

## Influenza

Influenza surveillance is conducted year-round in BC, with renewed annual monitoring typically commencing in the first week of October (week 40) and ongoing through the end of September (week 39). This report summarises surveillance data for the 2018-19 influenza season, spanning week 40 (starting October 1, 2018) through week 17 (ending April 27, 2019).

Influenza surveillance in BC consists of monitoring trends in influenza activity and circulating viruses to inform prevention and control programs, including vaccine effectiveness. Surveillance indicators for influenza and influenza-like illness (ILI) monitoring include: (1) sentinel practitioner ILI reporting; (2) BC Children's Hospital emergency room visits attributed to ILI; (3) Medical Service Plan (MSP) visits with a clinical diagnosis of influenza illness; (4) facility and school outbreak notifications; (5) provincial influenza laboratory diagnosis by the BCCDC Public Health Laboratory (PHL) and BC Children's and Women's Health Centre Laboratory; and (6) strain characterization and antiviral resistance testing by the National Microbiology Laboratory (NML) at the Public Health Agency of Canada.

Since 2004, the BCCDC has led a national surveillance initiative to monitor annual vaccine effectiveness (VE) against medically attended, laboratory-confirmed influenza, using a test-negative case-control design overlaid upon the national Sentinel Practitioner Surveillance Network (SPSN). Additional phenotypic and genetic characterization of circulating viruses is conducted to inform VE analysis and interpretation.

Detailed surveillance bulletins are issued throughout the year, distributed weekly or bi-weekly during the influenza season and periodically during inter-seasonal months, and are available from: <http://www.bccdc.ca/health-professionals/data-reports/communicable-diseases/>

[influenza-surveillance-reports](#).

### SUMMARY

The 2018-19 influenza season in BC was characterised by unusually prolonged activity, distinguished by two successive waves of influenza A: an early primary epidemic due to A (H1N1) pdm09 peaking in late December/early January followed by an atypical secondary wave of A (H3N2) that peaked in March. Also unusual was the very low level of influenza B detection throughout the 2018-19 season compared to previous seasons. This profile is in contrast to the 2017-18 season which was comprised of dominant influenza A (H3N2) and early influenza B (Yamagata) co-circulation.

Influenza activity remained at elevated levels above historical averages for an extended period of time this season. Among respiratory specimens submitted for influenza testing at the BCCDC Public Health Laboratory (PHL) and select external sites, the proportion of respiratory specimens testing influenza positive peaked twice, with about one third testing influenza positive in each of weeks 1 and 11. This corresponds with the unusual bi-modal influenza A epidemic this season including predominant circulation of A (H1N1) pdm09 viruses during the first wave, followed by predominant A (H3N2) viruses during the second lesser wave. Community influenza-like illness (ILI) activity began to increase around early December (weeks 49-50) and peaked twice in late December/early January (weeks 52-2) and in March (week 11). Activity gradually declined thereafter; however, levels remained elevated into April. Cumulatively, from week 40 to week 17, 94 laboratory-confirmed influenza outbreaks in long-term care facilities (LTCFs) were reported. The cumulative tally of LTCF outbreaks during this season of greater A (H1N1) pdm09 contribution is lower than that of the prior two A (H3N2)-domi-

nant seasons (where 179 and 198 outbreaks were reported in 2017-18 and 2018-19, respectively). Notably, the majority of outbreaks were accrued in the latter half of the current season, consistent with the secondary wave of A (H3N2) activity. This season, around 80% of all A (H1N1) pdm09 detections were reported in individuals younger than 65 years of age. Children were particularly affected by the A (H1N1) pdm09 epidemic: 21% of A (H1N1) pdm09 detections were observed among children  $\leq 9$  years who comprise about 10% of the BC population. Conversely, the majority (57%) of A (H3N2) detections were among elderly adults 65 years of age and older who otherwise comprise  $<20\%$  of the BC population.

Interim and end-of-season estimates from the BCCDC-led Canadian Sentinel Practitioner Surveillance Network (SPSN), suggest the 2018-19 northern hemisphere influenza vaccine provided substantial protection against circulating A(H1N1)pdm09 viruses; conversely, the vaccine provided little or no protection against late-season A(H3N2) viruses overall and particularly among working-age adults. SPSN investigators also reported that children under 10 years of age were more affected during the primary 2018-19 influenza A(H1N1)pdm09 epidemic compared to prior seasonal epidemics in Canada.

### 1. Sentinel practitioner reporting of ILI

During the 2018-19 season (week 40 to week 17), 24 active sentinel sites (with one or more contributing practitioners at each site) representing all regional health authorities in BC contributed to sentinel ILI surveillance. On average, 87% of sites reported data each week with some expected variation in timeliness and completeness, such as during holiday periods. The rate of ILI among patients presenting to these sentinel sites trended within or below 10-year historical averages for much of the season ([Figure 21.1](#)). However,

during the latter stages a resurgence in the proportion of patients visits due to ILI was observed, with rates exceeding historical averages in weeks 11 through 15.

### 2. BC Children's Hospital emergency room visits attributed to ILI

The proportion of visits to BC Children's Hospital Emergency Room attributed to ILI (based on records with a triage chief complaint of "flu" or "influenza" or "fever/cough") peaked twice during the 2018-19 season in week 52 (29%) and week 11 (23%) ([Figure 21.2](#)). ILI rates exceeded historical norms throughout much of the season and remained elevated at season close (week 17).

