February 11, 2010

H1N1 in Canada—A Context for Understanding Patients and Their Use of Hospital Services

Overview

A new strain of influenza, A/H1N1, was identified in April 2009. In June 2009, the World Health Organization declared that the outbreak of this virus had become a pandemic.1 As the pandemic unfolded, interest grew in understanding the effect of H1N1 on the acute hospital system. Full hospitalization data from the pandemic period—which is not yet available—will be an important tool in helping to understand this effect. In the meantime, we can provide preliminary insight on how H1N1 patients and the services they required were similar to (or different from) typical influenza patients.

This paper presents an analysis of Canadian baseline data for influenza/pneumonia, drawn from CIHI acute hospitalization data from April 1, 2007, to March 31, 2008. The CIHI baseline influenza/pneumonia data is contrasted with H1N1 information obtained from FluWatch, Canada’s influenza surveillance system. FluWatch is coordinated through the Centre for Immunization and Respiratory Infectious Diseases, Public Health Agency of Canada (PHAC). Using data collected by provincial and local public health partners across the country, FluWatch is able to provide detailed, timely information on H1N1 activity in Canada. Together, the CIHI baseline data and the publicly available FluWatch H1N1 information can help us understand

1. The difference between baseline influenza/pneumonia patients and those hospitalized with H1N1;
2. Whether the number of H1N1 patients who were severely ill, as measured by an ICU stay, ventilation and/or mortality, was different from the baseline number;
3. Whether the distribution of severely ill H1N1 patients by age group was different from the baseline; and
4. Whether the number of pregnant women hospitalized with H1N1 was different from the baseline influenza/pneumonia number, and whether there were differences in the proportion of each group that progressed to severe respiratory illness.
Until such time as more complete information is available, the juxtaposition of H1N1 analysis from FluWatch and baseline influenza/pneumonia data from CIHI provides some preliminary insight. However, it is important to note that it is not a strictly apples-to-apples comparison. Differences include the following:

- **Different data sources.** The surveillance system identifies and captures hospitalized cases where H1N1 was identified in the patient. The administrative data from which the baseline sample was drawn captures information on all hospitalizations. In the baseline data, influenza could be included as a diagnosis only if a positive lab test was available AND documented in the physician’s notes. There are also some definitional differences between the FluWatch analysis and the CIHI data, particularly for ventilation and mortality information.

- **Different time frames.** The baseline data involves a full fiscal year (April 1, 2007, to March 31, 2008), the most recent year for which data is available across Canada. The H1N1 analysis represents close to nine months, from the first hospitalized case in mid-April 2009 to January 2, 2010.

Some suggest that the best way to compare H1N1 with seasonal influenza is to use an excess hospitalization/mortality model. This type of analysis would require data that is not yet available. An excess mortality model looks at hospitalizations or deaths for any reason and compares numbers seen during peak periods of influenza with baseline data during the rest of the year. The assumption is that influenza causes the additional hospitalizations or deaths observed during the influenza season. This type of modelling for H1N1 can be done only after complete hospital information is available for all patients. Hospitalization data from the pandemic period will also be helpful in addressing other questions, such as

- Did hospitalizations for H1N1 effectively replace expected influenza/pneumonia cases or represent net new cases in the system?
- Did we observe changes—such as fewer cases or shorter lengths of stay—for other diagnostic groups using hospital beds, ICUs or ventilators?
- What was the impact on hospital emergency departments?

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i. This document focuses on a single year of baseline data. However, a five-year review (2004–2005 to 2008–2009, excluding Quebec) shows that influenza/pneumonia hospitalization rates were stable over time. In cases where influenza was explicitly documented on the chart, hospitalization rates were stable from 2005–2006 to 2008–2009, but were noticeably higher in 2004–2005.
Different testing approaches. During epidemics of seasonal influenza, most hospitalizations occur among the frail elderly, who often suffer from one or more chronic medical conditions. Although influenza can worsen these conditions, testing for influenza may not be done and hospitalizations may be attributed to another condition, such as pneumonia. Efforts to test for and document influenza were likely greater during the pandemic than in a typical year. To partly address this issue, the baseline data looked both at cases where influenza was explicitly documented in the chart and at a combination of influenza and pneumonia cases (the most common complication of influenza).

A technical appendix to this document outlines the codes selected and analytic approach used to identify baseline cases. It also highlights some important cautions in interpreting data results.

An Overview of Canadian Influenza/Pneumonia Patients Hospitalized in 2007–2008

Most influenza patients recover on their own, but some develop complications that require treatment in hospital. Across the country in 2007–2008, more than 1,500 patients were hospitalized with influenza (that is, they had a main diagnosis of influenza or they were admitted for pneumonia and influenza was identified as the underlying organism). However, tests to confirm that influenza was the cause of the pneumonia were often not performed or results were not available in physician documentation. As a result, baseline data on influenza under-represents the true number of cases.

To address the under-documentation of influenza, this report also examines more than 80,000 patients who were hospitalized with pneumonia without mention of influenza. It is expected that many (but not all) of these patients may have had pneumonia triggered by influenza, although the hospital records do not provide this specificity. Where there are a sufficient number of cases, the analysis reports data on both baseline groups:

- Cases where influenza was explicitly documented, whether or not the patient also had pneumonia; and
- All cases of influenza and/or pneumonia.

