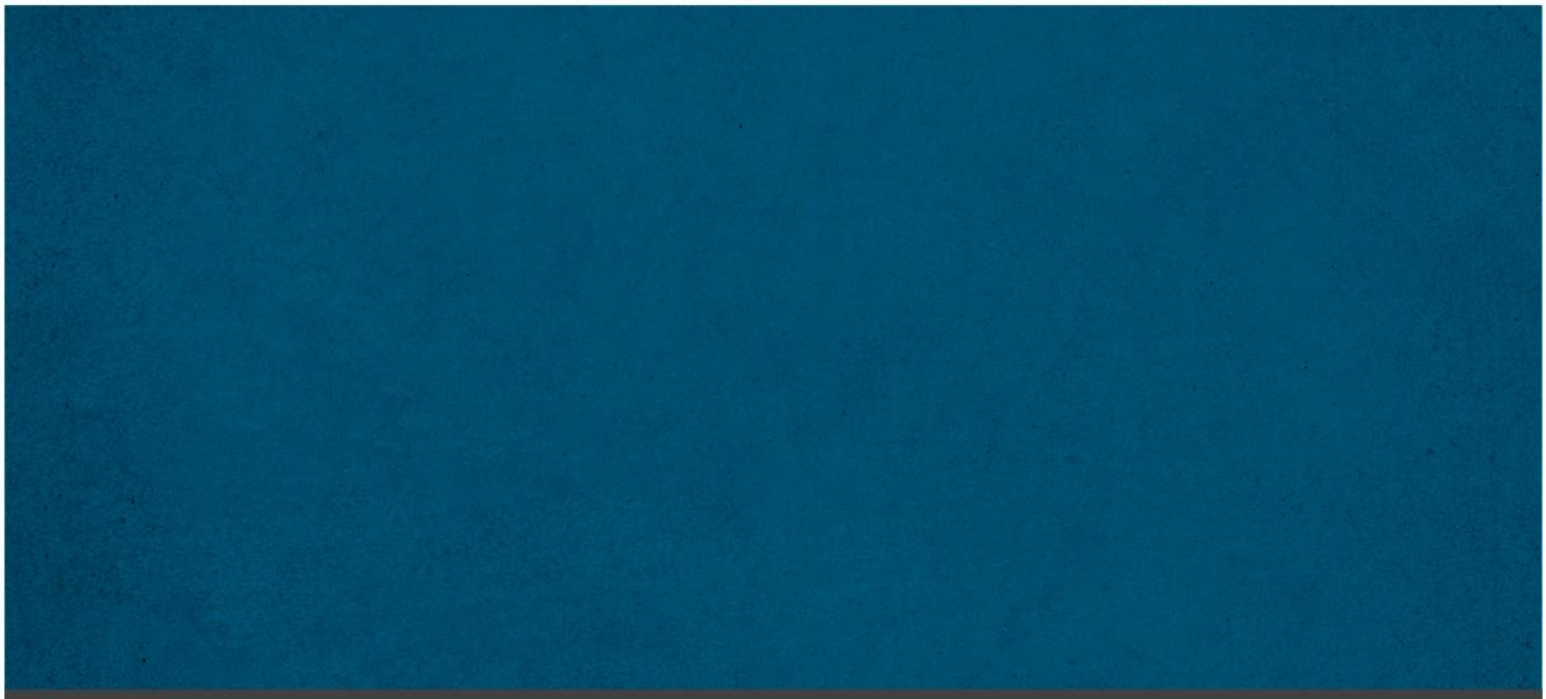
PUBLIC HEALTH AGENCY OF CANADA

INFLUENZA IN CANADA

2010–2011 SEASON



PROTECTING CANADIANS FROM ILLNESS

Public Health Agency of Canada
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Canada

TO PROMOTE AND PROTECT THE HEALTH OF CANADIANS THROUGH LEADERSHIP, PARTNERSHIP, INNOVATION AND ACTION IN PUBLIC HEALTH.

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INFLUENZA IN CANADA: 2010-2011 SEASON

Introduction

The Centre for Immunization and Respiratory Infectious Diseases (CIRID), Public Health Agency of Canada (PHAC), coordinates a national influenza surveillance network through the FluWatch program. The primary objectives of the FluWatch program are early detection and timely reporting of influenza activity in Canada and abroad; monitoring of circulating strains of influenza virus, including antigenic characterization and identification of new subtypes, antiviral resistance; and provision of virologic surveillance information to the World Health Organization (WHO) global influenza surveillance network to contribute to decision-making for the following season's vaccine components. This report provides an epidemiologic and virologic summary of influenza activity in Canada during the 2010-2011 season.

Methods

The FluWatch program consists of a network of sentinel laboratories, sentinel primary care practices, provincial and territorial ministries of health, and sentinel hospitals. Five main indicators of influenza activity were reported by the network on a weekly basis across Canada and throughout the season: (1) sentinel laboratory-based influenza and other respiratory virus detections; (2) strain identification and antiviral resistance for circulating influenza viruses; (3) sentinel primary care consultation rates of influenza-like illness (ILI); (4) regional influenza activity levels as assigned by provincial and territorial FluWatch representatives; and (5) paediatric influenza-associated hospital admissions and mortality data through the Canadian Immunization Monitoring Program Active (IMPACT). New for the 2010-2011 season was the monitoring and reporting of adult influenza-associated hospitalizations and deaths through the Canadian Nosocomial Infection Surveillance Program (CNISP). In addition, the FluWatch program conducted an assessment of international influenza activity by monitoring reports from other influenza surveillance programs worldwide.

Respiratory Virus Detections

Respiratory virus detections were reported through the sentinel laboratory-based Respiratory Virus Detections Surveillance System (RVDSS), which operated year-round from weeks 35 to 34 (early September to late August the following year). Laboratory methods used for the detection of influenza included virus culture, virus antigen detection (including direct fluorescent antibody (DFA), point-of-care (POC) and rapid antigen POC methods), nucleic acid amplification (i.e. polymerase chain reaction (PCR)), and, in a small number of cases, seroconversion. Participating laboratories reported the total number of influenza tests performed and the total number of tests positive for influenza by virus type (A or B) and where available, by hemagglutinin subtype (e.g. H1, H3), to CIRID, PHAC, on a weekly basis (aggregate data). Samples from the Yukon, Northwest Territories and Nunavut were sent for testing to reference laboratories in nearby provinces, results of which were included in the aggregated provincial results. Detailed case information such as dates of onset and specimen collection, age of case, influenza sub-type or strain were also reported by the majority of the sentinel laboratories.

Influenza Virus Strain Identification

The National Microbiology Laboratory (NML), PHAC, conducted national surveillance on human influenza virus strains in collaboration with provincial laboratories and other Canadian hospital- and university-based

laboratories. A proportion of the weekly influenza detections across Canada were referred to the NML for further testing to provide strain characterization, antigenic changes as well as antiviral resistance in the circulating influenza virus strains. Canadian influenza virus surveillance information and representative strains were shared with the WHO's collaborating centres for influenza to contribute to global influenza monitoring and decision-making for vaccine recommendations for the upcoming season and provide a comparison of the antigenic match between the circulating and vaccine strains.

ILI Consultations Reported by Sentinel Practitioners

FluWatch maintained a network of sentinel primary care practitioners across the country. The College of Family Physicians of Canada, National Research System (NaReS), was contracted to recruit and manage the participation of sentinel physicians and nurses in seven provinces and three territories across Canada. In the remaining three provinces (British Columbia, Alberta and Saskatchewan), sentinel recruitment and reporting was managed by independent provincial programs. The FluWatch program objective was to have at least one sentinel recruited from each of the census divisions across Canada or, in the case of Quebec, where there were 99 census divisions, representative recruitment was accomplished by targeting of health regions (n = 18) rather than by census division. In more densely-populated census divisions/health regions, the objective was to have at least one sentinel recruited per 250,000 population.

For one clinic day each week, sentinels were asked to report the total number of patients seen for any reason (denominator) and the total number of patients meeting a standard national case definition for ILI[i] (numerator). Age group information was also collected to allow for calculation and monitoring of age-specific ILI rates. In Alberta, however, age group information was only collected on the numerator data, while age group information for the denominator was calculated by applying the Canada-wide age-specific population distribution. The majority of sentinels recruited reported weekly data year-round; however, a proportion of sentinels reported weekly data only during the active influenza season (October to May or weeks 40 to 20).