### 3. MSP visits with an influenza diagnosis

BC Medical Services Plan (MSP) general practitioner claims with a clinical diagnosis of influenza illness (ICD-9 code 487), as a proportion of all submitted MSP claims, peaked twice during the 2018-19 season with the primary peak observed around week 52 and a secondary peak observed around week 12 ([Figure 21.3](#)). Overall, provincial MSP rates exceeded expected seasonal values during both peak periods, and remained elevated for a prolonged period compared to historical data for the past 10 years. Some expected regional variation in the timing and intensity of influenza illness activity was observed across health authorities, notably in the Interior Health Authority and Northern Health Authority where sharper primary peaks were observed, exceeding 10-year maximums.

### 4. Facility outbreak notifications

Residential facilities, such as long-term care facilities (LTCFs), are asked to notify their local health unit when two or more cases of ILI occur within their setting over a 7-day period. Influenza out-

breaks are defined as ILI outbreaks with at least one specimen laboratory-confirmed as influenza. Schools are asked to report when absenteeism, mostly likely due to ILI, is greater than 10% on any one day; school ILI outbreaks are generally reported without laboratory confirmation. Provincial reporting of ILI outbreaks to the BCCDC is at the discretion of the local Medical Health Officer/health authority and varies regionally, with less consistent reporting for school ILI outbreaks (few health authorities routinely contributing), acute care facility outbreaks and facility outbreaks where non-influenza respiratory viruses were detected. Provincial reports of ILI outbreaks are not generally audited to verify that patients met specific clinical criteria.

During the 2018-19 season (week 40 to week 17), 94 laboratory-confirmed influenza outbreaks in LTCFs were reported to the BCCDC. Of the 94 LTCF outbreaks reported, 92 were attributed to influenza A and 2 to influenza B. Of the 57 out of 92 influenza A outbreaks where subtype information was available, 39 (68%) were influenza A (H3N2) and 18 (32%) were A (H1N1) pdm09. The majority (62/94; 66%) of LTCF outbreaks were accrued between weeks 8 and 14, consistent with the observed secondary wave of A (H3N2) activity which peaked around weeks 11 and 12 in BC ([figure 21.4](#)).

The cumulative tally of LTCF outbreaks this A (H1N1) pdm09-dominant season remains far below that of the prior two seasons which were dominated by A (H3N2) (94, 182 and 198 outbreaks, respectively) ([Figure 21.5](#)). The number reported this season of mixed influenza A subtype circulation is the fourth highest for the same period of the past 16 seasons (since the 2003-04 season).

In addition to LTCF outbreak reports, 21 ILI outbreaks were reported from acute care facilities, 34

from schools, 1 from a correctional facility, and 1 from a mental health facility during the 2018-19 season (week 40 to week 17).

## 5. Laboratory diagnosis

### a. BCCDC Public Health Laboratory

The BCCDC Public Health Laboratory (PHL) routinely conducts testing for influenza and other respiratory viruses on specimens collected from inpatients at pediatric and acute care hospitals, residents of healthcare facilities associated with outbreaks, and patients presenting to community-based sentinel sites, or where otherwise clinically indicated or specifically requested. This includes specimens diagnosed with influenza A at other hospital/regional laboratories that are submitted to BCCDC PHL for influenza A subtyping. All submitted specimens are routinely tested for influenza A and B and respiratory syncytial virus (RSV), while testing for other respiratory viruses is conducted less systematically and only on a subset of influenza and RSV negative specimens. With expanded influenza testing by additional laboratories across BC this season, adjustments to percentage influenza positivity derivation were required and are summarized here based on primary specimens submitted for influenza testing at the BCCDC PHL and other external sites that shared complete testing data with the BCCDC PHL.

During the 2018-19 season (week 40 to week 17), of 16,319 specimens tested for influenza across BC, 3993 (24%) tested positive for influenza A and just 168 (1%) tested positive for influenza B. Virtually all (96%) influenza detections were therefore influenza A. Influenza A positivity began to increase in week 46, peaking twice in weeks 1 and 11 (35% and 34%, respectively) ([Figure 21.6](#)). Influenza A (H1N1) pdm09 viruses comprised the vast majority of detections during the first peak

period, while the second peak was attributed to influenza A (H3N2) viruses ([Figure 21.6](#)). Influenza B positivity remained low (0-4%) throughout the season.

Among influenza viruses typed at the BCCDC PHL this season, virtually all (97%) were influenza A. Influenza A (H1N1) pdm09 viruses predominated from October to mid-February, and accounted for 60% of subtyped influenza A viruses overall since season start. However, since mid-February (week 7), A (H3N2) viruses comprised a greater share of influenza A detections.

Children  $\leq 9$  years old were disproportionately represented among influenza A (H1N1) pdm09 detections during the 2018-19 season (21% of detections despite comprising 10% of the BC population<sup>1</sup>) ([Figure 21.7](#) and [21.8](#)). Conversely, the majority (58%) of A (H3N2) detections have been among elderly adults  $\geq 65$  years of age, despite comprising about 18% of the BC population<sup>1</sup>.

Among other respiratory viruses detected, respiratory syncytial viruses were the most commonly detected virus (excluding influenza) for the majority of the season (weeks 52 to 14). Enteroviruses/rhinoviruses were also detected throughout the season, most notably at the beginning of the season (weeks 40-47) before influenza activity began to increase.