Respiratory diseases ranked fourth among the leading causes of Canada’s 2.7 million acute hospitalizations, trailing admissions for circulatory disorders, pregnancy and childbirth, and digestive system disorders. The almost 85,000 patients with a main diagnosis of influenza or pneumonia represented about one-third of respiratory hospitalizations (3% of all acute hospitalizations). Influenza/pneumonia patients were in hospital for just fewer than 750,000 days in 2007–2008, representing about 4% of the more than 20 million acute patient days.
Hospitalization by Age Group

Sixty percent of cases were found among those 65 and older, while those 4 and younger accounted for 11% of hospitalizations. Older patients tended to stay in hospital longer, with the median length of stay for influenza/pneumonia starting at two days for children 4 and younger and increasing to six days for seniors 65 and older. In situations where influenza was explicitly documented, a similar pattern was evident. For both baseline groups, there was a significant range in the length of stay within each age group. Detailed data by age group is provided in the appendix.

The elderly and young children had the highest rates of hospitalization for influenza/pneumonia. When looking at hospitalizations where influenza was explicitly documented, the highest hospitalization rate was among children 4 and younger. As a result, the median age was much lower (36) in cases where influenza was explicitly documented than in the overall influenza/pneumonia population (median age 71). Across all age groups, most patients in both the influenza (86%) and influenza/pneumonia (90%) baseline groups were admitted to hospital through the emergency department.

Figure 1 Rates of Influenza/Pneumonia Hospitalization by Age Group

Sources
Figure 2  Rates of Influenza Hospitalization by Age Group

Sources

FluWatch analysis on H1N1 showed some significant differences from the baseline information:

• For the nine months from April 12, 2009, to January 2, 2010, more cases were hospitalized for H1N1 (8,507) than were hospitalized for all influenza in 2007–2008 (2,614 total cases: 1,507 main diagnoses and 1,107 secondary diagnoses). It is unclear how much of this was related to more testing to identify underlying organisms and how much represented a real increase in influenza-related hospitalizations.

• PHAC surveillance analysis indicated that H1N1 affected a younger age group, with a median age of 28 for hospitalized cases, compared to median ages in the baseline data of 36 (influenza explicitly documented) and 71 (influenza/pneumonia).

• Consistent with baseline influenza data, H1N1 surveillance information showed that children 4 and younger had the highest rate of hospitalization.
**Seasonal Trends**

Hospitalizations for influenza/pneumonia were much more common at certain times of the year. This trend was more pronounced for cases where influenza was explicitly documented on the chart. February and March were peak admission months for influenza, with December, January and April having moderate activity. Very few hospitalizations for influenza occurred from May to November. By contrast, there were at least 5,000 admissions for influenza/pneumonia each month. Peak activity months for influenza/pneumonia were January to March, with more moderate activity from October to December and from April to May.

H1N1 surveillance analysis showed a very different pattern. The peak of both the first wave (June 2009) and the second wave (late October through mid-November 2009) occurred when very few influenza cases were hospitalized in a typical year. In fact, the number of H1N1 cases reported at the peak of the second wave exceeded the total influenza/pneumonia cases hospitalized during the same time period in 2007–2008.

**Figure 3  Seasonal Trends for Influenza/Pneumonia by Week of Admission, Canada, 2007–2008, and H1N1, 2009**

![Graph showing seasonal trends](image)

**Note**
H1N1 information is based on the week the hospitalization was reported in FluWatch.

**Sources**
A clearer picture of baseline hospitalizations where influenza was explicitly documented is presented in Figure 4.

**Figure 4  Seasonal Trends for Influenza by Week of Admission, Canada, 2007–2008**

![Graph showing seasonal trends for influenza by week of admission, Canada, 2007–2008.](image)

**Sources**

**Patients With Severe Illness**

Most influenza/pneumonia patients were discharged from hospital within a week, but some experienced more severe illness. Baseline data helps provide a profile of this latter group: patients who made use of specialized hospital services, as well as those who died.
Table 1 Percent of Hospitalized Patients With Severe Illness

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>ICU Admission</td>
<td>11%</td>
<td>7%</td>
<td>17%</td>
</tr>
<tr>
<td>Mechanical Ventilation</td>
<td>4%</td>
<td>3%</td>
<td>10%</td>
</tr>
<tr>
<td>Mechanical Ventilation—Duration 96+ Hours</td>
<td>2%</td>
<td>1%</td>
<td>N/A</td>
</tr>
<tr>
<td>In-Hospital Death</td>
<td>9%</td>
<td>1.6%</td>
<td>5%</td>
</tr>
</tbody>
</table>

Notes
H1N1 patients receiving ventilation were estimated based on FluWatch analysis. Among the 1,088 ICU patients for whom ventilation status information was available, 58% required ventilation. Baseline data on ICU admission includes only hospitals with more than 50 beds. H1N1 surveillance analysis reports all deaths, not just those occurring in hospital.

Sources

ICUs have specialized staff and equipment to care for critically ill patients. They tend to be available in larger hospitals only, so we restricted our analysis of ICU beds to hospitals with more than 50 beds. In 2007–2008, about 7,800 Canadians with a main diagnosis of influenza/pneumonia were admitted to an ICU with a median length of stay of four days (95th percentile length of stay was 19 days). In 2009, the proportion of H1N1 patients receiving ICU care was substantially higher than in the baseline influenza/pneumonia group and more than double the proportion for influenza patients in the baseline data.

Invasive mechanical ventilation may be required for influenza/pneumonia patients who have extreme difficulty breathing. Ventilation is a constrained resource, both in terms of limited equipment and limited ICU beds, where ventilated patients are typically cared for (our analysis showed a small number of patients received ventilation outside the ICU). In 2007–2008, about 3,500 influenza/pneumonia patients received ventilation, representing 4% of hospitalized influenza/pneumonia patients. About half (49%) of these patients required ventilation for four days or longer.

