COLORADO
Department of Public Health & Environment

Dedicated to protecting and improving the health and environment of the people of Colorado

Influenza Surveillance Summary
Colorado, 2017-2018

Summary

Surveillance for the 2017 –2018 influenza season officially began Oct. 1, 2017 and ran through May 19, 2018. In contrast to the 2016-2017 season, the 2017-2018 influenza season was an extremely high severity season. In Colorado, there were 4,650 reported hospitalizations, with a rate of 85.2 per 100,000 people from 61 counties (compared to 3,340 hospitalized cases and a rate of 61.4/100,000 reported from 55 counties in the 2016-17 season). This was the highest number of influenza-associated hospitalizations reported in a season to date. Influenza A viruses were the predominant circulating strain among hospitalized cases until a shift to influenza B viruses occurred the week ending Feb.10, 2018. Individuals age 65 years or older and children under 6 months of age had the highest rates of hospitalization. There was one pediatric death associated with influenza in children younger than 18 years. Molecular typing of influenza-positive patient specimens conducted by the Colorado Department of Public Health and Environment (CDPHE) laboratory showed that Influenza A, H3N2 was the predominant subtype. The 2017-2018 influenza season peaked earlier compared to the previous season, during the week ending December 30, 2017.

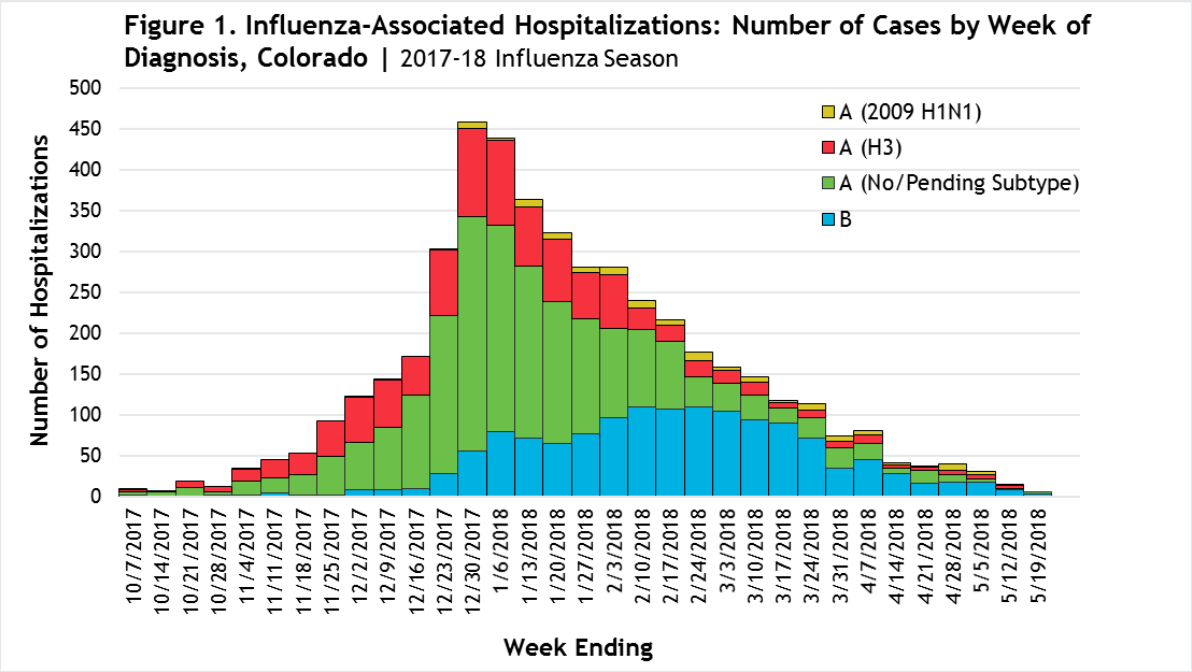
Components of Colorado's Influenza Surveillance

Surveillance activities during the 2017-2018 influenza season included:

- Influenza-associated hospitalizations
- Influenza-like illness (ILI) visits at outpatient facilities
- Positivity data from sentinel hospital laboratories
- Virologic surveillance
- Outbreaks of influenza in long-term care facilities
- Influenza-associated pediatric deaths
- Pneumonia and influenza mortality

Influenza-associated hospitalizations

A hospitalized patient with a positive influenza test, resulting from a rapid antigen, polymerase chain reaction (PCR), direct fluorescent antibody (DFA), or viral culture, was considered an influenza-associated hospitalization.