#### b. BC Children's and Women's Health Centre Laboratory

During the 2018-19 season (week 40 to week 17), the BC Children's and Women's Health Centre Laboratory conducted 2,630 tests for influenza A and B. Of these, 364 (14%) were positive for influenza A and 31 (1%) were positive for influenza B. Influenza A therefore accounted for the vast majority

(92%) of influenza detections. Influenza A positivity peaked twice in week 1 (24%) and between weeks 9 and 12 (~26%), while influenza B activity fluctuated at very low levels during the latter half of the season only (weeks 4-17), peaking at 6% in week 11 ([Figure 21.9](#)).

RSV was the dominant respiratory virus detected at the BC Children's and Women's Health Centre Laboratory, with 398 out of 2577 (15%) tests positive cumulatively during the season. RSV co-circulated with influenza A throughout the season, with percent positivity peaking in week 52 at 32%.

#### c. Strain characterisation by the National Microbiology Laboratory

Select influenza isolates have historically been sent by the BCCDC PHL to the National Microbiology Laboratory (NML) for strain characterisation by haemagglutination inhibition (HI) assay. More recently, however, HI characterization has become more challenging and difficult to interpret, especially for A (H3N2) viruses. Recognizing that, only a small proportion of BC viruses were submitted for HI characterization and/or could be successfully characterised antigenically (or genetically) (n=38). Here we have therefore summarised HI characterisation findings based on viruses submitted to the NML from all provinces.

From September 1, 2018, to April 25, 2019, the NML characterised 2006 influenza viruses [353 A (H3N2), 1553 A (H1N1) pdm09 and 100 B (23 Yamagata lineage and 77 Victoria lineage)] received from Canadian laboratories.

Of the 1553 influenza A (H1N1) pdm09 viruses characterised, 1510 (97%) were considered antigenically similar to an A/Michigan/45/2015-like virus: the WHO-recommended influenza A (H1N1) component of the 2018-19 northern

<sup>1</sup> Government of British Columbia, BC Stats. Population Estimates 2017. URL: <https://www.bcstats.gov.bc.ca/apps/PopulationEstimates.aspx>.

hemisphere influenza vaccine. However, 43 (3%) viruses showed reduced titer with ferret antisera raised against cell culture-propagated A/Michigan/45/2015.

Of the 353 influenza A (H3N2) viruses, only 189 (54%) had sufficient haemagglutination titre for successful antigenic characterisation by HI assay. Of these viruses, 111 (59%) were considered antigenically similar to an egg-propagated A/Singapore/INFIMH-16-0019/2016-like virus, the WHO-recommended A (H3N2) component of the 2018-19 northern hemisphere influenza vaccine. However, 78 (41%) viruses showed reduced titer with ferret antisera raised against egg-propagated A/Singapore/INFIMH-16-0019/2016.

Of 329 A (H3N2) viruses successfully sequenced, 38 (12%) belonged to genetic group (clade) 3C.2a, 210 belonged to genetic group 3C.2a1 (64%), and 81 (25%) belonged to genetic group 3C.3a. The 2018-19 northern hemisphere influenza vaccine included a clade 3C.2a1 virus.

Of the 100 influenza B viruses characterised, 23 (23%) belonged to the B(Yamagata) lineage and 77 (77%) to the B(Victoria) lineage. All of the B(Yamagata) viruses were considered antigenically similar to a cell-culture passaged B/Phuket/3073/2013-like virus. Among the 77 B(Victoria) viruses, 16 (21%) were antigenically similar to a cell-culture passaged B/Colorado/06/2017-like virus while 61 (79%) viruses showed reduced titre with ferret antisera raised against cell culture-propagated B/Colorado/06/2017.

For context, the WHO-recommended components of the 2018-19 and upcoming 2019-20 northern hemisphere trivalent (TIV) and quadrivalent (QIV) vaccines are listed below. Note that all influenza vaccines used in Canada are based on egg-propagated viruses that may not be identical to the WHO-recommended vaccine strains:

2018-19*	2019-20**
A/Michigan/45/2015 (H1N1) pdm09-like virus	an A/Brisbane/02/2018 (H1N1) pdm09-like virus §
A/Singapore/IN-FIMH-16-0019/2016 (H3N2)-like virus †	A/Kansas/14/2017 (H3N2)-like virus §
B/Colorado/06/2017-like virus (Victoria lineage) ‡	B/Colorado/06/2017-like virus (Victoria lineage)
B/Phuket/3073/2013-like virus (Yamagata lineage) [QIV only]	B/Phuket/3073/2013-like virus (Yamagata lineage) [QIV only]

\* Recommended strains represent a change for two of the three components used in the 2017-18 northern hemisphere TIV.

† Recommended strain represents a change from the 2017-18 season vaccine which contained an A/Hong Kong/4801/2014 (H3N2)-like virus .

‡ Recommended strain represents a change from the 2017-18 season vaccine which contained a B/Brisbane/60/2008-like virus (Victoria lineage).

\*\* Recommended strains represent a change for two of the three components used in the 2018-19 northern hemisphere TIV

§ Recommended strain represents a change from the 2018-19 season vaccine.

#### d. Antiviral resistance assessment by the National Microbiology Laboratory

Among influenza isolates submitted to the NML for HI characterization, selected viruses are also tested for antiviral drug susceptibility. Since BC contributed few viruses for characterization this season, we have summarized findings below based on viruses submitted to the NML from all provinces for the period September 1, 2018 to April 25, 2019.