FluWatch analysis with full information on ventilation status was available for three-quarters of H1N1 patients in ICUs. Fifty-eight percent of these H1N1 patients required ventilation. Assuming this proportion was representative of all H1N1 patients in ICUs, it suggests that H1N1 patients were more than twice as likely to require ventilation as either of the baseline groups. Note that the baseline data included only invasive mechanical ventilation (where a tube is inserted in the trachea), while the surveillance analysis was more inclusive and tracked both invasive and non-invasive ventilation. It is unclear whether this difference in definition had a material impact on the data.
In-hospital deaths occurred for just fewer than 8,000 influenza/pneumonia patients in 2007–2008, for an in-hospital mortality rate of about 9%. In-hospital mortality rates increased with age, reaching almost 15% for seniors. The median age of patients who died was 82. Although pre-school age children had the second-highest hospitalization rate, in-hospital mortality was very low (<0.1%). In cases where influenza was explicitly documented, the overall death rate was much lower (1.6%), although the median age of those who died was similar (83). From April 2009 to January 2, 2010, FluWatch analysis showed death rates for H1N1 patients were just less than 5%. H1N1 surveillance analysis reports all deaths, not just those occurring in hospital. Further analysis would be required to understand the impact of this difference in definition.

Figure 5  Influenza/Pneumonia In-Hospital Mortality by Age Group, Canada, 2007–2008

Sources

How quickly patients died after being admitted to hospital varied by age group in the 2007–2008 baseline data. While few school-age patients with influenza/pneumonia died in hospital, those who did died rapidly—85% within four days. This may suggest that school-age children decompensate quickly and may require more immediate attention than other age groups. Alternatively, children admitted to hospital with influenza/pneumonia may be fragile patients with significant comorbidities. Further research is required to more completely understand these factors. Note that this analysis must be interpreted with caution, due to the small number of deaths in patients younger than 20.
Does Gender Matter?

Looking at 2007–2008 baseline data, males represented 52% of influenza/pneumonia cases in Canadian hospitals. This translates to a crude influenza/pneumonia hospitalization rate of 271 per 100,000 population for men, compared to 242 for women. Once in hospital for influenza/pneumonia, men were slightly more likely to be admitted to the ICU, to require invasive mechanical ventilation and to die while in hospital.

Some early H1N1 research suggested that women, particularly young women, were disproportionately affected by the disease. FluWatch surveillance analysis revealed that female H1N1 patients represented a slightly larger proportion of those who were hospitalized and admitted to ICUs than in either the influenza or influenza/pneumonia baseline groups. Looking at those who died, the proportion of women in the H1N1 group was slightly higher than that seen in the influenza/pneumonia baseline group but noticeably lower than that seen in the influenza baseline group. The role of age distribution and comorbidity profile in explaining these differences is not yet well understood.

Sources
Table 2  Gender Differences in Selected Categories of Hospitalized Patients—Percentage of Patients Who Were Female

<table>
<thead>
<tr>
<th></th>
<th>Baseline 2007–2008</th>
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<th>H1N1 2009</th>
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<tbody>
<tr>
<td></td>
<td>Influenza/Pneumonia</td>
<td>Influenza</td>
<td>April 12, 2009–January 2, 2010</td>
</tr>
<tr>
<td>Hospitalization</td>
<td>48%</td>
<td>49%</td>
<td>50%</td>
</tr>
<tr>
<td>ICU Admission</td>
<td>45%</td>
<td>44%</td>
<td>51%</td>
</tr>
<tr>
<td>Mechanical Ventilation</td>
<td>45%</td>
<td>37%</td>
<td>N/A</td>
</tr>
<tr>
<td>In-Hospital Death</td>
<td>47%</td>
<td>67%</td>
<td>50%</td>
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Notes
Baseline data on ICU admission includes only hospitals with more than 50 beds. H1N1 surveillance analysis reports all deaths, not just those occurring in hospital.

Sources

How About Age?
Public health agencies in both Canada and the United States noted that young people were especially hard hit by the 2009 H1N1 virus.

Baseline data showed that influenza/pneumonia typically affected an older age group. Sixty percent of hospitalizations were for patients 65 and older, as were 90% of in-hospital deaths. The median age of those receiving ICU care or being placed on a ventilator was the mid-60s. When influenza was explicitly documented on the chart, the median age of those dying in hospital was similar to the broader influenza/pneumonia group. However, the median age of those hospitalized, needing ICU care or being ventilated was much younger, reflecting high influenza admission rates for children 4 and younger.

Surveillance analysis on H1N1 patients suggested a different profile. The median age of patients hospitalized with H1N1 (28) was younger than that for typical influenza (36) or influenza/pneumonia (71) patients. The median age of H1N1 patients in the ICU was the mid-40s, much younger than the baseline influenza/pneumonia group (68) but substantially older than the baseline influenza-only group (23). Strikingly, the median age (early 50s) of the nearly 400 H1N1 patients who died was much lower than that of either baseline group (early 80s).
Table 3  Hospitalizations, Specialized Services and Median Patient Age

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<thead>
<tr>
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<tbody>
<tr>
<td>Hospitalization</td>
<td>71</td>
<td>36</td>
<td>28</td>
</tr>
<tr>
<td>ICU Admission</td>
<td>68</td>
<td>23</td>
<td>45</td>
</tr>
<tr>
<td>Mechanical Ventilation</td>
<td>65</td>
<td>6</td>
<td>N/A</td>
</tr>
<tr>
<td>In-Hospital Death</td>
<td>82</td>
<td>83</td>
<td>53</td>
</tr>
</tbody>
</table>

**Notes**
Baseline data on ICU admission includes only hospitals with more than 50 beds. H1N1 surveillance analysis reports all deaths, not just those occurring in hospital.