Overall, 4,650 influenza hospitalizations from 61 counties were reported between Oct. 1, 2017, and May 19, 2018. This was the highest end-of-season count for influenza-associated hospitalizations in the state of Colorado (Figure 2). Influenza activity began early, as influenza-associated hospitalizations began occurring in August and September 2017. Hospitalizations steadily increased until the season peaked during the week ending Dec. 30, 2017 with 458 hospitalizations reported that week (Figure 1). The 2017-18 season peaked earlier than the previous season (Table 1). Influenza A continued to be the predominant type until the shift to influenza B during the week ending Feb. 10, 2017 (Figure 1). Among hospitalized cases, 3,286 (71%) were type A, 1,363 (29%) were type B, and 1 (<1%) specimen was positive but not typed. Among influenza A cases, 1,003 (30%) were where subtype A (H3N2), 124 (4%) were subtype A (2009 H1N1), and the remaining 2,158 (66%) were not subtyped. For influenza B viruses, 123 (9%) were Yamagata lineage and 1 (<1%) was Victoria lineage.

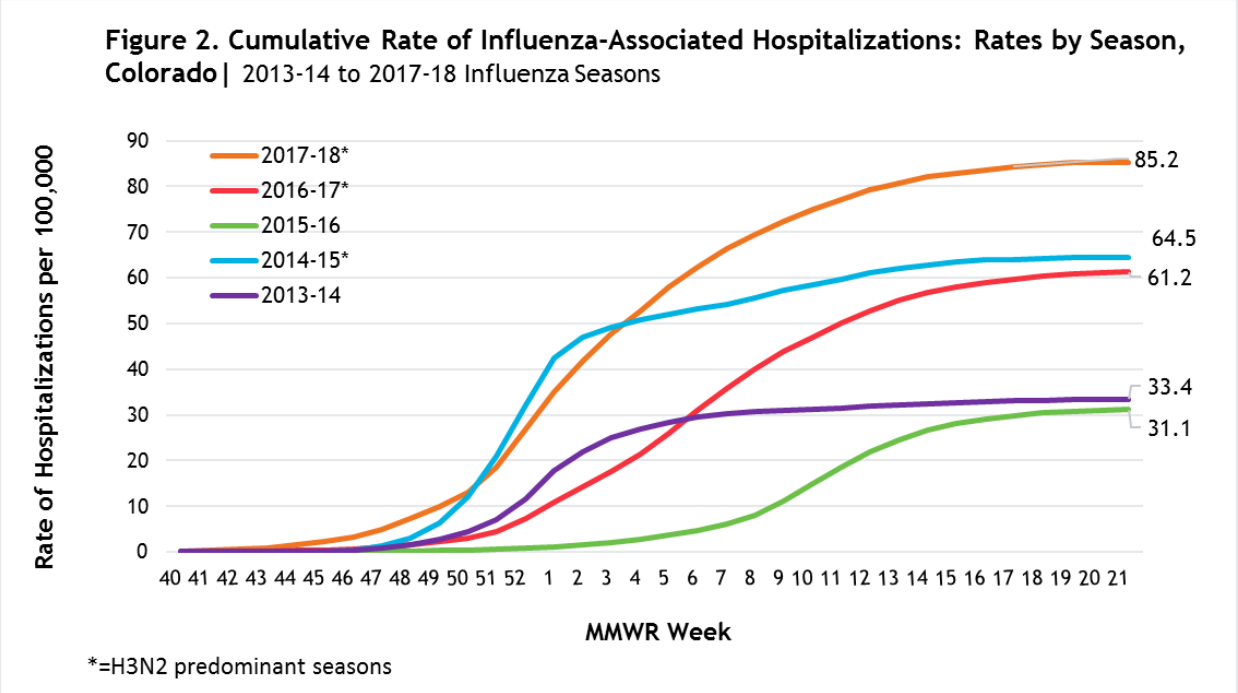
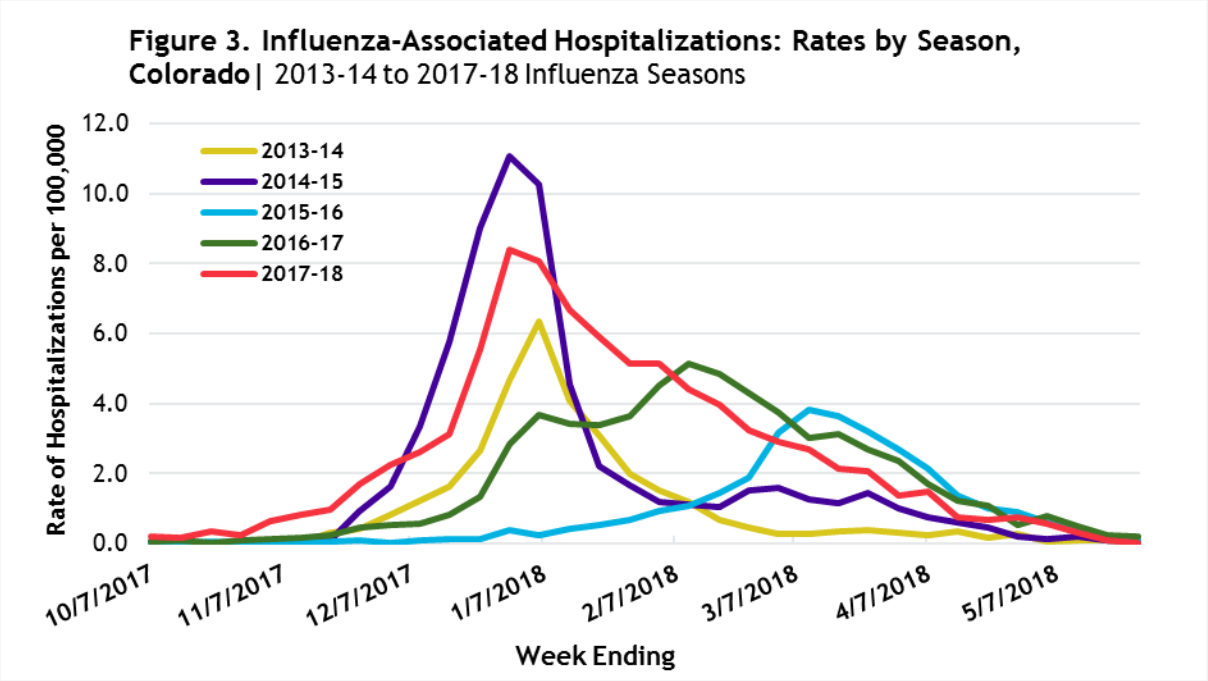


Table 1. Week of Peak Influenza Hospitalizations by Season

Flu Season	Date of Peak
2004-05	2/19/05
2005-06	3/4/06
2006-07	3/17/07
2007-08	2/23/08
2008-09	2/28/09
2009-10	10/17/09
2010-11	2/26/11
2011-12	3/17/12
2012-13	1/4/13
2013-14	1/4/14
2014-15	12/27/14
2015-16	3/12/16
2016-17	2/11/17
2017-18	12/30/2017

Colorado influenza activity

Overall, influenza activity was high in Colorado during the 2017-18 season. The 2017-18 season was the most severe season on record in terms of hospitalizations and outbreaks in long-term care facilities. Influenza activity steadily increased October through December. In Colorado, the peak of the season occurred during the week ending on Dec. 30, 2017 (Figure 3). Nationally, influenza hospitalization trends and positivity data from World Health Organization (WHO) and National Respiratory and Enteric Virus Surveillance System (NREVSS) collaborating laboratories peaked during January 2018. The peak of influenza-associated hospitalizations for the 2017-18 season occurred earlier than last season. Influenza B viruses began increasing at the end of December and peaked the week ending Feb. 10, 2018 and Feb. 24, 2018.