Data from sentinels were weighted by the estimated population for each of the census divisions being represented during the respective week. This was done in order to produce a summary ILI rate for the Canadian population. Each week the weights were re-calculated based on the actual census divisions with data to report. Weighted rates were then summed to create a national ILI rate each week. The mean ILI consultation rates and 95% confidence intervals from the 1996-1997 to 2008/2009 seasons for weeks 40 through 18 were calculated and served as a reference for comparison.

Regional Influenza Activity Levels Assessed by Provincial and Territorial Representatives

Provinces and territories were subdivided into influenza surveillance regions. Provincial and territorial FluWatch representatives assessed the weekly influenza activity level in their respective jurisdictions based on laboratory reports of influenza detections, presence of ILI, and reports of outbreaks[ii] of influenza or ILI. Influenza activity levels were reported to CIRID as meeting one of four standard categories: no activity,

[i] **Influenza-like-illness (ILI) in the general population:** Acute onset of respiratory illness with fever and cough and with one or more of the following - sore throat, arthralgia, myalgia, or prostration which is likely due to influenza. In children under 5 years of age, gastrointestinal symptoms may also be present. In patients under 5 or 65 years and older, fever may not be prominent.

[ii] **Outbreak definitions** – **Hospitals and Residential institutions**: two or more cases of ILI within a seven-day period, including at least one laboratory confirmed case. Institutional outbreaks should be reported to Provincial/Territorial health authorities within 24 hours of identification. Residential institutions include, but are not limited to, long-term care facilities (LTCF) and prisons. **Schools**: Greater than 10% absenteeism (or absenteeism that is higher (e.g. >5-10%) than expected level as determined by school or public health authority) which is likely due to ILI. Note: it is recommended that ILI school outbreaks be laboratory confirmed at the beginning of influenza season as it may be the first indication of community transmission in an area. **Other settings:** two or more cases of ILI within a seven-day period, including at least one laboratory confirmed case; i.e. closed communities.

sporadic activity, localized activity, or widespread activity[iii].

Paediatric Influenza-associated Hospitalizations and Deaths

Since the 2003-2004 influenza season, hospital-based surveillance of influenza in children (≤ 16 years) has been reported to FluWatch through the Canadian Immunization Monitoring Program Active (IMPACT) network of paediatric tertiary care hospitals. This national network included 12 centres across Canada, which represented approximately 90% of all tertiary care paediatric beds in the country. A trained nurse monitor at each participating centre identified laboratory-confirmed cases of influenza that required admission to hospital. Upon identification, detailed case report forms were completed (mostly based on information from the hospital chart) and entered into a database electronically via a secure web server. Case reports were further reviewed and validated at the IMPACT data centre in Vancouver, British Columbia prior to the data being available to CIRID for analysis. In addition, weekly aggregate reports of hospitalizations and deaths due to influenza by province, age group, influenza type and/or subtype were reported.

Influenza-associated Hospitalizations and Deaths in Adults

During the 2010-2011 influenza season, 32 sentinel hospitals reported detailed case information on adult (≥ 16 years) influenza-associated hospitalizations and deaths to CIRID through the Canadian Nosocomial Infection Surveillance Program (CNISP) on a bi-weekly basis. CNISP participating hospitals were located in the following provinces (number of hospitals): British Columbia (7), Alberta (1), Saskatchewan (1), Manitoba (1), Ontario (13), Quebec (5), Nova Scotia (1), New Brunswick (1), and Newfoundland and Labrador (2). In addition, all 32 hospitals also reported weekly aggregate counts of all laboratory-confirmed influenza hospitalizations and deaths, including information on influenza types/subtypes, age group and aboriginal status.

International

The FluWatch program also monitored and reported weekly on international influenza activity through synthesis of information from official international government organization sources (e.g. World Health Organization (WHO), National Ministries of Health) and international influenza surveillance reports. The FluWatch program also monitored and reported weekly on international cases of human infections with avian (i.e. H5N1) and swine-origin influenza viruses.

Dissemination

FluWatch disseminated information through weekly reports during the active influenza season and biweekly reports during the low season (mid-May to September). These were available to health professionals and the public through e-mail listserv and PHAC's FluWatch Website <http://www.phac-aspc.gc.ca/fluwatch/index.html>.

In addition, summaries of influenza and other respiratory virus detections were made available weekly throughout the year through the RVDSS Web site <http://www.phac-aspc.gc.ca/bid-bmi/dsd-dsm/ rvdi-divr/index.html>.

[iii] **Activity level definitions:** 1 = **No activity:** no laboratory-confirmed influenza detections in the reporting week, however, sporadically occurring ILI may be reported. 2 = **Sporadic**: sporadically occurring ILI and laboratory confirmed influenza detection(s) with no outbreaks detected within the influenza surveillance region. 3 = **Localized**: evidence of increased ILI (more than just sporadic as determined by the P/T epidemiologist) and laboratory confirmed influenza detection(s) together with outbreaks in schools, hospitals, residential institutions and/or other types of facilities occurring in less than 50% of the influenza surveillance region. 4 = **Widespread**: evidence of increased ILI (more than just sporadic as determined by the P/T epidemiologist) and laboratory confirmed influenza detection(s) together with outbreaks in schools, hospitals, residential institutions and/or other types of facilities occurring in greater than or equal to 50% of the influenza surveillance region.

Results

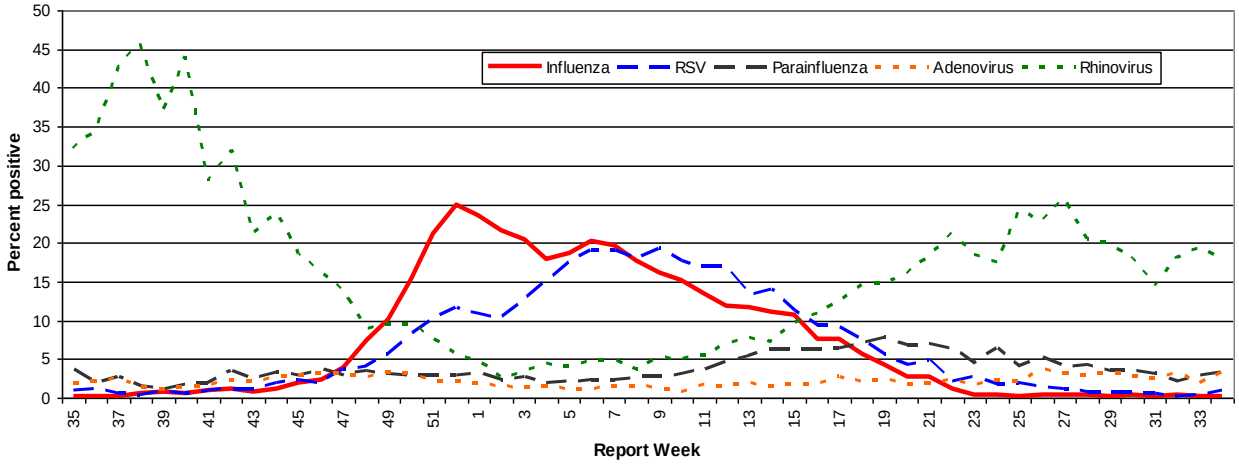
1) Sentinel laboratory-based influenza and other respiratory virus detections

Influenza and other respiratory virus detections from the Respiratory Virus Detections Surveillance System (RVDSS) (aggregate reporting)

In the 2010-2011 season, a total of 140,945 influenza tests were conducted by sentinel RVDSS laboratories across Canada of which 12.5% (17,573/140,945) were positive for influenza viruses. Of these, 84.5% (14,852/17,573) were positive for influenza A viruses and 15.5% (2,721/17,573) were positive for influenza B viruses. Of the 14,852 positive influenza A viruses, 50.1% (7,440) were not subtyped, 6.9% (1,027) were confirmed A(H1N1)pdm09, and 43.0% (6,385) were of H3 subtype (Table 1).

The percent positive for respiratory syncytial viruses (RSV) was 10.0% (11,299 positive tests/112,502 tests), was 3.6% (3,689/101,107) for parainfluenza viruses, and 2.0% (1,987/101,501) for adenoviruses. A large majority of the sentinel laboratories also reported results for other respiratory viruses, of which the percent positive for the season were as follows: 2.3% (1,533/67,239) for human metapneumovirus (hMPV); 11.2% (7,392/65,961) for rhinovirus; and 3.2% (1,698/52,409) for coronavirus. Weekly percent positive results for influenza compared to select respiratory viruses are displayed in Figure 1.