Of the 428 influenza A viruses [77 A (H3N2), 351 A (H1N1) pdm09] tested against amantadine, all were resistant.

Of the 1183 influenza viruses [134 A (H3N2), 989 A (H1N1) pdm09, and 60 B] tested against oseltamivir, 1179 were sensitive, and 4 A (H1N1) pdm09 viruses with an H275Y mutation were resistant.

Of the 1182 influenza viruses [134 A (H3N2), 988 A (H1N1) pdm09, and 60 B] tested against zanamivir, all were sensitive.

## 6. Sentinel influenza vaccine effectiveness monitoring

Mid-season estimates of influenza vaccine effectiveness (VE) against the primary A(H1N1)pdm09 epidemic were published by the BCCDC-led Canadian Sentinel Practitioner Surveillance Network (SPSN). Given the bimodal nature of the 2018-19 influenza A epidemic, VE against both A(H1N1)pdm09 and A(H3N2) viruses could be reported in end-of-season analyses. For all sets of analyses, respiratory specimens and epidemiological information were collected from patients presenting with ILI to SPSN sites in British Columbia, Alberta, Ontario, and Quebec and VE estimates were based on the test-negative design as per usual.

Based on data collected between November 1, 2018, and April 30, 2019, VE against any influenza, foremost driven by A(H1N1)pdm09 viruses, was 56% (95% CI: 47-64%), and for A(H1N1) pdm09 alone was 67% (95% CI: 58-75%). This substantial protection against A(H1N1)pdm09 was observed in all age groups. Conversely, the SPSN reported little or no vaccine protection against A(H3N2) viruses, with an overall VE against medically-attended outpatient A(H3N2) illness of 17% (95% CI: -13-39). VE was particularly low among working-age adults 20-64 years old who comprise the majority of SPSN participants (VE of -7%; 95% CI: -56-26%). Overall, the A(H3N2) VE estimate for 2018-19 was lower than

expected generally for A(H3N2) vaccines (~30%), and similar to that observed in the 2017-18 A(H3N2)-dominant season where VE was estimated at 15% (95% CI: -6-32).

As in the past several years, SPSN mid-season findings were submitted to the WHO in February 2019 to support vaccine strain selection for the 2019-20 northern hemisphere influenza vaccines. End-of-season findings are also being shared with the WHO in September 2019 to support vaccine strain selection for the 2020 southern hemisphere influenza vaccines.

Mid-season findings by the Canadian SPSN were published in *EuroSurveillance*, an open-access, online, peer-reviewed journal, on January 24, 2019: <https://www.eurosurveillance.org/content/10.2807/1560-7917.ES.2019.24.4.1900055>.

Late-season, updated, 2018-19 interim VE estimates were disseminated via the weekly reports produced by FluWatch (included in reports distributed since week 14): <https://www.canada.ca/en/public-health/services/diseases/flu-influenza/influenza-surveillance/weekly-influenza-reports.html>.

2018/19 end-of-season findings will be published in due course.

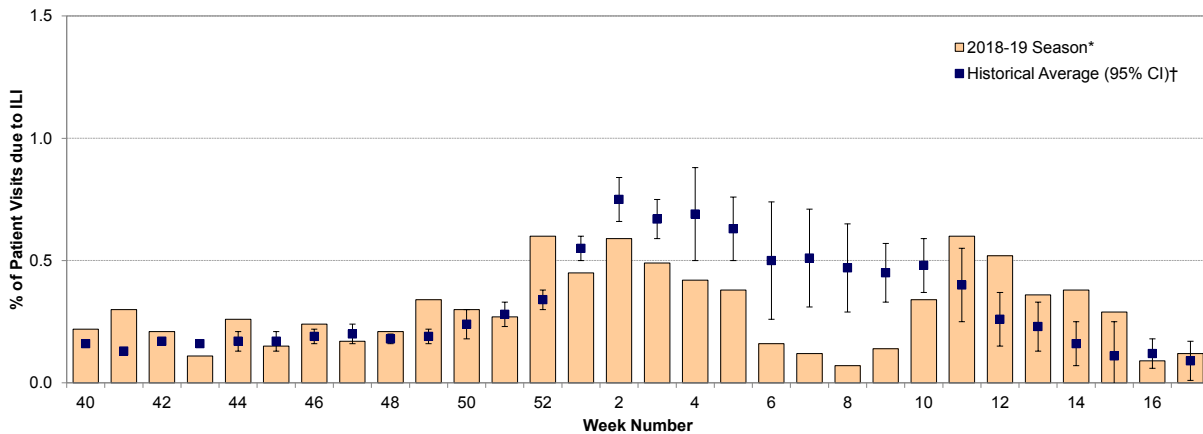
Current and historic VE findings of the Canadian SPSN since 2004-05 are available here: <http://www.bccdc.ca/health-info/diseases-conditions/influenza/sentinel-network-spsn>

## 7. Additional findings of the Canadian SPSN

SPSN investigators also published within season observations showing that children under 10 years of age were more affected during the primary 2018-19 influenza A (H1N1) pdm09 epidemic compared to prior seasonal epidemics

in Canada. The full report, which also explores potential reasons for this surveillance observation (notably hypothesizing a cohort effect following the 2009 pandemic), was published April 11, 2019, in *Eurosurveillance*: <https://www.eurosurveillance.org/content/10.2807/1560-7917.ES.2019.24.15.1900104>.