**Sources**

**Focus on Pregnant Women**
Early data on H1N1 suggested that pregnant women might be particularly affected by this strain of influenza. The reasons were not fully understood. Some speculated that pregnant women have a suppressed immune system and were more vulnerable to the virus. Others weren’t convinced, advising that pregnant women were no more likely to get the H1N1 flu virus than the rest of the population. However, there was consensus that pregnant women seemed more likely to develop complications from an H1N1 infection. Physiological issues may explain the higher rate of severe illness. Restricted lung space (resulting from a growing fetus) may make it easier for pneumonia to develop, as it is harder to expel fluid that might accumulate.

In 2007–2008, about 13% of female patients of child-bearing age (15 to 44) who were hospitalized for influenza/pneumonia were pregnant. PHAC H1N1 analysis from April to December 2009 revealed proportionately more pregnant women among this group (21%). ICU use by pregnant women was proportionately similar among both H1N1 and baseline influenza/pneumonia patients. Particularly striking were the four deaths of pregnant women with H1N1. In the baseline data, in-hospital death among pregnant women with influenza/pneumonia was exceedingly rare: outside Quebec, there were four deaths over three years for pregnant women hospitalized with influenza/pneumonia.

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ii. Note that there was likely some under-reporting of pregnancy, particularly for women in the first trimester.
Table 4  Pregnant Women as a Proportion of Women of Child-Bearing Age

<table>
<thead>
<tr>
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<th>Baseline 2007–2008</th>
<th>H1N1 April 12, 2009–January 2, 2010</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Influenza/Pneumonia</td>
<td>Influenza</td>
</tr>
<tr>
<td></td>
<td>Women 15–44</td>
<td>Women 15–44</td>
</tr>
<tr>
<td></td>
<td>% Pregnant</td>
<td>% Pregnant</td>
</tr>
<tr>
<td>Hospitalization</td>
<td>3,450</td>
<td>94</td>
</tr>
<tr>
<td></td>
<td>13%</td>
<td>13%</td>
</tr>
<tr>
<td>ICU Admission</td>
<td>393</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>12%</td>
<td>17%</td>
</tr>
<tr>
<td>In-Hospital Death</td>
<td>40</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Notes
In baseline data on pregnant women with influenza, percentages are based on very low numbers and should be interpreted with extreme caution.

As a point of reference in interpreting data on pregnant women with influenza and/or pneumonia, it is helpful to understand that about 3% of women between age 15 and 44 (about 204,000 out of 6.9 million) were pregnant on any given day in 2007–2008.

The sample of this analysis is slightly different than that used in the rest of the baseline data. It focuses on identifying all pregnant women with influenza/pneumonia, regardless of whether it had a material impact on the hospitalization.

Baseline data on ICU admission includes only hospitals with more than 50 beds.

H1N1 surveillance analysis reports all deaths, not just those occurring in hospital.

Sources

A recent article in the *New England Journal of Medicine* reviewed the experience of pregnant women with H1N1 in California. The study found that 10% of H1N1 hospitalizations were for pregnant women and 8% of these patients died. The authors also calculated that the H1N1-specific maternal mortality ratio (the number of maternal deaths in H1N1 patients per 100,000 live births) was 4.3. The authors suggested that this finding was significant, given that it represented 20% to 30% of the previously published all-cause maternal mortality ratio. The study concluded that high H1N1 mortality rates among pregnant women may influence overall mortality rates for pregnant women in the U.S.10

This observation appeared less pronounced in Canada. For the period April 12, 2009, to January 2, 2010, pregnant women represented 3% of all H1N1 hospitalizations, with fewer than 2% dying. The H1N1-specific maternal mortality ratio was about 1.5. In 2005, the World Health Organization reported that the maternal mortality ratio in Canada was 7, compared to 11 in the U.S.11 To date, maternal mortality attributable to H1N1 (four cases, ratio of 1.5) may have a slight impact on overall in-hospital mortality rates of pregnant women in Canada. More comprehensive data and research on the H1N1 period is required to more fully understand this issue.
Conclusion

As highlighted at the outset of the document, there are several caveats to direct comparisons between baseline administrative data on influenza/pneumonia and surveillance analysis on H1N1. That said, looking at both types of data offers some early insights on the pandemic. Compared to baseline influenza/pneumonia patients, this analysis found that

- Peaks of H1N1 activity occurred at times of the year when hospitalizations for influenza were typically rare;
- There were proportionally more H1N1 hospitalizations for younger age groups compared to both influenza-only and influenza/pneumonia groups;
- Proportionally more H1N1 cases required intensive care and needed ventilation;
- There was a slight difference in gender profile, with proportionally more women being hospitalized and requiring intensive care for H1N1 than for influenza/pneumonia. The role of age distribution and comorbidity profile in explaining these differences needs to be more fully assessed;
- Mortality rates for H1N1 were substantially lower than in-hospital mortality rates for the influenza/pneumonia group but higher than in-hospital mortality rates for the influenza-only group. It is not yet clear to what extent this was influenced by the difference in the age profile; and
- When compared with baseline influenza/pneumonia patients, proportionately more pregnant women were hospitalized with H1N1. However, ICU use by pregnant women was proportionately similar among both H1N1 and baseline influenza/pneumonia patients. Particularly striking were the four deaths of pregnant women with H1N1. In the baseline data, in-hospital death among pregnant women with influenza/pneumonia was exceedingly rare.