Figure 1. Percent positive influenza tests, compared to other respiratory viruses, by report week, Canada, 2010-2011 season



Influenza virus detections from the RVDSS (case-level reporting)

For the 2010-2011 season, a total of 15,819 detailed case-by-case records were reported to CIRID from nine provinces and three territories (see Table 1). In all reporting provinces and territories, the proportion of influenza A detections was greater than the proportion of influenza B detections overall. However, some variations were observed in the extent of the predominance of influenza A detections across regions. Regionally, the highest proportions of influenza A detections were reported in the Yukon, Nova Scotia and Manitoba (range: 97.8%-100%). The highest proportions of influenza B detections were reported in Alberta, Saskatchewan, British Columbia and the Northwest Territories (range: 28.6%-44.1%) (Table 1).

Table 1: Aggregate detections and detailed case data by type and sub-type, by reporting province, Canada, 2010-2011

Reporting Province	Aggregate Detections					Detailed Case Data				
	Influenza A				Influenza B	Influenza A				Influenza B
	Influenza A (by subtype)					Influenza A (by subtype)				
	A (H3) *(% of all A)*	A(H1N1) pdm09 *(% of all A)*	A un-subtyped *(% of all A)*	Total A (% of all flu)	Total B (% of all flu)	A (H3) *(% of all A)*	A(H1N1) pdm09 *(% of all A)*	A un-subtyped *(% of all A)*	Total A (% of all flu)	Total B (% of all flu)
British Columbia	202 *(42.2%)*	164 *(34.2%)*	113 *(23.6%)*	479 **72.6%**	181 **27.4%**	181 *(40.0%)*	230 *(50.9%)*	41 *(9.1%)*	452 **71.4%**	181 **28.6%**
Alberta	795 *(71.4%)*	282 *(25.3%)*	37 *(3.3%)*	1114 **59.5%**	757 **40.5%**	592 *(65.1%)*	281 *(30.9%)*	36 *(4.0%)*	909 **55.9%**	716 **44.1%**
Saskatchewan	213 *(66.4%)*	31 *(9.7%)*	77 *(24.0%)*	321 **64.1%**	180 **35.9%**	212 *(82.2%)*	36 *(14.0%)*	10 *(3.9%)*	258 **69.5%**	113 **30.5%**
Manitoba	56 *(10.9%)*	2 *(0.4%)*	457 *(88.7%)*	515 **97.2%**	15 **2.8%**	16 *(3.6%)*	2 *(0.4%)*	428 *(96.0%)*	446 **97.8%**	10 **2.2%**
Ontario	3,225 *(66.2%)*	298 *(6.1%)*	1,347 *(27.7%)*	4,870 **87.9%**	673 **12.1%**	3,089 *(85.8%)*	256 *(7.1%)*	257 *(7.1%)*	3,602 **88.9%**	451 **11.1%**
Quebec	957 *(15.9%)*	41 *(0.7%)*	5,030 *(83.4%)*	6,028 **88.8%**	760 **11.2%**	1,073 *(17.8%)*	42 *(0.7%)*	4,927 *(81.5%)*	6,042 **88.8%**	762 **11.2%**
New Brunswick	656 *(69.9%)*	176 *(18.7%)*	107 *(11.4%)*	939 **90.6%**	97 **9.4%**	700 *(71.7%)*	168 *(17.2%)*	108 *(11.1%)*	976 **88.2%**	130 **11.8%**
Nova Scotia	80 *(29.4%)*	11 *(4.0%)*	181 *(66.5%)*	272 **97.5%**	7 **2.5%**	18 *(7.2%)*	8 *(3.2%)*	224 *(89.6%)*	250 **98.4%**	4 **1.6%**
Prince Edward Island	79 *(81.4%)*	16 *(16.5%)*	2 *(2.1%)*	97 **93.3%**	7 **6.7%**	0 *(0.0%)*	0 *(0.0%)*	0 *(0.0%)*	0 **0.0%**	0 **0.0%**
Newfoundland & Labrador	122 *(56.2%)*	6 *(2.8%)*	89 *(41.0%)*	217 **83.1%**	44 **16.9%**	195 *(96.1%)*	8 *(3.9%)*	0 *(0.0%)*	203 **83.2%**	41 **16.8%**
Yukon						5 *(45.5%)*	5 *(45.5%)*	1 *(9.1%)*	11 **100.0%**	0 **0.0%**
Northwest Territories						22 *(91.7%)*	1 *(4.2%)*	1 *(4.2%)*	24 **58.5%**	17 **41.5%**
Nunavut						179 *(89.5%)*	0 *(0.0%)*	21 *(10.5%)*	200 **90.9%**	20 **9.1%**
Canada	**6,385** ***(43.0%)***	**1,027** ***(6.9%)***	**7,440** ***(50.1%)***	**14,852** **84.5%**	**2,721** **15.5%**	**6,282** ***(47.0%)***	**1,037** ***(7.8%)***	**6,054** ***(45.3%)***	**13,373** **84.5%**	**2,445** **15.5%**

NOTE: Specimens from NT, YT, and NU are sent to reference laboratories in other provinces for aggregate detections. A case from AB who was infected with both influenza A and B is not included in the table above.

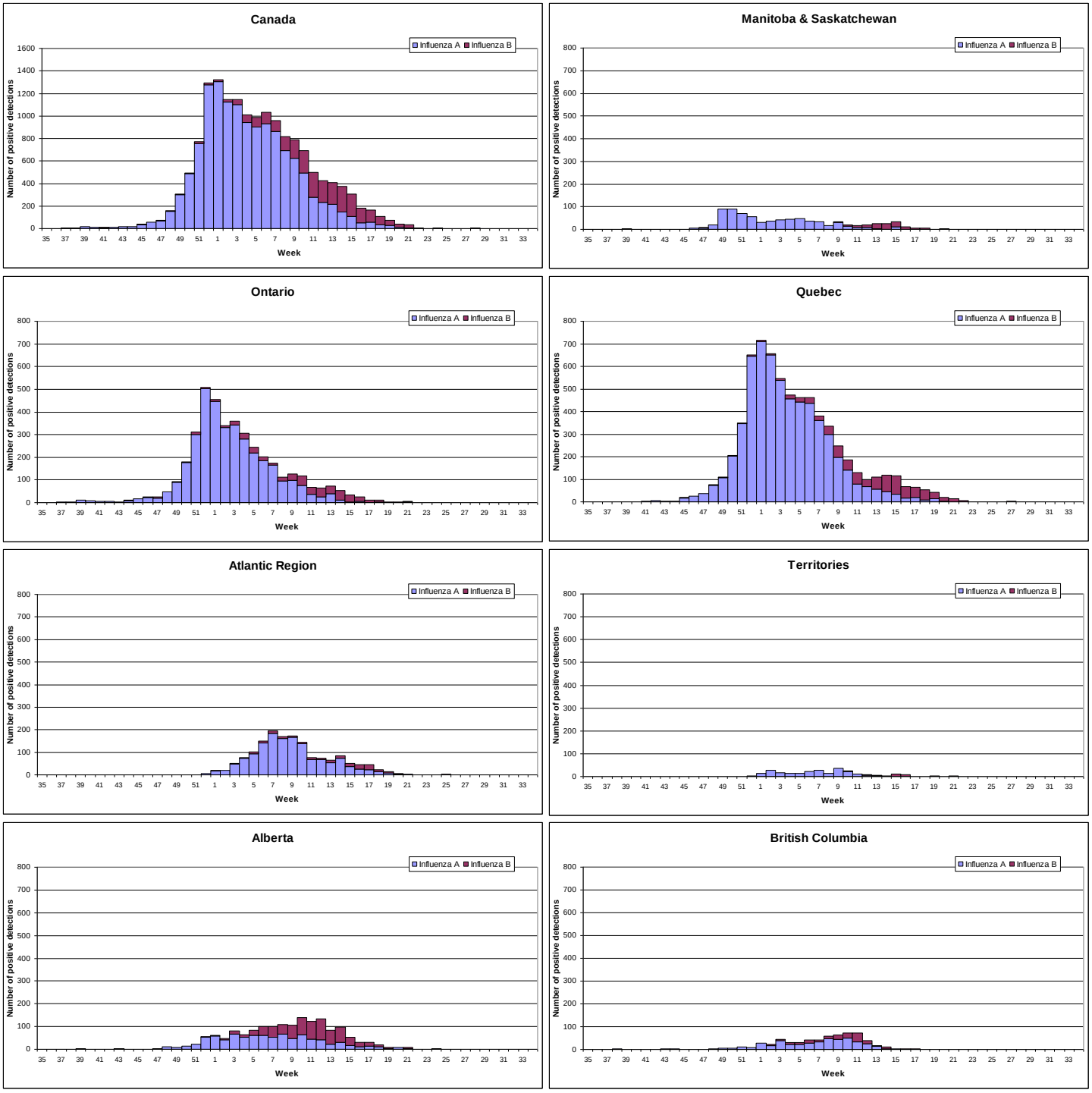
Nationally, 76% of all influenza cases were identified in the 12-week period between mid-December 2010 to mid-March 2011 (week 51 and week 10), with roughly 37% identified during the peak period from late December 2010 to late January 2011 (week 52 to week 04). The peak occurred in early January (week 01, *n* = 1,323) (Figure 2). The majority of influenza A cases (74%) were identified in the 10-week period between mid-December 2010 and the end of February 2011 (week 51 and week 08), with 36% identified during the peak period from late December 2010 to mid-January 2011 (week 52 to week 03). The peak occurred in early January 2011 (week 01, *n* = 1,305). Of the influenza B cases, 80% were identified in the 12-week period between mid-February and late April 2011 (week 06 and week 17), with 50% identified during the peak period between mid-March and mid-April 2011 (week 10 to week 15), and the number per week peaking in early April (week 14, *n* = 225).