21.1 Percent of patient visits to sentinel practitioners due to influenza-like illness by week compared to the historical 10-season average, British Columbia, 2018-19 season

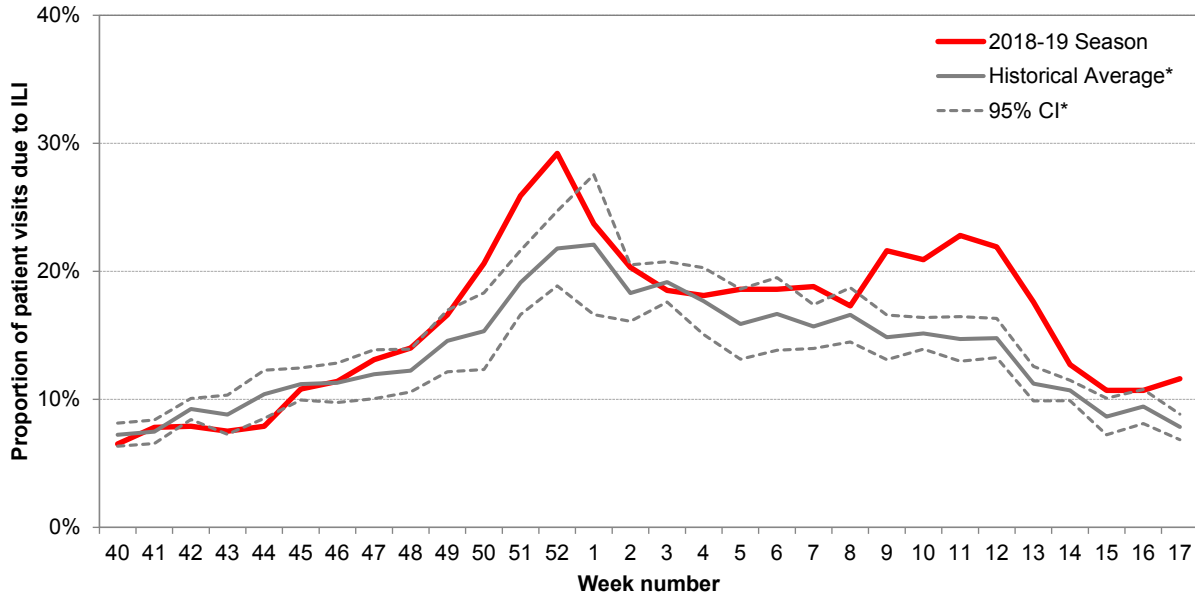


ILI: influenza-like illness; CI: confidence interval.

\*Surveillance period spans week 40 (starting October 1, 2018) to week 17 (ending April 27, 2019), inclusive.

†Ten-year historical average based on 2005-06 to 2017-18 seasons, excluding 2008-09 and 2009-10 seasons due to atypical seasonality.

*21.2 Percent of patients presenting to BC Children's Hospital Emergency Room attributed to influenza-like illness, British Columbia, 2018-19 season*



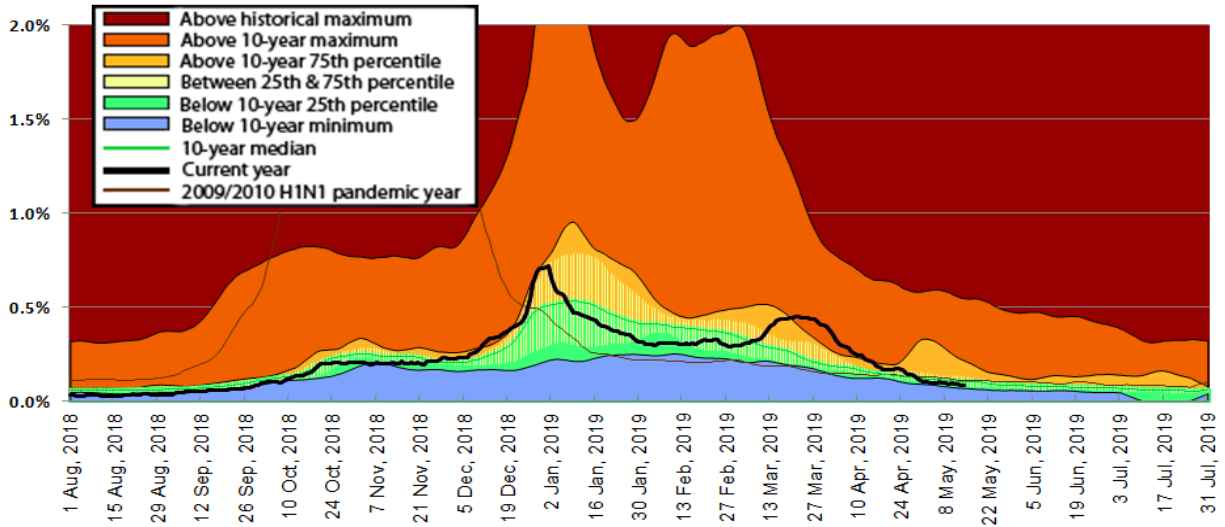
ILI: influenza-like illness; CI: confidence interval

Source: BCCH Admitting, Discharge, Transfer database. Data includes records with a triage chief complaint of “flu” or “influenza” or “fever/cough.”

\* 5-year historical average for 2018-19 season based on 2012-13 to 2017-18 seasons.