These observations represent some of the key findings emerging from a straightforward comparison of the H1N1 experience as documented in PHAC’s surveillance analysis and the influenza/pneumonia historical experience as documented in CIHI’s hospital administrative data. Soon, more comprehensive data on the H1N1 period will be available through CIHI’s hospitalization data. This information will provide detail on H1N1-related hospitalizations, pneumonia hospitalizations and hospitalizations from all other causes. The comprehensive hospitalization data will be instrumental in assessing the validity of early observations from this analysis. It will also support additional analyses, such as 1) whether H1N1 cases replaced cases that would be included in the typical influenza/pneumonia data or whether they represented net new cases to the health system; and 2) whether H1N1 had an impact on the use of hospital services by patients with non-respiratory conditions.
For More Information

Copies of this report are available free of charge in both official languages on the CIHI website at www.cihi.ca. You can also find

- Presentation slides with highlights from this analysis that you can use to share the results with others;
- Information on other CIHI activities related to H1N1, including guidance regarding the collection of H1N1 data for health information professionals; and
- Planned analyses connected to H1N1, including assessing the impact of H1N1 on case mix data and assessing the impact of H1N1 on other acute hospital activity.

Acknowledgements

CIHI would like to acknowledge and thank the many individuals who contributed to the development of this analysis. Foremost, we would like to recognize the Public Health Agency of Canada for use of the FluWatch analysis. We know that this analysis could not be available without the dedication and commitment of provincial, territorial and local public health partners across the country.

Several very busy public health officials made time to assist with the conceptualization and review of this paper. We gratefully acknowledge the assistance of the following:

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- Dr. George Samuel, Ontario Ministry of Health and Long-Term Care
- Dr. Cordell Neudorf, Saskatoon Health Region

Finally, appreciation goes to the CIHI staff involved, including Jean-Marie Berthelot, Jennifer Frood, Jenny Lineker, Tracy Johnson, Janet Manuel, Anne McFarlane, Kathleen Morris and Jessica Ramirez-Mendosa.
About CIHI

The Canadian Institute for Health Information (CIHI) collects and analyzes information on health and health care in Canada and makes it publicly available. Canada’s federal, provincial and territorial governments created CIHI as a not-for-profit, independent organization dedicated to forging a common approach to Canadian health information. CIHI’s goal: to provide timely, accurate and comparable information. CIHI’s data and reports inform health policies, support the effective delivery of health services and raise awareness among Canadians of the factors that contribute to good health.

Production of this analysis is made possible by financial contributions from Health Canada and provincial and territorial governments. The views expressed herein do not necessarily represent the views of Health Canada or any provincial or territorial government.

Appendix: Data Sources, Case Selection and Cautions Regarding Historical Comparability

Data Sources

CIHI maintains the Discharge Abstract Database (DAD), which contains demographic, administrative and clinical data on all acute hospital discharges across Canada, excluding Quebec. For this analysis, hospitalization information for all provinces/territories (except Quebec) came from the 2007–2008 DAD. Quebec data came from the Fichier des hospitalisations Med-Écho (Maintenance et exploitation des données pour l’étude de la clientèle hospitalière), 2007–2008, ministère de la Santé et des Services sociaux. 2007–2008 was selected as the baseline year as it was the most recent year for which data was available across Canada prior to any H1N1 cases being reported.

FluWatch is coordinated through the Centre for Immunization and Respiratory Infectious Diseases, Public Health Agency of Canada (PHAC). The program collects data and information from various sources to provide a national picture of influenza activity. Using this data collected by provincial and local public health partners across the country, FluWatch is able to provide detailed, timely information on H1N1 activity in Canada. This study used the following FluWatch case definitions:
Hospitalizations With Pandemic (H1N1) 2009
Any person admitted to hospital with laboratory-confirmed pandemic (H1N1) 2009 influenza. A laboratory-confirmed pandemic (H1N1) 2009 case was considered to be a person with (or without) clinical symptoms confirmed by one of the following tests:

- Reverse-transcriptase polymerase chain reaction (RT-PCR)
- Viral culture
- Fourfold rise in pandemic (H1N1) 2009–specific neutralizing antibodies. Note that serology is not recommended as a front-line testing procedure because of concerns pertaining to sensitivity and specificity as well as the intensity of labour associated with hemagglutination inhibition (HI) assays

Provinces/territories may decide whether this case definition of hospitalization applies to someone who is admitted for a short period for observation. In this instance a “short period” is defined as less than 24 hours. Patients admitted to hospital for other reasons in whom pandemic (H1N1) is an incidental finding (for example, some obstetric or psychiatric patients) are still considered hospitalized cases with pandemic (H1N1) 2009.

Deaths With Pandemic (H1N1) 2009
A death occurring in any person with laboratory-confirmed pandemic (H1N1) 2009 influenza with no period of complete recovery between illness and death.

Ventilation
Ventilation was considered as any ventilation, invasive or non-invasive, while the case was in hospital.

Who’s Included in the Baseline Data?
In an ideal world, we would simply compare patients hospitalized for H1N1 to the numbers hospitalized with seasonal influenza in previous years. Unfortunately, there are some challenges with this approach.

- Few Canadians are hospitalized for influenza alone. Most are hospitalized only when a complication of influenza develops—usually from lung infections, such as pneumonia.
- Once hospitalized, treatment is focused on the pneumonia, and information on the organism that triggered the infection is not usually available. In 2007–2008 Canadian hospital discharge data, about 90% of cases with a main diagnosis of pneumonia were coded as “organism unspecified.” This can happen for two reasons:
  - Physician diagnosis documentation most often does not specify the causative organism (and coders are not permitted to infer the causative organism from a lab report); and
– Often, once a patient develops pneumonia and starts treatment, the treatment prevents physicians from isolating the causative organism. For example, the patient may be started on antivirals before he or she is tested or may be prescribed antibiotics that could affect the results of lab tests for culturing bacterial infections.