Regional peaks in the number of cases identified were also observed (Figure 2). The first peak occurred in early December 2010 (week 49) in Manitoba, followed by peaks in Ontario in late December (week 52), Quebec in early January 2011 (week 01), Saskatchewan in early February (week 05), the Atlantic Region in mid-February (week 07), the Territories in early March (week 09), and in Alberta and British Columbia in mid-March (week 10).

Age information was obtained from 15,585 (98.5%) of the 15,819 case records and the distribution by age group is as follows: 18.9% (n=2,953) were between 0 to 4 years; 7.6% (n=1,184) between 5 to 9 years; 3.3% (n=521) between 10 to 14 years; 5.6% (n=874) between 15 to 24 years; 16.1% (n=2,515) between 25 to 44 years; 13.2% (n=2,058) between 45 to 64 years; and 35.2% (n=5,480) were 65 years and older.

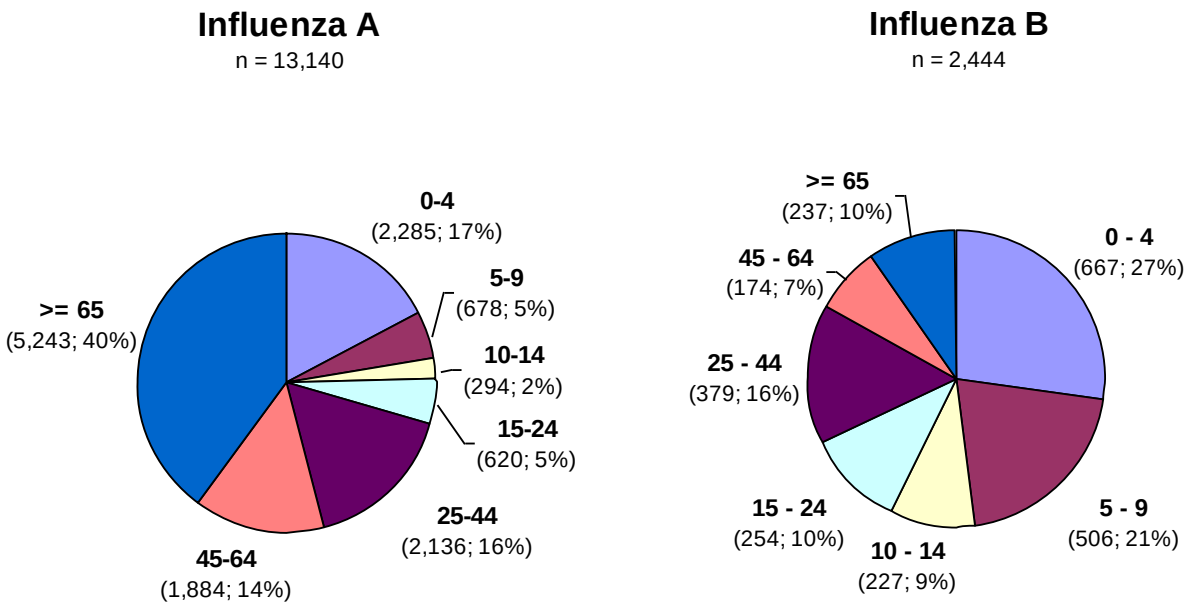
The distribution of cases by age group varied according to the type of influenza infection (A or B) as displayed in Figure 3. Of the 13,140 influenza A cases, the majority (70.5%) were among adults 25 years and over; however a large proportion of the cases were in children between 0 to 4 years as well (17.4%). Of the 2,444 influenza B cases, 57.3% were in children under 15 years of age. Age and sub-type information were available for 7,091 (1,034 A/H1 and 6,057 A/H3) influenza A cases. The largest proportion of influenza A/H1 cases were in those 20 to 44 years of age (42.8%) and the smallest in those 65 years and older (5.9%). Of the influenza A/H3 cases, the largest proportion was in those 65 years and older (46.0%) and the smallest in those 5 to 19 years of age (8.4%).

Figure 2. Number of influenza cases, by influenza type and week*, Canada and by Province or Region in order of earliest peak, 2010-2011 (N=15,818)



* Week is defined as the earliest date available (i.e. date of onset, date of specimen collection, date of receipt by lab, date of positive test result, and report week) based on case information provided.
Note: A case from Alberta who was infected with both influenza A and B is not included in the Figures above.

Figure 3. Proportionate distributions of cases, by influenza type and age group, Canada, 2010-2011



2) Strain characterization and antiviral resistance for circulating influenza viruses by the National Microbiology Laboratory (NML)

Influenza virus strain characterization

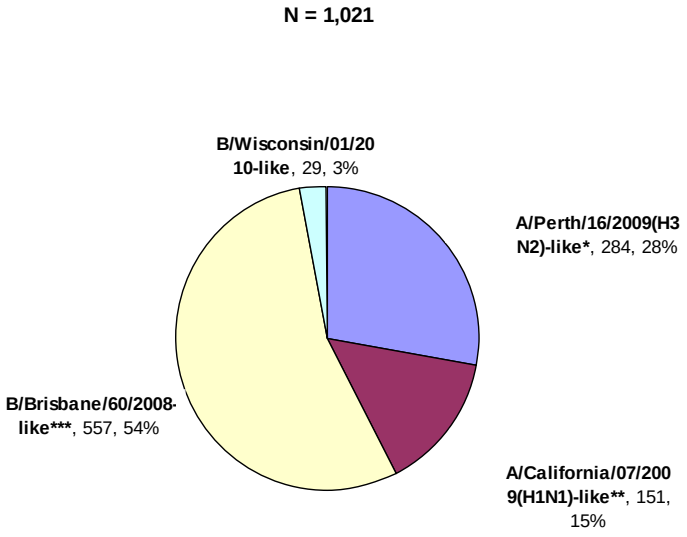
During the 2010-2011 season, the NML characterized 1,021 isolates from provincial and hospital laboratories across Canada. Of these, 14.8% (151) were influenza A (H1N1), 27.8% (284) were influenza A (H3N2), and 57.4% (586) were influenza B viruses (Figure 4).

Of the 151 influenza A (H1N1) viruses characterized, 98.7% (149) were antigenically related to A/California/07/2009, the influenza A (H1N1) component of the 2010-2011 vaccine. The other 1.3% (2) of the viruses tested showed reduced titer with antiserum produced against A/California/07/2009.

Of the 284 influenza A (H3N2) viruses characterized, 98.9% (281) were antigenically related to A/Perth/16/2009, which was the influenza A (H3N2) component in the 2010-2011 vaccine. The other 1.1% (3) of the viruses tested showed reduced titer with antiserum produced against A/Perth/16/2009.