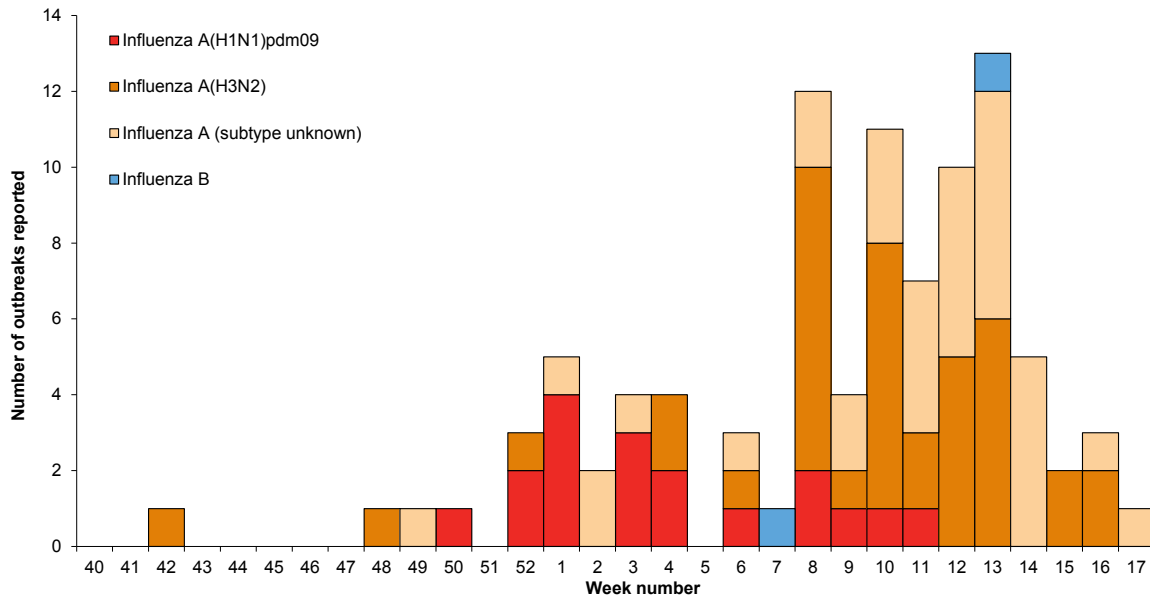
21.3 BC MSP general practitioner service claims for influenza illness as a proportion of all submitted service claims (7-day moving average), British Columbia, 2018-19 season



MSP: Medical Services Plan

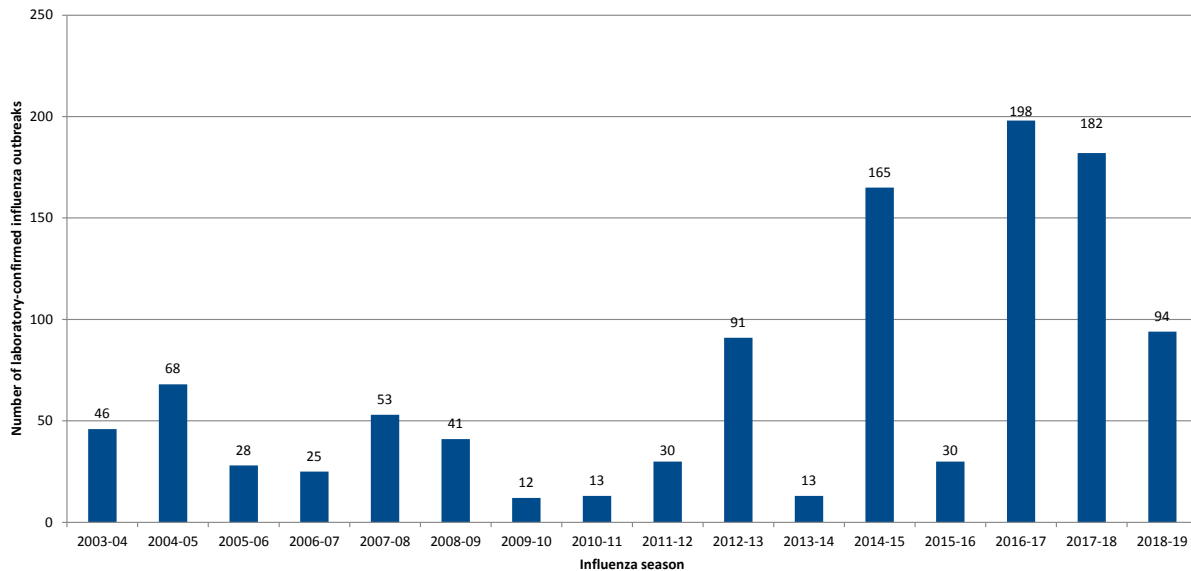
Influenza illness is tracked as the percent of all submitted MSP service claims for selected general practitioner services with a diagnosis of influenza (ICD-9 code 487). Data are provided by Population Health Surveillance and Epidemiology, BC Ministry of Health Services. Data for the period August 1, 2009 to July 31, 2010 have been excluded from the 10-year median calculation due to atypical seasonality during the 2009-10 H1N1 pandemic year. Note: Week beginning August 1, 2018 corresponds to calendar week 31; data are current to May 14, 2019.