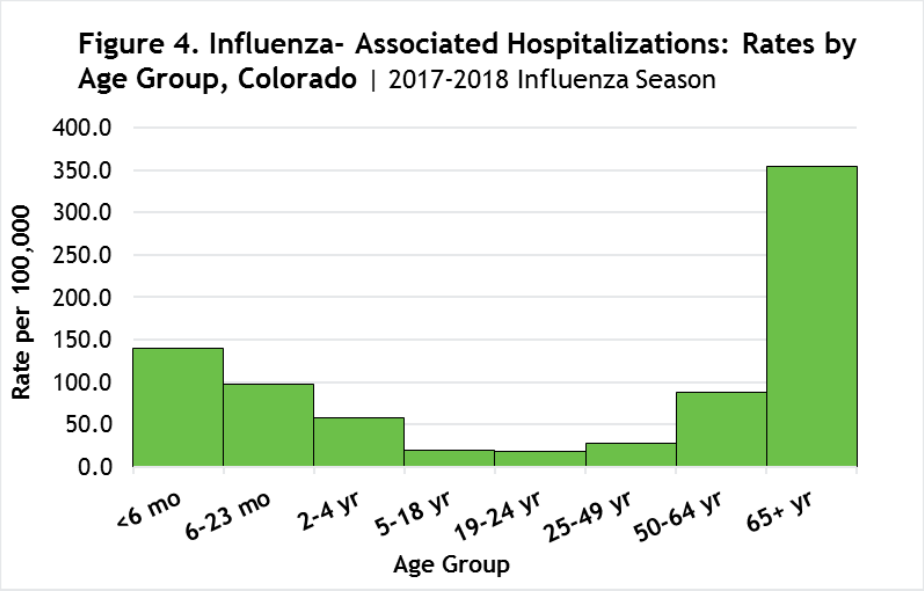
Overall influenza activity was high in Colorado during the 2017-18 season and had a higher hospitalization rate (85.2) compared with the preceding season of 2016-17. Since Colorado began reporting influenza hospitalizations in the 2004, one season peaked in October, two peaked in December, two seasons peaked in January, five seasons peaked in February and four peaked in March (Figure 3).

Influenza-associated hospitalizations by age group

The highest rates of hospitalization are in the elderly over 65 years of age (354.5 per 100,000 people), followed by children less than 6 months of age (139.9 per 100,000 people) which is a typical pattern demonstrated by influenza (Table 2 & Figure 4).

Table 2. Influenza-Associated Hospitalizations by Age Group, Colorado

Age	No.*	%	Rate per 100,000
<6 mo	47	1.0%	139.9
6-23 mo	99	2.1%	97.9
2-4 yr	114	2.5%	57.1
5-18 yr	198	4.3%	19.7
19-24 yr	85	1.8%	18.2
25-49 yr	537	11.5%	27.8
50-64 yr	932	20.0%	88.2
65+ yr	2638	56.7%	354.5
Total	4650	100.0%	85.2