Influenza B viruses that circulated could be divided into two antigenically distinct lineages represented by B/Yamagata/16/1988-like and B/Victoria/2/1987-like viruses. Of the 586 influenza B viruses characterized, 95.1% (557) were characterized as B/Brisbane/60/2008-like (Victoria lineage), the B component for the 2010-2011 vaccine. Approximately 0.7% (4/557) of the viruses tested showed reduced titer with antiserum produced against B/Brisbane/60/2008. The other 4.9% (29/586) influenza B viruses were characterized as B/Wisconsin/01/2010-like (Yamagata lineage). B/Wisconsin/01/2010-like viruses are antigenically and genetically different from the previous Yamagata lineage vaccine strain B/Florida/04/2006.

Figure 4. Influenza strain characterizations, Canada, 2010-2011



* Three viruses showed reduced titer with antiserum produced against A/Perth/16/2009
** Two viruses showed reduced titer with antiserum produced against A/California/07/2009
*** Four viruses showed reduced titer with antiserum produced against B/Brisbane/60/2008

Antiviral susceptibility tests

Amantadine Resistance
During the 2010-2011 season, the NML tested 667 influenza A viruses (including 170 A(H1N1)pdm09 and 497 H3N2 viruses) for amantadine resistance. All of the A(H1N1)pdm09 viruses were resistant to amantadine. Of the 497 H3N2 viruses tested, 99.8% (496) were resistant to amantadine (Table 2).

Oseltamivir Resistance
During the 2010-2011 season, the NML tested a total of 993 influenza isolates for oseltamivir resistance (including 154 A(H1N1)pdm09, 259 A(H3N2) and 580 influenza B viruses). Of the 154 A(H1N1)pdm09 viruses tested, 0.6% (1) were resistant to oseltamivir with the H274Y mutation. The resistant case was associated with oseltamivir treatment. Of the 259 A(H3N2) viruses tested, 0.4% (1) were resistant to oseltamivir with the E119V mutation. The resistant case was associated with oseltamivir prophylaxis/treatment. Of the 580 influenza B viruses tested, 0.2% (1) was resistant to oseltamivir with the D198N mutation (Table 2).

Zanamivir Resistance
During the 2010-2011 season, the NML tested 985 influenza isolates (including 151 seasonal A(H1N1)pdm09, 255 A(H3N2) and 579 influenza B viruses) for zanamivir resistance. All of the influenza A isolates tested were sensitive to zanamivir. Of the 579 influenza B viruses tested, 0.2% (1) were resistant to zanamivir with the D198N mutation (Table 2).

Table 2: Antiviral resistance by influenza virus type and subtype, Canada, 2010-2011

Virus type and subtype	Oseltamivir		Zanamivir		Amantadine	
	# tested	# resistant (%)	# tested	# resistant (%)	# tested	# resistant (%)
A (H3N2)	259	1 (0.4%)	255	0	497	496 (99.8%)
A(H1N1)pdm09	154	1 (0.6%)	151	0	170	170 (100%)
B	580	1 (0.2%)	579	1 (0.2%)	NA*	NA*
TOTAL	993	3 (0.3%)	985	1 (0.1%)	667	666 (99.9%)

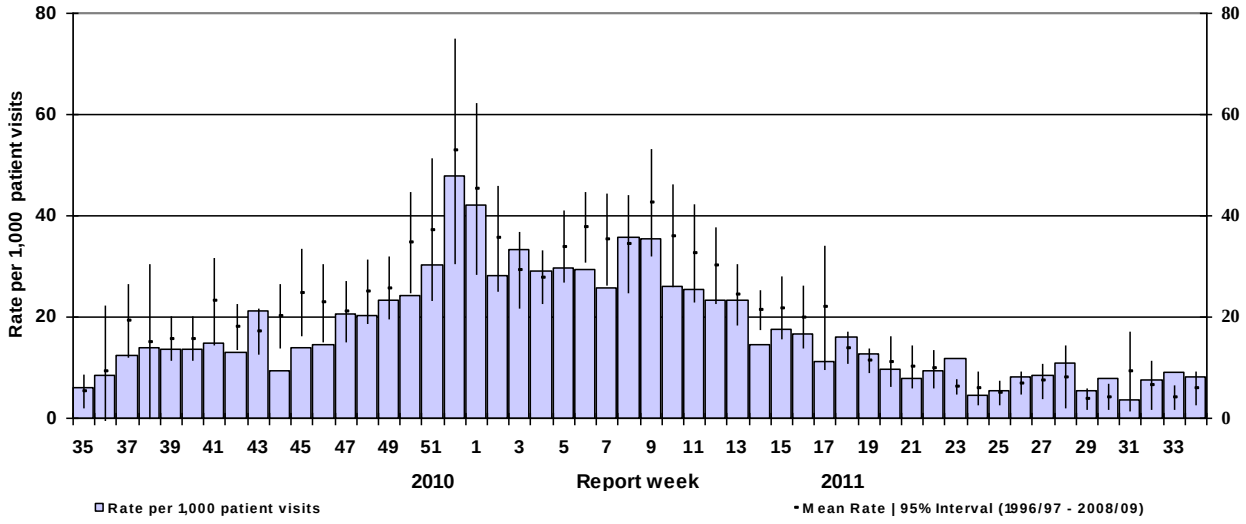
* NA – not applicable

3) Sentinel primary care consultation rates of influenza-like illness (ILI) reported by sentinel practitioners

During the 2010-2011 influenza season, ILI consultation rates increased around late November 2010 (week 47) and peaked in week 52 (late December) with a rate of 48 per 1,000 patient visits. This is the same period during which the highest percentage of positive detections for influenza was reported. A second smaller peak was observed in week 08 (late-February 2011) with a rate of 36 per 1,000 patient visits and corresponds to the period when the number of regions reporting localized and widespread influenza activity was highest (Figure 5).

For most of the season (except for a few weeks in the summer months between weeks 23 and 34 or June to August 2011), weekly ILI consultation rates remained within or below the expected range, based on mean observation rates for the previous seasons since 1996-1997 and excluding rates from the pandemic period (Figure 5). The highest ILI consultation rates were reported in children, averaging 54/1,000 patients seen in the 0 to 4-year age group and 38/1,000 in those aged 5 to 19 years between October 2010 and May 2011.

Figure 5. Influenza-like illness (ILI) consultation rates, Canada, by report week, 2010-2011 compared to baseline (1996/97 through to 2008/09 seasons)



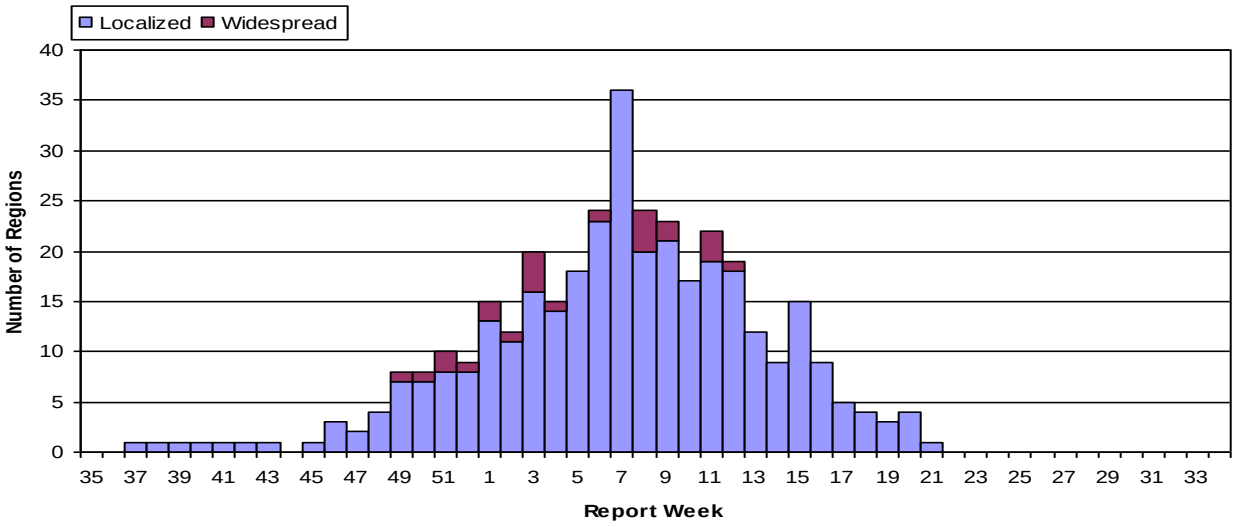
4) Regional influenza activity levels as assigned by provincial and territorial FluWatch representatives

During the 2010-2011 season, weekly influenza activity level assessments were provided for 56 influenza surveillance regions within Canada. Sporadic influenza activity was first reported in regions of British Columbia, Alberta, Ontario and Quebec in early to late-September 2010. Reports of localized influenza activity were first reported in several regions in Ontario between mid-September and late October 2010. Influenza activity then increased in Quebec and Manitoba from mid-November to mid-December 2010, shortly followed by reports of increased activity in the rest of the provinces and territories. Reports of widespread influenza activity were first reported in a region in Ontario in early December, followed by a region in Manitoba in late December and several regions in Quebec from early to late January 2011 (Figure 6).