To address these challenges, this study adopted an approach used elsewhere: looking at all inpatient cases where either influenza or pneumonia was the main reason for hospitalization (most responsible diagnosis).12, 13 Where there were a sufficient number of cases, the analysis reports data on two groups:

• Cases where influenza was explicitly documented, whether or not the patient also had pneumonia; and
• All cases of influenza and/or pneumonia.

The following codes were used to select patients for the baseline data:

A. Cases where influenza was explicitly documented. There are three codes that identify cases where influenza information is available and explicitly documented in the inpatient chart.

J09  *Influenza due to certain identified influenza virus*\(^{\text{iii}}\)

J10.–  *Influenza due to other identified influenza virus*

J11.–  *Influenza, virus not identified*

Within each of these codes, patients may have influenza alone, influenza with pneumonia, influenza with other respiratory manifestations or influenza with non-respiratory manifestations. Note that code J09 was previously used for avian influenza, but the World Health Organization (WHO) re-purposed it to collect H1N1 information as of April 2009.

B. Cases coded as pneumonia. The classification system provides unique codes for identifying pneumonia resulting from different underlying organisms. Note that 90% of the cases within the code range listed below fell into J18.– *Pneumonia, organism unspecified*.

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iii. In 2007–2008, code J09 was titled *Influenza due to identified Avian influenza virus*. While PHAC indicates that no avian flu cases were confirmed in Canada, 55 J09 codes were reported in the 2007–2008 data. Follow-up with submitting hospitals indicated that these cases should have been coded to J10\(^{\text{iv}}\). The current code description for J09 was approved by the WHO and is immediately applicable to data for 2009–2010.
J12.– Viral pneumonia, not elsewhere classified
J13 Pneumonia, due to Streptococcus pneumoniae
J14 Pneumonia due to Haemophilus influenzae
J15.– Bacterial pneumonia, not elsewhere classified
J16.– Pneumonia due to other infectious organisms, not elsewhere classified
J18.– Pneumonia, organism unspecified
U04 Severe acute respiratory syndrome (included to provide consistency with ICD-9 codes used in other influenza/pneumonia studies; fewer than five cases were reported in 2007–2008)

J85.1 Abscess of lung with pneumonia

C. Cases with both COPD and influenza/pneumonia. In situations where a patient has both chronic obstructive pulmonary disease (COPD) and pneumonia, CIHI coding standards require that the COPD code be assigned as the most responsible diagnosis when COPD with pneumonia is the focus of hospitalization. We included these patients in the baseline sample, provided that an influenza or pneumonia diagnosis was also present on the abstract.

J44.0 COPD with acute lower respiratory infection (providing an influenza/pneumonia code identified in Section A or B above was also specified)

D. Cases where pneumonia was the proxy main diagnosis. In CIHI data, diagnosis type (6) identifies a proxy most responsible diagnosis. Type (6) is assigned when a diagnosis is the manifestation of an underlying condition (designated by an asterisk) and, according to coding rules, must be sequenced following the code for the underlying cause. In the baseline data, we were interested in a type (6) diagnosis of pneumonia, which implied that pneumonia was the condition most responsible for the patient’s stay in hospital. Septicemia (diagnosis code A40.– or A41.–) was the most commonly reported main diagnosis when pneumonia (J17.–) was present as type (6).

In Quebec, diagnosis typing is not used; therefore, a different technique was used to identify patients for the baseline analysis. In Quebec, cases were included in baseline data if the most responsible diagnosis was septicemia (A40.– or A41.–) and J17.– was reported in any other position.

J17.– Pneumonia in diseases classified elsewhere, type (6)
E. Pregnant women hospitalized for influenza/pneumonia. If pregnancy was incidental to the treatment of influenza/pneumonia, pregnant women would have had a main diagnosis of influenza/pneumonia as identified by the codes listed above (sections A to D). However, if the influenza/pneumonia resulted in complications to the pregnancy, coding guidelines require that an obstetrical complication code be assigned as the most responsible diagnosis. For this reason, we included two obstetrical complication codes in the baseline data, provided that an influenza/pneumonia code was also present on the abstract. Note that this excluded situations where the sixth digit of the code was 4, indicating that the situation occurred during the post-partum time frame.

O98.8– Other maternal infectious and parasitic diseases complicating pregnancy, childbirth and the puerperium

O99.5– Diseases of the respiratory system complicating pregnancy, childbirth and the puerperium

Focus on Special Risk Groups: Pregnant Women

When looking at baseline data for a particular risk group, analysts may be interested in all patients who have both the risk factor and influenza/pneumonia, regardless of whether the influenza/pneumonia was the main reason for hospitalization. This would lead to a different approach for selecting the population of interest. In this analysis, we developed a unique baseline data set for pregnant women with influenza/pneumonia, combining two approaches to select baseline cases:

1) Women with a main code for influenza/pneumonia (as outlined in sections A to D) as well as a code indicating pregnancy (listed below):

Z32 Pregnancy examination and test
Z33 Pregnant state, incidental
Z34 Supervision of normal pregnancy
Z35 Supervision of high-risk pregnancy
Z36 Antenatal screening
Z37 Outcome of delivery

Or

2) Pregnant women with an influenza or pneumonia code (as outlined in sections A to D) in any diagnostic position. Pregnancy was identified using a main diagnosis in the ICD-10-CA “O” range (Pregnancy, childbirth and the puerperium), excluding post-partum conditions (those with a sixth digit of 4) and complications of pregnancy with abortive outcomes (those starting with O08).
Table A1 outlines the number of cases by diagnosis category in both the main sample and the sample of pregnant women.