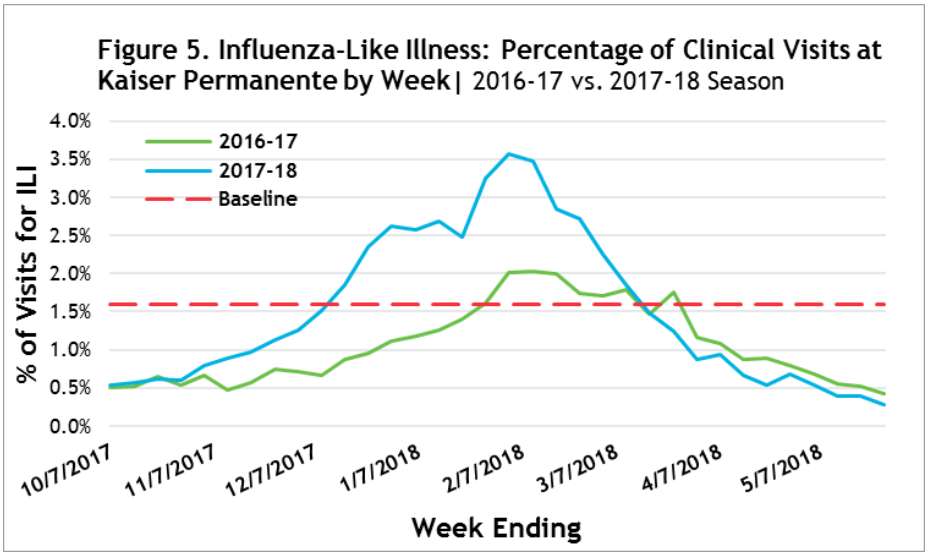


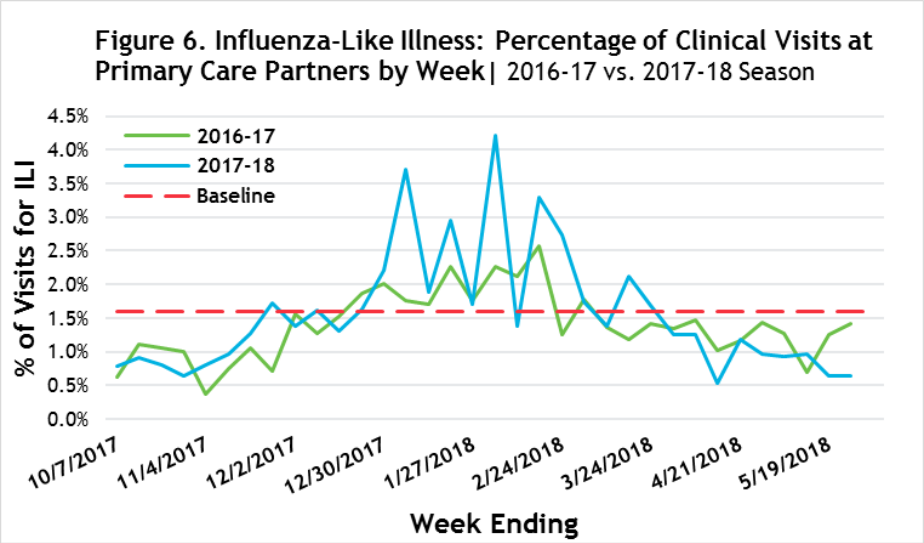
Influenza-like illness (ILI) from outpatient facilities

Kaiser Permanente and Primary Care Partners report influenza-like illness (ILI) visits for outpatient encounters based on ICD-10 diagnostic codes. Kaiser Permanente includes providers from the North Central, Northeast, Northwest, South and South Central regions of the state. Primary Care Partners includes providers in the Northwest region. Kaiser Permanente reported the following ICD-10 codes: J11.1 (influenza due to unidentified influenza virus with other respiratory manifestations) and B34.9 (viral infection). Primary Care Partners reported the following ICD-10 codes: J10.1 (influenza due to other identified influenza virus with other respiratory manifestations), J11.1 (influenza due to unidentified influenza virus with other respiratory manifestations), and B97.89 (other viral agents as the cause of diseases classified elsewhere).

Baseline levels are calculated using an average of non-influenza weeks for the past three seasons plus two standard deviations. A non-influenza week is defined as periods of two or more consecutive weeks in which each week accounted for less than 2% of the season's total number of influenza-associated hospitalizations.