The proportion of regions reporting widespread and localized activity peaked in mid-February 2011 (week 7) at 64% (36/56). The peak period in reporting of widespread and localized influenza activity occurred between mid-January and the end of March 2011 during which 61% of the widespread and localized activity was reported. Additionally, 86% of the widespread and localized influenza activity was reported between mid-December 2010 to mid-April 2011 (Figure 5).

During the 2010-2011 influenza season, a total of 569 outbreaks of influenza or ILI were reported: 55% (314) were in long-term care facilities (LTCFs); 5% (30) in hospitals; 28% (158) in schools and 12% (67) in other types of facilities. The vast majority of the outbreaks (81%) were reported between mid-December 2010 and late March 2011.

Figure 6. Number of surveillance regions reporting localized or widespread influenza activity, by week, Canada, 2010-2011



5) *Influenza-associated hospitalizations and mortality*

Influenza-associated paediatric hospitalizations reported by IMPACT

During the 2010-2011 influenza season, a total of 671 influenza-associated paediatric hospitalizations were reported through IMPACT of which 67.2% (451) were due to influenza A and 32.8% (220) were due to influenza B. Of the 451 hospitalizations due to influenza A, 33.5% (151) were influenza A/H3N2, 6.0% (27)

were influenza A/H1N1 and 60.5% (273) were influenza A but not subtyped or the subtype was unknown.

The first hospitalization was reported in mid-October 2010 due to influenza A and the last hospitalization was reported in mid-June 2011 due to influenza B. Approximately 81% of all paediatric hospitalizations occurred in the 16-week period between mid-December 2010 and early April 2011 (week 51 and week 14), with roughly 36% identified during the peak period between late December 2010 and early February 2011 (week 52 to week 05). The peak number of hospitalizations occurred late December (week 52, *n* = 56). The majority of influenza A cases (82%) were hospitalized between mid-December 2010 to early March 2011, with the number of hospitalizations per week peaking in late December (week 52, *n* = 54). Of the influenza B cases, 76% were hospitalized between late January to mid-April 2011, with the number per week peaking in early April (week 14, *n* = 26).

The distribution of hospitalized cases by age group was as follows: 16.7% (112/671) were aged 0 to 5 months; 27.3% (183/671) were 6 to 23 months; 29.1% (195/671) were 2 to 4 years; 16.5% (111/671) were 5 to 9 years; and 10.4% (70/671) were 10 to 16 years old. The distribution of cases by age group varied slightly according to the type (A or B) of influenza. Among the hospitalizations due to influenza A, there was a larger proportion of cases under 2 years of age compared to influenza B (51.0% vs. 29.5% respectively). Subsequently, there was a larger proportion of cases between 5 and 16 years of age among the hospitalizations due to influenza B than those due to influenza A (38.6% vs. 21.3% respectively).

The median delay between symptom onset and hospitalization was 3 days (mean=3.4 days) and the median length of stay in the IMPACT hospital for the cases was 3 days (mean=4.9 days). Of the 671 cases, 53.2% (357) had at least one underlying medical condition and 4.2% (28) had a secondary bacterial co-infection. Immunization history was obtained for 70.6% (474) of the 671 cases. Of those, 6.5% (31/474) were immunized against influenza for the 2010-2011 season. Antiviral treatment for influenza was given to 19.2% (129/671) of the cases while antibiotic therapy was given in hospital to 76.0% (510/671) of the cases.

Analysis of the 2010-2011 season IMPACT data revealed 23 cases of influenza complicated by myositis, a condition affecting skeletal muscles. Of the 23 cases, 4 were associated with influenza A (two of which were A/H3N2, the other two were not subtyped) and 19 with influenza B. Of the 23 cases, 30.4% (7) were <5 years of age, 52.2% (12) were between 5 to 9 years of age, and 17.4% (4) were between 10 to 16 years of age. Seventy percent (16) of the 23 cases were unvaccinated, one case (with influenza B) was vaccinated, while vaccination status was unknown for the remaining 6 cases.

Of the 671 hospitalizations, 12.7% (85) were admitted to an intensive care unit (ICU). The median length of stay (LOS) in ICU was 3 days (mean=6.9). Approximately 63.5% (54/85) of those admitted to ICU had at least one underlying medical condition. The distribution of cases requiring ICU admission by influenza type was as follows: 72.9% were due to influenza A (and of those further sub-typed, 77.8% were due to influenza A/H3 and 22.2% were due to influenza A/H1) and 27.1% were due to influenza B.

Five influenza-associated paediatric deaths were reported through IMPACT during the 2010-2011 season and an additional death may have succumbed to co-morbid conditions. All five influenza related deaths had underlying medical conditions. Three deaths were due to influenza A infection (two with A/H1 and one with A/H3 infection) and two were due to influenza B. Four cases were not vaccinated for the 2010-2011 season's vaccine and one case had an unknown vaccination history. Antiviral treatment for influenza was given to four of the five cases and antibiotic therapy was provided to all five. Three of the deaths were in children 6 to 23 months of age; one was in a child between 2 to 4 years of age and the other was in a child between 10 to 16 years old.

Influenza-associated adult hospitalizations reported by CNISP

During the 2010-2011 influenza season, a total of 831 community-acquired influenza-associated adult (≥16 years) hospitalizations were reported through CNISP of which 90.7% (754) were due to influenza A and 9.3% (77) were due to influenza B. Of the 754 hospitalizations due to influenza A, 42.2% (318) were influenza A/H3N2, 9.0% (68) were influenza A/H1N1 and 48.8% (368) were unsubtyped influenza A. An additional 273 hospitalizations with influenza were reported; however, the infections were either healthcare-associated (nosocomial, n=255) or source of infection unknown (n=18) as opposed to community-acquired influenza infections. Only details on the 831 community-acquired influenza hospitalizations will be provided in this report.

The first hospitalization was reported in late September 2010 due to influenza A and the last hospitalization was reported in early May 2011 due to influenza B. The peak period for influenza A hospitalizations occurred between late December 2010 and early January 2011; while the peak period for influenza B hospitalizations occurred from mid- to late March 2011.

The distribution of hospitalized cases by age group was as follows: 2.8% (23/831) were aged 16 to 24 years; 15.0% (125/831) aged 25 to 44 years; 20.5% (170/831) aged 45 to 64 years; and 61.7% (513/831) aged 65 years and older. The distribution of cases by age group varied slightly according to the type (A or B) and sub-type (A/H1 or A/H3) of influenza infection. The majority of influenza A and B cases were in those 65 years and over; however those infected with influenza A represented 63.4% (478/754) and those with influenza B only 45.5% (35/77). The proportion of cases in the younger age groups was higher among the influenza B cases than those with influenza A. Age and sub-type information were available for 386 (68 A/H1 and 318 A/H3) influenza A cases. The largest proportion of influenza A/H1 cases were in those 45 to 64 years of age (36.8%) and the smallest in those 16 to 24 years of age (10.3%). Of the influenza A/H3 cases, the largest proportion was in those 65 years and older (73.6%) and the smallest in those 16 to 24 years of age (2.2%).

Of the 831 adult hospitalizations, 87.1% (724) had at least one underlying medical condition. The median length of stay (LOS) in hospital for the cases was 5 days (mean=8 days). Immunization information was obtained from 38.1% (317) of the 831 cases; of those, 43.2% (137/317) received the 2010-2011 season influenza vaccine.