Table A1  Inclusions for Baseline Analyses

<table>
<thead>
<tr>
<th>Description of Diagnosis</th>
<th>Inclusion Criteria</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sample of Influenza and Pneumonia Cases (N = 84,801)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>Influenza as Main Diagnosis</td>
<td>MRDx in J09^, J10^ or J11^</td>
</tr>
<tr>
<td>B</td>
<td>Pneumonia as Main Diagnosis</td>
<td>MRDx in J12^, J13^, J14^, J15^, J16^, J18^, U04^ or J85.1</td>
</tr>
<tr>
<td>C</td>
<td>COPD as Main Diagnosis With Influenza or Pneumonia in Chart</td>
<td>MRDx in J44.0 with any diagnosis in J10.0, J11.0, J12^, J13^, J14^, J15^, J16^ or J18^</td>
</tr>
<tr>
<td>D</td>
<td>Pneumonia as Proxy Main Diagnosis</td>
<td>J17 as type 6^</td>
</tr>
<tr>
<td>E</td>
<td>Pregnant Women Hospitalized With Obstetric Complications From Influenza or Pneumonia</td>
<td>Pregnancy complicated by respiratory MRDx (O98.8 or O99.5) specific to influenza/pneumonia in any position (see A and B above)†</td>
</tr>
</tbody>
</table>

| **Sample of Pregnant Women (N = 456)** | | |
| A + B | Pregnancy Cases With a Main Diagnosis of Influenza or Pneumonia Who Are Pregnant | MRDx from A or B and any pregnancy diagnosis‡ | 86 |
| C | Pregnancy Cases With a Main Diagnosis of COPD Who Are Pregnant | MRDx from C and any pregnancy diagnosis‡ | <5 |
| D | Pregnancy Cases With Pneumonia as a Proxy Main Diagnosis Who Are Pregnant | J17 as type 6^ and any pregnancy diagnosis‡ | <5 |
| E | Pregnant Women Hospitalized With Obstetric Complications From Influenza or Pneumonia | Pregnancy complicated by respiratory MRDx (O98.8 or O99.5) specific to influenza/pneumonia in any position (see A and B above)† | 183 |
| | Pregnant Women With Influenza or Pneumonia in Chart | Cases NOT identified above that have an MRDx beginning with O^ and a diagnosis from A or B in any position | 182 |

Notes
* In three cases, the patient had J17 as a type 6 AND one of the other criteria.
† Excludes codes with a sixth digit of 4 (indicating the post-partum period) and those starting with O08 (complications to abortion procedure).
‡ Pregnancy diagnoses are those in Z32^, Z33^, Z34^, Z35^, Z36^ or Z37^ or those starting with O, excluding those with a sixth digit of 4 (post-partum period) and O08^ (complications to abortion).

Sources
Review of influenza/pneumonia hospitalization data from the DAD (excluding Quebec) over five years shows that, overall, hospitalizations were quite consistent from year to year. Where influenza was explicitly documented on the chart, the most recent four years (2005–2006 to 2008–2009) were reasonably consistent, but there was a notable increase in cases hospitalized in 2004–2005. A more detailed demographic analysis was not performed to assess whether there were significant differences among the years.

Table A2 Cases and Crude Rates of Influenza and Influenza/Pneumonia Over Time, Canada (Excluding Quebec)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Influenza/Pneumonia Cases</td>
<td>67,134</td>
<td>66,965</td>
<td>67,252</td>
<td>65,540</td>
<td>66,498</td>
<td>66,678</td>
</tr>
<tr>
<td>Influenza/Pneumonia Crude Rates</td>
<td>27.4</td>
<td>27.0</td>
<td>26.9</td>
<td>25.9</td>
<td>25.9</td>
<td>26.6</td>
</tr>
<tr>
<td>Influenza Cases</td>
<td>2,059</td>
<td>1,159</td>
<td>1,334</td>
<td>1,062</td>
<td>1,165</td>
<td>1,356</td>
</tr>
<tr>
<td>Influenza Crude Rates</td>
<td>0.8</td>
<td>0.5</td>
<td>0.5</td>
<td>0.4</td>
<td>0.5</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Source
### Table A3  Summary Statistics—Influenza and Pneumonia Hospitalizations by Age Group