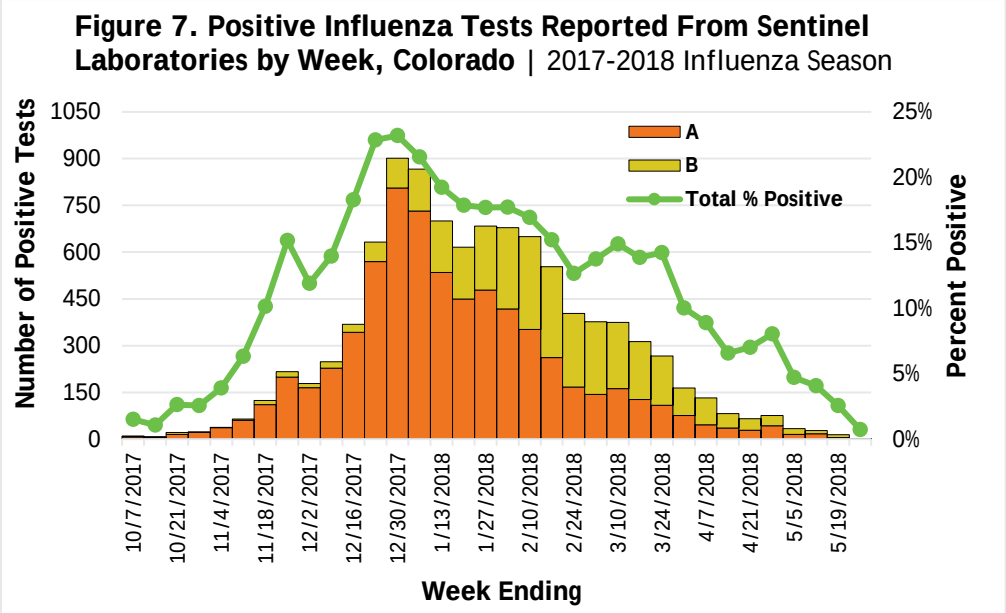
Kaiser Permanente ILI had a peak of 3.57% during the weeks ending February 3, 2018 (Figure 5). Primary Care Partners ILI also peaked during the week ending February 3, 2018 at 4.22% (Figure 6). The peak percentage of outpatient ILI visits for both sentinel providers was higher during the 2017-18 season than the 2016-17 season.





Positivity data from sentinel hospital laboratories

During the influenza season, 24 clinical hospital laboratories report how many influenza tests they perform and how many are positive. The percentage of respiratory specimens that tested positive for influenza peaked during the week ending Dec. 30, 2017 (figure 7) at 23% of influenza specimens tested were positive. During this week, 3,885 specimens were tested and 901 were positive. Type A viruses predominated until the week ending Feb. 17, 2018, after which B viruses were predominant.



Virologic surveillance

Clinical Laboratories

For typing and subtyping performed on specimens from hospitalized patients throughout Colorado, 3286 (71%) of positive specimens were positive for influenza A, and 1,363 (29%) were positive for influenza B. For

influenza A specimens, 2,158 (66%) were not subtyped, 1,003 (30%) were H3N2 and 124 (4%) were H1N1. For influenza B specimens, 1,240 (91%) did not have lineage performed, 123 (9%) were Yamagata lineage and 1 (<1%) were Victoria lineage (Table 3).

National viral surveillance and characterization data can be accessed at:
https://www.cdc.gov/mmwr/volumes/67/wr/mm6722a4.htm

Table 3. Virologic Surveillance, Colorado and National Data, 2017-2018

	CO Cumulative Data (October 1, 2017- May 26, 2018)	National Cumulative Data* (October 1, 2017- May 19, 2018)
Total Positive Specimens	**4,650**	**53,581**
Influenza A	**3286 (71%)**	**38198 (71%)**
H1N1	124 (4%)	5,670 (15%)
H1N2v	1 (<1%)	4 (<1%)
H3N2	1003 (30%)	31,908 (84%)
Subtyping not performed	2,158 (66%)	620 (2%)
Influenza B	**1,363 (29%)**	**15383 (29%)**
Yamagata lineage	123 (9%)	10,498 (68%)
Victoria lineage	1 (<1%)	1,326 (9%)
Lineage not performed	1,240 (91%)	1,326 (9%)
A/B Not Distinguished	1 (<1%)	n/a

Colorado Department of Public Health and Environment Laboratory

In the fall of 2017, Colorado implemented a right-sizing strategy to collect influenza specimens at the state public health laboratory. Nine clinical laboratories were recruited from seven different regions of the state to participate in the program. This is called the Sentinel Specimen Submitter program. Each site was asked to send up to five influenza specimens to the public health lab per week during non-peak weeks and up to ten specimens per week during the peak weeks.