Fourteen percent (118/831) of cases required admission to ICU for complications or symptoms associated with influenza. The median LOS for those admitted to ICU was 8 days (mean=9). Approximately 45.8% (54/118) of those admitted to ICU were 65 years of age and older and 84.7% (100/118) had at least one underlying medical condition. The distribution of cases requiring ICU admission by influenza type and/or sub-type was similar to the distribution observed for all of the hospitalized cases.

Patient outcome at one month post-infection was obtained for all 831 cases. Among those, 41 deaths were reported for which influenza was identified as the primary cause of death or influenza was confirmed to have contributed to the death (attributable to influenza). Of the 41 deaths, the large majority (70.7%) were in adults 65 years and older. Of the 41 cases who died, 95.1% (39) had at least one underlying medical condition. In addition, of the 255 healthcare-associated influenza cases reported, there were 24 deaths that were attributable to influenza.

Assessment of International Influenza Activity

International

Northern Hemisphere Influenza Season (October 2010 - April 2011)[1]

Influenza virus transmission peaked in temperate North America during late January and early February 2011, and returned to national baseline levels by the end of April. Influenza A(H3N2) was the most common virus circulating in Canada, the USA, and Mexico; however influenza B and influenza A(H1N1)pdm09 viruses were also circulating. Increased influenza activity in Europe and the Middle East first became evident in December 2010. Transmission peaked in western Europe during late January and early February 2011 and peaked 2-3weeks later in eastern Europe. In contrast with North America, the predominant virus causing illness in Europe and the Middle East was influenza A(H1N1)pdm09; influenza B was less common, and influenza A(H3N2) was rare. The influenza season in the northern temperate areas of Asia began during late October and early November 2010, and peaked by the end of December 2010. Both influenza A(H3N2) and influenza A(H1N1)pdm09 viruses circulated in Northern Asia; however the predominance of each varied by country; only a small number of influenza B cases were reported.

During the 2010–2011 season circulation occurred during the expected time frame, and no out-of-season community transmission was reported in temperate northern countries. Influenza A(H1N1)pdm09 viruses continued to be more pathogenic for young adults and middle-aged adults, while influenza A(H3N2) viruses caused more severe disease in people aged >65 years. Influenza B viruses appeared to affect young children disproportionately. Overall, 99% of influenza A(H1N1)pdm09 viruses and 96% of influenza A(H3N2) viruses characterized antigenically were related to the strains contained in the 2010-2011 trivalent seasonal influenza vaccine. Approximately 91% of influenza B viruses were of the Victoria lineage, a small percentage of which had low cross-reactive antibody titres to B/Brisbane/60/2008; the remainder were of the Yamagata lineage. These proportions did not vary substantially from region to region. In addition, all but a small percentage of the viruses that were tested remained sensitive to neuraminidase inhibitors.

Southern Hemisphere Influenza Season (January - September 2011)[2]
Active influenza transmission in the southern cone of South America was first noted during mid-late May 2011, peaked between mid-late July, and returned to baseline levels by the end of September. The predominant influenza A virus circulating in the southern cone differed among countries; and influenza B was detected only rarely. The overall severity of influenza during the season in the southern cone was relatively mild. In South Africa, active transmission was first noted at the beginning of May 2011, then peaked in the beginning of June which was then followed by a smaller peak in late August, and returned to low levels by the end of September. Influenza A(H1N1)pdm09 virus was the predominant influenza subtype associated with the first peak in activity while the secondary peak was primarily associated with influenza A (H3N2) and influenza B viruses. In Australia, active transmission of influenza was first noted in July, peaked in early August and remained slightly increased in September 2011 but seemed to be returning to baseline. The predominant virus in Australia was influenza A(H1N1)pdm09 which co-circulated with relatively low levels of influenza B viruses. In contrast, influenza B viruses predominated in New Zealand.

Overall, the 2011 influenza season in the southern hemisphere was mild. The vast majority of influenza A(H1N1)pdm09 viruses and influenza A(H3N2) viruses characterized antigenically were related to the viruses contained in the trivalent seasonal influenza vaccine for the 2011 season. Overall, 72% of the influenza B viruses analysed between March and August 2011 were from the B/Victoria lineage (included in the vaccine) and only 28% were from the B/Yamagata lineage. Antiviral resistance among influenza A(H1N1)pdm09 viruses remained low, although reports of cases with resistance in the absence of exposure to antiviral medications appear to be increasing.

United States[3]
During the 2010-2011 influenza season, influenza activity first began to increase in the southeastern United States, and peaked nationally in early February. Between October 3, 2010 and May 21, 2011, 246,128 specimens were tested for influenza viruses of which 22% (54,226) were positive. Of the positive specimens, 74% (40,282) were influenza A viruses, and 26% (13,944) were influenza B viruses. Among the influenza A viruses, 71% (28,545) were subtyped; 62% (17,599) were influenza A (H3N2) viruses, and 38% (10,946)

were 2009 influenza A (H1N1) viruses. Although influenza A (H3N2) viruses predominated, influenza A (H1N1)pdm09 and influenza B viruses also circulated widely. The relative proportion of each type and subtype of influenza virus varied by region and week.

From October 1, 2010 to May 21, 2011, the CDC antigenically characterized 2,494 influenza viruses, including 613 influenza A(H1N1)pdm09 viruses, 1,139 influenza A (H3N2) viruses, and 742 influenza B viruses. Of the 613 influenza A(H1N1)pdm09 viruses tested, 99.8% (612) were characterized as A/California/7/2009-like and 0.2% (1) showed reduced titers with antiserum produced against A/California/7/2009. Of the 1,139 influenza A (H3N2) viruses, 96.8% (1,103) were characterized as A/Perth/16/2009-like and 3.2% (36) showed reduced titers with antiserum produced against A/Perth/16/2009. Of the 742 influenza B viruses tested, 94.2% (699) belonged to the B/Victoria lineage and 5.8% (43) belonged to the B/Yamagata lineage. Of the 699 B/Victoria lineage viruses, 99.9% (698) were characterized to be B/Brisbane/60/2008-like and 0.1% (1) showed reduced titers with antisera produced against B/Brisbane/60/2008.

In addition, a total of 5,758 influenza virus specimens were tested for antiviral resistance. All 723 influenza B viruses tested were sensitive to both oseltamivir and zanamivir. All of the influenza A(H1N1)pdm09 (n=771) and influenza A(H3N2) (n=784) viruses tested were sensitive to zanamivir. Of the 806 influenza A (H3N2) viruses tested, 0.2% (2) were resistant to oseltamivir. Of the 4,229 influenza A(H1N1)pdm09 viruses tested, 0.9% (39) were resistant to oseltamivir. High levels of resistance to the adamantanes (i.e., amantadine and rimantadine) persisted among influenza A(H1N1)pdm09 and influenza A(H3N2) viruses that were circulating globally during the 2010-2011 season.

From 3 October 2010 to 21 May 2011, 105 laboratory-confirmed influenza-associated paediatric deaths were reported of which 38% (40) were associated with influenza B viruses, 26% (27) with influenza A(H1N1)pdm09 viruses, 17% (18) with influenza A (H3N2) viruses, and 19% (20) with influenza A viruses for which the subtype was not determined. The distribution by age group of the pediatric deaths were as follows: 14% (15) were aged <6 months, 13% (14) were aged 6-23 months, 16% (17) were aged 2-4 years, 29% (30) were aged 5-11 years, and 28% (29) were aged 12-17 years.

Human Avian Influenza

From 1 September 2010 to 31 August 2011, the World Health Organization (WHO) reported a total of 60 cases (31 fatal) of human infection with avian influenza A(H5N1) from five countries (number of cases (number of deaths)): Bangladesh – 2(0), Cambodia – 8(8), China – 1(0), Egypt – 39(16) and Indonesia – 10(7). From 2003 to the end of August 2011, a total of 565 cases have been reported (of these 331 have died - 59% fatality) from the following countries: Vietnam, Thailand, Cambodia, Indonesia, Azerbaijan, China, Djibouti, Egypt, Iraq, Turkey, Nigeria, Lao People's Democratic Republic, Myanmar, Pakistan, and Bangladesh.[4]

A general epidemiologic summary of the cases from 2003 to the end of 2010 (n= 516) was provided by the WHO.[5] Overall, women seem to have a worse outcome than men, and the disease appears more likely to be mild in children. Children and young adults seem to be more frequently diagnosed with the infection, although the median age increased in 2010. In addition, early hospitalization was found to have a positive impact on survival. Most human cases are exposed through direct or indirect contact with poultry or contaminated environments; and the exposures that result in symptomatic infection happen almost exclusively in households or markets rather than in association with commercial poultry. The influenza A(H5N1) virus remains an avian virus that has not substantially changed in its zoonotic behaviour since emerging. There are no signs of increasing antiviral resistance to oseltamivir in influenza A(H5N1) viruses or reassortment with any of the circulating human influenza viruses. Despite continued widespread circulation of the influenza A(H5N1) virus in poultry in some countries, human infections with virus remains uncommon and sporadic and there continues to be no evidence of sustained human-to-human transmission.