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>0–4</th>
<th>5–19</th>
<th>20–64</th>
<th>65+</th>
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</thead>
<tbody>
<tr>
<td><strong>Influenza</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospitalizations</td>
<td>1,507</td>
<td>507</td>
<td>152</td>
<td>350</td>
<td>498</td>
</tr>
<tr>
<td>Total Days</td>
<td>7,233</td>
<td>1,768</td>
<td>590</td>
<td>1,387</td>
<td>3,488</td>
</tr>
<tr>
<td>Total Length of Stay</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>(Median Days)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Length of Stay (95th</td>
<td>15</td>
<td>10</td>
<td>13</td>
<td>9</td>
<td>21</td>
</tr>
<tr>
<td>Percentile Days)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Admit Through Emergency</td>
<td>1,295</td>
<td>408</td>
<td>127</td>
<td>312</td>
<td>448</td>
</tr>
<tr>
<td>Department</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical Ventilation</td>
<td>38</td>
<td>18</td>
<td>5</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>(Cases)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In-Hospital Death</td>
<td>24</td>
<td>0</td>
<td>&lt;5</td>
<td>&lt;5</td>
<td>21</td>
</tr>
<tr>
<td>ICU Stays in Facilities With</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50+ Beds</td>
<td>79</td>
<td>31</td>
<td>7</td>
<td>19</td>
<td>22</td>
</tr>
<tr>
<td>(Hospitalizations in Facilities</td>
<td>(1,189)</td>
<td>(480)</td>
<td>(130)</td>
<td>(230)</td>
<td>(349)</td>
</tr>
<tr>
<td>With 50+ Beds)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Influenza and/or Pneumonia</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospitalizations</td>
<td>84,801</td>
<td>9,415</td>
<td>3,368</td>
<td>21,092</td>
<td>50,926</td>
</tr>
<tr>
<td>Total Days</td>
<td>747,899</td>
<td>30,576</td>
<td>13,275</td>
<td>150,287</td>
<td>553,761</td>
</tr>
<tr>
<td>Total Length of Stay</td>
<td>5</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>(Median Days)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Length of Stay (95th</td>
<td>28</td>
<td>8</td>
<td>11</td>
<td>21</td>
<td>34</td>
</tr>
<tr>
<td>Percentile Days)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Admit Through Emergency</td>
<td>76,304</td>
<td>7,585</td>
<td>2,754</td>
<td>18,824</td>
<td>47,141</td>
</tr>
<tr>
<td>Department</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical Ventilation</td>
<td>3,518</td>
<td>155</td>
<td>73</td>
<td>1,512</td>
<td>1,778</td>
</tr>
<tr>
<td>(Cases)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In-Hospital Death</td>
<td>7,943</td>
<td>13</td>
<td>20</td>
<td>754</td>
<td>7,156</td>
</tr>
<tr>
<td>ICU Stays in Facilities With</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>50+ Beds</td>
<td>7,795</td>
<td>340</td>
<td>191</td>
<td>2,846</td>
<td>4,418</td>
</tr>
<tr>
<td>(Hospitalizations in Facilities</td>
<td>(70,207)</td>
<td>(8,005)</td>
<td>(17,247)</td>
<td>(42,105)</td>
<td></td>
</tr>
<tr>
<td>With 50+ Beds)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes**

Newborns are excluded from the “admit through emergency department” statistic. As well, in 2007–2008, four Quebec facilities did not submit the admission category variable needed to calculate this statistic. Abstracts from these facilities accounted for approximately 2% of Quebec data (representing 0.5% of data nationally).

**Sources**

What Services Were Considered in Baseline Data Describing Use of Hospital Services?

The baseline data included information on the use of select hospital services by influenza/pneumonia patients. This section explains how these services were identified in the abstract.

**ICU.** Intensive care unit (ICU) data is provided by hospitals as part of the discharge abstract and includes any type of special care unit other than “step-down” care. To improve consistency of the data, hospitals with fewer than 50 beds were excluded from the analysis. Within a hospitalization, some influenza/pneumonia patients (409, or 0.5%) had more than one admission to an ICU. In these cases, the first admission was selected for analysis. In most parts of the country, the length of stay in the ICU is measured in hours, while in Quebec the unit of measurement is days. In the baseline data, all ICU stays were converted to days and rounded to the nearest whole day. ICU analysis included patients in neonatal intensive care units.

**Ventilation.** CIHI has information on the date invasive mechanical ventilation was initiated and whether the duration of ventilation was more or less than 96 hours. Some influenza/pneumonia hospitalizations (222, or 0.3%) involved more than one ventilation episode. When a hospitalization involved multiple ventilations, the first ventilation was selected for analysis. Some patients receiving ventilation had no reported ICU stay but were still considered in the ventilation analysis. Procedure codes used to identify ventilated patients were as follows:

- 1GZ31CAND Ventilation, respiratory system NEC, positive pressure, invasive per orifice approach by endotracheal intubation
- 1GZ31CRND Ventilation, respiratory system NEC, positive pressure, invasive per orifice with incision approach for intubation through tracheostomy
- 1GZ31GPND Ventilation, respiratory system NEC, positive pressure, invasive percutaneous transluminal approach (e.g. transtracheal jet) through needle

**In-hospital mortality.** In-hospital mortality is defined as a patient having died while in acute care (includes both ICU and general beds).
Historical Comparability

Baseline data on a “typical” influenza season would ideally look at the average and range of values over several years. While this analysis is possible, there are a few important limitations.

Change in classification system. Classification systems in health care provide a standard mechanism for capturing and coding diagnoses and interventions. ICD-10-CA, the enhanced Canadian version of the 10th revision of the International Statistical Classification of Diseases and Related Health Problems, replaced the earlier ICD-9 and ICD-9-CM classifications. CCI, the Canadian Classification of Health Interventions, was developed and is maintained by CIHI. It contains a comprehensive list of diagnostic, therapeutic and support interventions and replaced the CCP and ICD-9-CM intervention codes.


The change in the classification systems makes historical trending difficult. Some of the challenges apply specifically to pneumonia cases. For example, about one in four patients admitted to hospital for treatment of pneumonia had underlying COPD. In ICD-9, coders were asked to assess which condition (the COPD or the pneumonia) was responsible for the longest portion of the patient’s stay and to use that as a guide for selecting the most responsible diagnosis. ICD-10-CA introduced a new code, J44.0 COPD with acute lower respiratory infection. This new code requires that all patients with both COPD and pneumonia must have COPD (J44.0) as the most responsible diagnosis when COPD with pneumonia is the focus of care. This single example has a significant impact on trending pneumonia cases in Canada.

A second example is the coding requirements for ventilation. Beginning in 2006–2007, it became mandatory to document all cases of invasive mechanical ventilation, regardless of the length of the ventilation episode. In previous years, coders were required to submit this information only if the ventilation was provided for four days (96 hours) or longer. This change in requirements has a significant impact on trending ventilated patients in Canada.
References