Overall, the virology trends in Colorado followed a similar trend to the national trends. Based on typing and subtyping at the CDPHE laboratory, influenza A H3N2 viruses predominated. Among 624 influenza-positive specimens tested at the CDPHE laboratory, 372 (60%) were type A, H3N2; 156 (25%) were B, Yamagata; 50 (8%) were negative, 43 (7%) were A, H1N1; 1 (0.16%) was positive for both A, H3N2 and B, Yamagata; 1 (0.16%) was B, Victoria; and 1 (0.16%) was inconclusive.

Centers for Disease Control (CDC)

A sample of specimens tested at the CDPHE laboratory are then forwarded to CDC for further genetic and antigenic characterizations. Hemagglutinin inhibition (HI) assays are used to antigenically characterize the viruses. 34 specimens from Colorado were antigenically characterized at CDC:

- Eight (24%) of viruses were A/HONG KONG/4801/2014-LIKE (H3N2), which means they were similar to the H3N2 viruses in the influenza vaccine.
- Two (6%) of viruses were not antigenically similar to A/HONG KONG/4801/2014-LIKE (H3N2), which means they were different than the H3N2 viruses in the influenza vaccine
- Eleven (32%) of viruses were A/MICHIGAN/45/2015-LIKE (H1N1)pdm09, which means they were similar to the H1N1 viruses in the influenza vaccine.

- Twelve (35%) of viruses were B/PHUKET/3073/2013-LIKE (Yamagata), which means they were similar than the H3N2 viruses in the influenza vaccine.
- One (3%) of viruses was B/BRISBANE/60/2008-LIKE LOW, which means it was different than the B-Victoria strain that was in the influenza vaccine.

CDC uses Next Generation Sequencing (NGS) to genetically characterize influenza viruses. 53 Colorado viruses were genetically characterized at CDC:

- Eighteen (34%) H3N2 viruses were part of the 3C.2a clade/ subclade
- One (2%) H3N2 virus was part of the 3C.2a1 clade/ subclade
- Four (8%) H3N2 viruses were part of the 3C.3a clade/ subclade
- Twelve (22%) H1N1 viruses were part of the 6B.1 clade/ subclade
- One (2%) B, Victoria virus was part of the V1A-2del clade/subclade
- Seventeen (32%) B, Yamagata viruses were part of the Y3 clade/subclade

Influenza-associated pediatric deaths

Pediatric influenza-associated deaths have been a reportable condition in Colorado since the 2004-05 influenza season. The highest number of influenza-associated deaths occurred during the 2008-2009 season with 12 pediatric deaths. The 10-year average is 3.7 deaths per year (Table 4). During the 2017-2018 season, there was one pediatric deaths (in a child less than 18 years of age). Colorado had one less influenza-associated pediatric deaths compared to the preceding season of 2016-17 in which there were 2 influenza-associated pediatric deaths. Nationally, there were 180 influenza-associated pediatric deaths reported during the 2017-18 season, which was also higher than the 110 influenza-associated pediatric deaths reported for the preceding season.

