any depth. Sood et al. (2010) investigated kidney outcomes and dialytic requirements in critically ill H1N1 influenza patients in seven intensive care units in Manitoba during the first wave of the pandemic. Approximately 48% of the 50 patients admitted to ICU reported Indigenous ethnicity. In comparison to all patient outcomes, Indigenous patients had lower rates of kidney injury (57% compared to 66.7%), lower rates of kidney failure (56% compared to 66%), but higher rates requiring dialysis (38% compared to 22%). Given that Manitobans (especially First Nations) were especially hard hit by the H1N1 influenza during the first wave of the pandemic, this study cannot be said to be representative of the experiences of all Indigenous patients across Canada. It is clear that there is a significant knowledge gap in this area.

Conclusion

What is clear from this review of the epidemiology literature is that there are considerable knowledge gaps pertaining to Indigenous peoples' experiences with the 2009 H1N1 influenza pandemic. The publications retrieved for this review reported more on the experiences of First Nations people (especially those living on reserve or in remote/isolated locations), rather than those of Inuit or Métis people, despite some evidence in two studies indicating that Inuit may have been particularly affected by H1N1 influenza during the first wave of the pandemic. Most studies described the epidemiology of the H1N1 influenza during the first wave. In this wave, the over-representation of Indigenous people in cases of H1N1 hospitalization, ICU admission, and fatalities was particularly pronounced. The studies also do not equally represent all

regions across Canada: there are more studies describing H1N1 influenza in Manitoba, a province that was especially hard hit during the first wave of the pandemic. The majority of the literature is also focused on critically ill patients. Given the inadequacy of flu surveillance data for assessing total counts and rates, we are therefore left with an incomplete picture of the epidemiology of the H1N1 influenza pandemic, especially in regards to First Nations, Inuit and Métis populations.

Nevertheless, there is consistent evidence indicating that First Nations people in particular were at increased risk of severe outcomes from H1N1 influenza, especially during the first wave of the pandemic, and that there were some strong associations between certain risk factors and severe H1N1 outcomes that may help explain some of this

over-representation, including age, pregnancy, and geography. The Indigenous population has some unique characteristics that may have contributed to these findings. It is much younger than the non-Indigenous population (Statistics Canada, 2013), Indigenous women have higher fertility rates compared to non-Indigenous women (O'Donnell & Wallace, 2011), and more Indigenous people are likely to live in rural and remote areas where there may be challenges to accessing quality health care (Statistics Canada, 2008, 2013). These and other determinants of H1N1 influenza infection will be explored in greater detail in the evidence review, *Determinants of influenza prevalence and severity in First Nations, Inuit and Métis populations in Canada*.

In 2013 the six National Collaborating Centres for Public Health initiated a two-year project on Influenza and Influenza-Like Illness (ILI). As part of this collaborative project, the NCCAH produced three reports in order to understand how influenza, such as the 2009 H1N1 pandemic, is particularly experienced by Indigenous populations in Canada; the knowledge gaps in the epidemiological research related to influenza and Indigenous peoples; and how public health responses can be better tailored to the unique needs and characteristics of Indigenous peoples and communities. The three papers in this series include:

1. The 2009 H1N1 influenza pandemic among First Nations, Inuit and Métis peoples in Canada: Epidemiology and gaps in knowledge
2. Determinants of the prevalence and severity of influenza infection in Indigenous populations in Canada
3. Pandemic planning in Indigenous communities: Lessons learned from the 2009 H1N1 influenza pandemic in Canada



Additional NCC documents in this series are available at: <http://nccid.ca/collection/influenza/>

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⁶ Items with an * were identified as relevant to this review using the search methods described in the methodology section.

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How to use this fact sheet

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Talk to others in your community, reflect on the content of this fact sheet, and contemplate how you could make a difference in the health and well-being for yourself, your family or your community.



ENGAGE

Find local friendship centers, community organizations or groups where you can volunteer or participate in healthy positive actions. You too can share knowledge and make a difference in the health and well-being of First Nations, Inuit, and Métis Peoples' of Canada.

sharing knowledge · making a difference
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