Human Swine Influenza in the United States

Swine influenza viruses do not normally infect humans; however, sporadic human infections with influenza viruses that normally circulate in swine have occurred.[6] During the 2010-2011 influenza season, five cases of human infection with a novel swine-origin influenza A virus were reported in the United States from three states (2 from Pennsylvania, 1 from Wisconsin and 2 from Minnesota). The cases occurred between September and November 2010. All five cases were infected with swine-origin influenza A (H3N2) viruses. Two of the five cases occurred in adults, and three occurred in children. Two of the five cases were hospitalized and all five have recovered fully from their illness. The case in Wisconsin and the two cases from Pennsylvania (who were not related) had direct contact with swine or lived in areas close to swine farms. The two cases from Minnesota occurred in a father (index case) and child. The father had direct swine exposure 6 days prior to illness onset. The child did not have direct swine exposure and most likely acquired infection from close contact with her father. Other persons in the same household also had ILI during the same period, but serologic results were either negative or inconclusive.[1]

Discussion

Overall, surveillance data collected during the 2010-2011 influenza season indicate that the influenza season was mild to moderate in severity. Seasonal influenza A (H3) viruses predominated throughout the season and some influenza B viruses were circulating towards the end. The peak period for influenza activity occurred between late December 2010 to late January 2011 based on the majority of influenza indicators (i.e. laboratory detections, ILI, influenza-associated hospitalizations and outbreaks in long-tern care facilities). However, the peak period for the reporting of higher influenza activity levels occurred later in the season (between mid-February and mid-March 2011) because of increased reports of outbreaks in both schools and long-term care facilities during this period.

During the 2010-2011 season, there were a total of 17,573 influenza cases detected and reported which is less than the average reported during the 2008-2009 and 2009-2010 seasons when the pandemic of 2009 occurred (average = 31,200 cases) but greater than the average number of cases reported in the previous three seasons prior to the pandemic (average = 9,270 cases from 2005-2007 seasons). The influenza testing rate for the 2010-2011 season (413 influenza tests per 100,000 population) was significantly lower than the rate observed during the pandemic period (956 per 100,000) but similar to the rate during the 2007-2008 season (379 per 100,000). Although part of the increase in the number of influenza cases identified in 2010-2011 may have been caused by an increase in testing practices and changes to laboratory testing protocols over time, it most likely only accounts for a small proportion of the increase in cases observed. It appears that there was a true increase in the number of influenza cases identified in the 2010-2011 season compared to previous seasons prior to the pandemic of 2009.

Influenza A(H3N2) viruses predominated in the 2010-2011 influenza season, unlike in the previous 2 seasons where seasonal influenza A(H1N1) viruses predominated and in the 2007-2008 season where influenza B and influenza A (mostly H1N1) viruses co-circulated. Similarly, a greater proportion of cases among the elderly ($\geq$65 years old) and the very young (<5 years old) was observed this season compared to the previous three seasons which is similar to the distribution observed in other seasons where influenza A(H3N2) predominated. The greater proportion of cases observed among the elderly is also reflected in the increase in number of long-term care facility (LTCF) outbreaks reported in the 2010-2011 season (n=314) compared to the previous two seasons (range: 57-153 outbreaks). In contrast, the number of school outbreaks reported in the 2010-2011 season (n=158) was considerably less than the number reported in the previous season (n=2,638) where influenza A(H1N1)pdm09 predominated and slightly lower than the average number reported over the 2006-2008 seasons (average per year = 192). The findings are also reflected in the smaller proportion of influenza cases in school-aged children in the 2010-2011 season compared to previous seasons since 2006-2007.

Of the 1,021 viruses that were antigenically characterized in the 2010-2011 season, only a small proportion (3.7%) either showed reduced titers with antiserum produced against the viruses included in the 2010-2011 season influenza vaccine or belonged to a different lineage than that included in the season's vaccine. Rates of resistance among circulating influenza A(H3N2) and A(H1N1)pdm09 viruses to amantadine have remained high over the past three seasons (range: 99.9-100.0%). However, rates of resistance among circulating influenza A(H3N2), A(H1N1)pdm09 and B viruses have remained low over the same period (range: 0.1-1.1% for oseltamivir and 0.0-0.1% for zanamivir).

During the 2010-2011 season, a total of 671 influenza-associated paediatric hospitalizations were reported through the IMPACT network. This was less than the average number reported during the pandemic seasons (2008-2009 to 2009-2010, mean per year for the two years=857.5), but a 38% increase over the average number of hospitalizations reported during the 2005 - 2007 seasons (average per year over the three seasons=414). The number of IMPACT hospitals, it's surveillance protocols and laboratory testing procedures during the 2010-2011 season were similar to those from the 2005-2007 seasons; therefore the observed increase in the 2010-2011 season appears to be a true increase in the number of children requiring hospitalization from infection with the circulating influenza strains.

Limitations

The following limitations should be considered when interpreting results from the FluWatch influenza surveillance program:

1. Laboratory testing protocols have varied in the seasons prior to, during, and post pandemic. For example, there were jurisdictional variations with regards to: provisions on the number and timing of samples/tests sent for testing; methods for laboratory detection (i.e. via panel tests, culture, etc.); use of targeted (i.e. severe cases or those related to an outbreak) versus community-based testing. Therefore comparisons of laboratory findings (i.e. percent positive and number of positive laboratory-confirmed cases) over time and differences in findings between jurisdictions need to be interpreted in light of these differences.

2. Although 5.8% of the total number of influenza virus detections in Canada for the 2010-2011 season were characterized by the NML, the distribution of strain information is not necessarily consistent with the distribution of positive influenza detections by influenza type/sub-type (i.e. 57.4% of the strains characterized were for influenza B viruses even though influenza B virus detections only represented 15.5% of total influenza virus detections for the season) or by Province/Territory (i.e. 46.9% of the viruses characterized were from Ontario while fewer than 1% were from Newfoundland and Labrador, Prince Edward Island, Nova Scotia, Manitoba, and the Territories).

3. Age-specific data may be affected by biases in health care utilization and physician testing behaviour. For example, ILI surveillance does not capture influenza activity occurring in the elderly in long-term care facilities, children who visit paediatricians and the majority of consultations that occur in emergency departments and after-hours clinics. Also, ILI consultation rates across time may vary with sentinel participation and coverage rates as well as co-circulation of other respiratory viruses.

4. Most of the data provided to the FluWatch program come from sentinel data sources (i.e. provincial public health and hospital-based laboratories, physicians who report ILI, and hospitals that provide hospitalization data); therefore the data presented here may not reflect the true number of individuals affected by influenza in the population.

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Authors: *F. Domingo[1] (MHSc), B. Winchester[1] (MSc), S. Aziz[1] (MSc), C. Sevenhuysen[1] (MSc), M. Sumner[1] (MA), Y. Li[2] (PhD), N. Bastien[2] (PhD), J. Bettinger[3] (PhD, MPH), R. Mitchell[4] (MHSc), H. Akwar[1] (DVM PhD).*
[1]Centre for Immunization and Respiratory Infectious Diseases (CIRID), Public Health Agency of Canada (PHAC), Ottawa, Ontario
[2]Influenza and Respiratory Viruses Section, National Microbiology Laboratory, PHAC, Winnipeg, Manitoba
[3]University of British Columbia, BC Children's Hospital, Department of Pediatrics, Vancouver, British Columbia (for the Canadian Immunization Monitoring Program Active, IMPACT)
[4]Centre for Communicable Diseases and Infection Control, PHAC, Ottawa, Ontario (for the Canadian Nosocomial Infection Surveillance Program, CNISP)