21.4 Number of laboratory-confirmed influenza outbreaks in long-term care facilities (LTCF) reported to the BCCDC by week, British Columbia, 2018-19 season



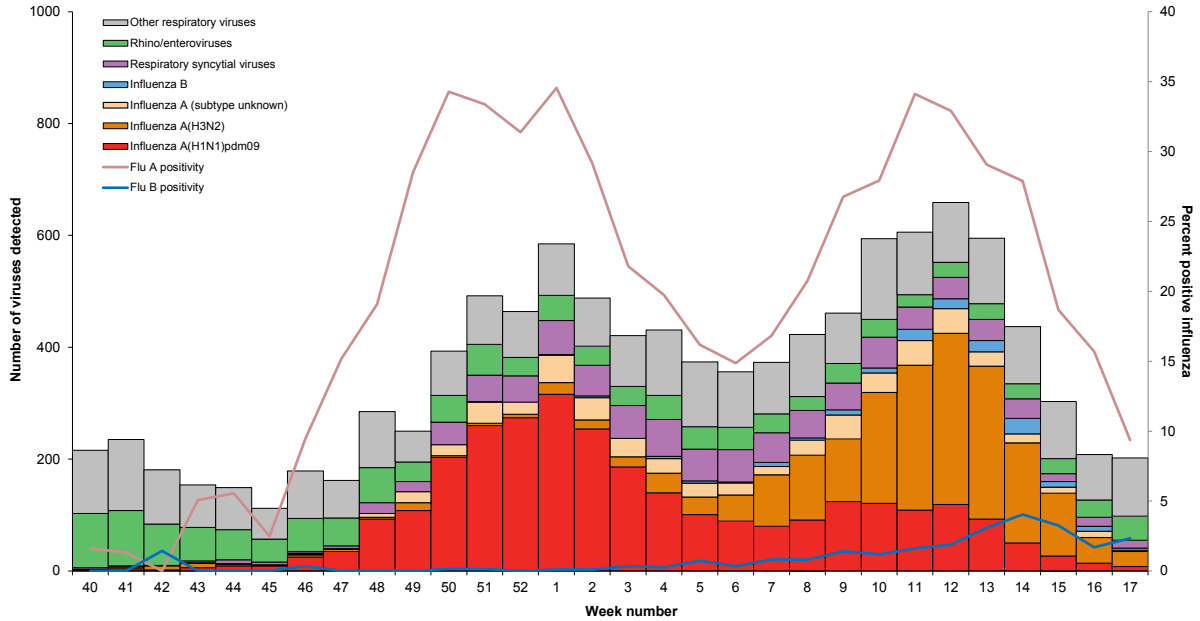
LTCF influenza outbreaks are defined as 2 or more cases of ILI within a 7-day period, with at least one specimen laboratory-confirmed as influenza.

*21.5 Number of laboratory-confirmed influenza outbreaks in long-term care facilities (LTCF) reported to the BCCDC by season, British Columbia, 2003-04 - 2018-19*



The 2014-15 season's outbreak tally includes one laboratory-confirmed influenza outbreak reported in an assisted living facility. Historic outbreak tallies are from the BC Annual Summary of Reportable Diseases: <http://www.bccdc.ca/health-professionals/data-reports/communicable-diseases/annual-summaries-of-reportable-diseases>. Tallies for 2018-19 are preliminary and may be adjusted with final data reconciliation. Influenza outbreaks are defined according to the national FluWatch case definition of two or more cases of influenza-like illness within a 7 day period including at least one laboratory-confirmed case but reporting is based upon notification by the health authority to BCCDC without further audit: <https://www.canada.ca/en/public-health/services/diseases/flu-influenza/influenza-surveillance/about-fluwatch.html#a5>

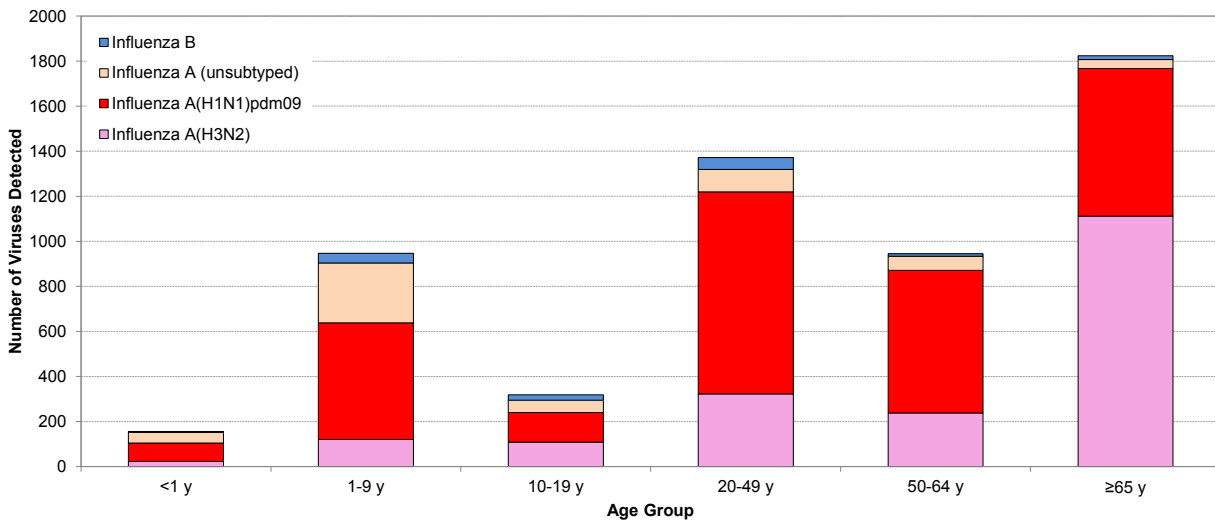
**21.6 Influenza and other respiratory virus detections among respiratory specimens submitted to the BCCDC Public Health Laboratory, British Columbia, 2018-19 Season\***



\* Influenza positivity is derived based on primary specimens submitted for influenza testing at the BCCDC PHL and other external sites that share complete testing data with the BCCDC PHL. Findings support trend analysis but data do not include all testing sites in British Columbia.