Table 4. Influenza-associated pediatric deaths

Influenza-Associated Pediatric Deaths, Colorado
2003-04 through 2017-18 Influenza Seasons

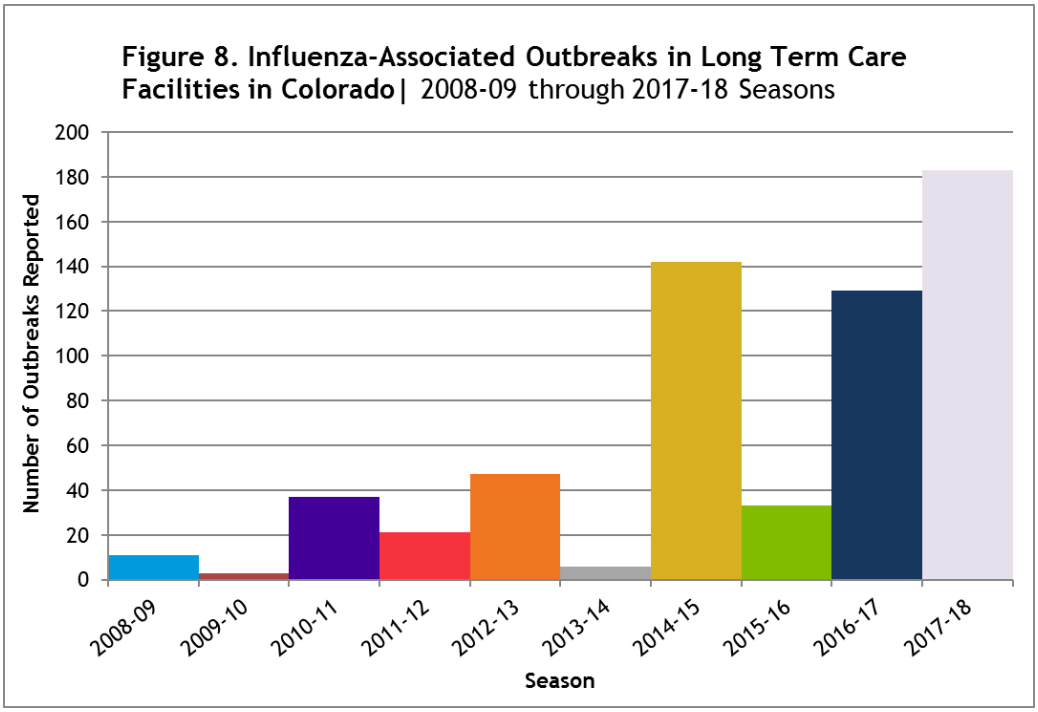
Flu Season	Pediatric Deaths
2008-09	7*
2009-10	12**
2010-11	3
2011-12	0
2012-13	5
2013-14	0
2014-15	6
2015-16	1
2016-17	2
2017-18	1

*Includes death reported in 2008-09 but after defined season dates which may have been acquired on domestic and/or international travel
**2009 H1N1 Pandemic

Influenza Outbreaks in long-term care facilities

While all influenza-associated outbreaks in any setting are reportable to public health per state regulations, for the purpose of this surveillance report, we report on influenza outbreaks that occur in residential settings (such as long-term care facilities, correctional facilities, and group homes). An outbreak is defined as at least one resident with a positive test for influenza among two or more residents with ILI.

During the 2017-18 influenza season, 183 influenza-associated outbreaks were reported. Of those outbreaks, 178 occurred in long-term care facilities (LTCF), one in a group-home and four in correctional facilities. This is the highest number of outbreaks reported in a single influenza season. The second highest number of outbreaks occurred during the 2014-15 season, with 142 outbreaks reported.



Pneumonia and influenza mortality

Pneumonia and influenza mortality data comes from the National Center for Health Statistics mortality surveillance. This information comes from death certificate data provided by state and vital statistics offices (Figure 9).

The seasonal baseline is calculated by using data applied from the previous five years. The epidemic threshold represents the point at which the observed proportion of deaths attributed to pneumonia or influenza was significantly higher than what is expected for that time of year in absence of substantial influenza-related mortality.

During the 2017-18 season, the highest percentage of deaths due to pneumonia and influenza occurred during the week ending Jan. 27, 2018. This week had 11.4% of deaths related to pneumonia and influenza. National levels peaked one week earlier than Colorado. The national trends peaked at 10.9% of deaths related to pneumonia and influenza.

Figure 9. Pneumonia & Influenza Mortality from the National Center for Health Statistics | CO vs. National, 2017-18 Season