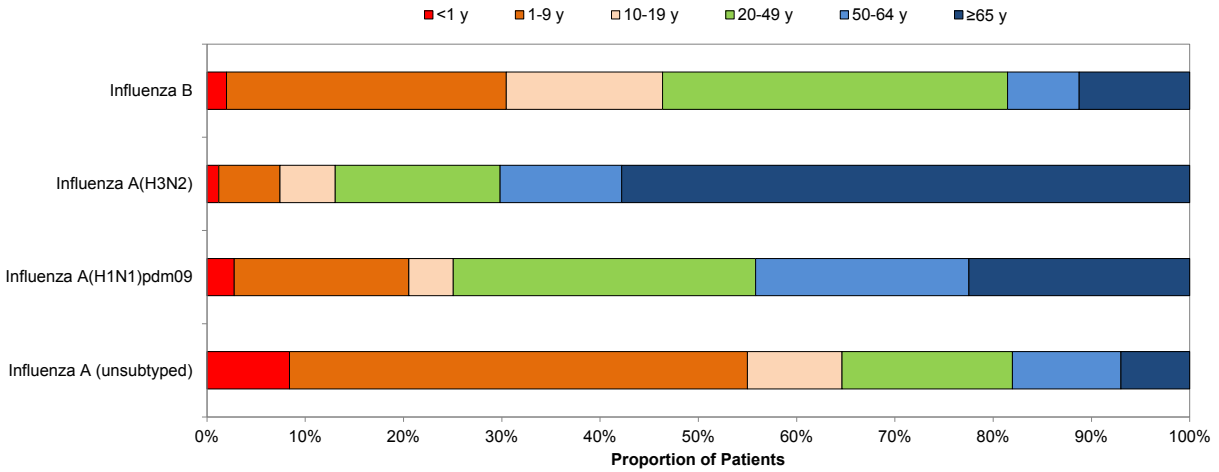
Data are current to May 22, 2019.

**21.7 Cumulative number of influenza detections by type/subtype and age group, BCCDC Public Health Laboratory, 2018-19 season**



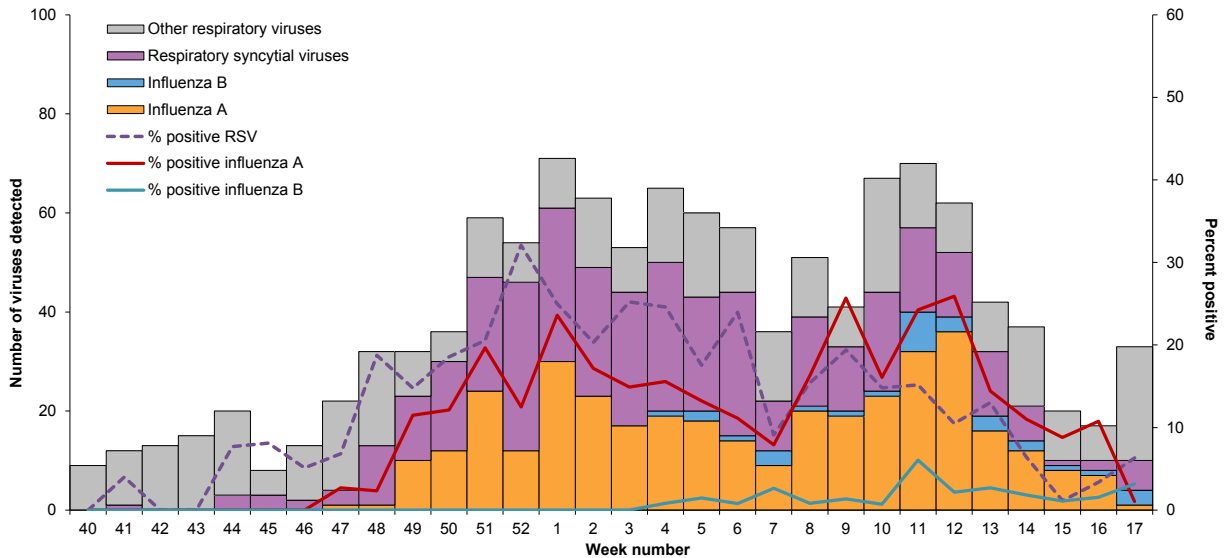
Data are current to May 22, 2019; figure includes cumulative influenza detections for specimens collected from weeks 40-17.

21.8 Age distribution of influenza detections by type/subtype, BCCDC Public Laboratory, 2018-19 season



Data are current to May 22, 2019; figure includes cumulative influenza detections for specimens collected from weeks 40-17.

21.9 Influenza and other respiratory virus detections among respiratory specimens submitted to the BC Children's and Women's Health Centre Laboratory, British Columbia, 2018-19 season



Positive rates were calculated using aggregate data. The denominators for each rate represent the total number of tests; multiple tests may be performed for a single specimen and/or patient.