Influenza Surveillance Report

2016–2017 Season

October 2018

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Notes: This report will primarily focus on influenza surveillance in California; however, information on other respiratory viruses is provided where data are available. The majority of data in this report cover the influenza season (October 2, 2016–May 20, 2017 [calendar weeks 2016-40 – 2017-20]); however, data sources that represent reportable conditions, i.e., outbreaks and severe (intensive care unit admissions) and fatal influenza infections in persons <65 years of age, cover the period October 2, 2016–September 30, 2017 (calendar weeks 2016-40 – 2017-39). Data presented in this report are as of January 6, 2018; any deviations from this are noted where applicable.

Synopsis

Nationally, the 2016–2017 influenza season (October 2, 2016–May 20, 2017) had moderate activity levels.[1] National influenza activity remained low through November, began increasing during December, and peaked in February, although there were regional differences in the timing of influenza activity. Influenza A (H3N2) viruses predominated overall.[1,2] Influenza activity in California also differed regionally; Northern and Central California had more severe activity, compared to Southern California, where the season was more moderate. Influenza activity in California began increasing in December, peaking in early-January (Figure 1). This timing is earlier than the previous five influenza seasons in California. In California, influenza A (H3N2) viruses predominated.

Figure 1. Selected influenza surveillance parameters, California Department of Public Health, 2016–2017
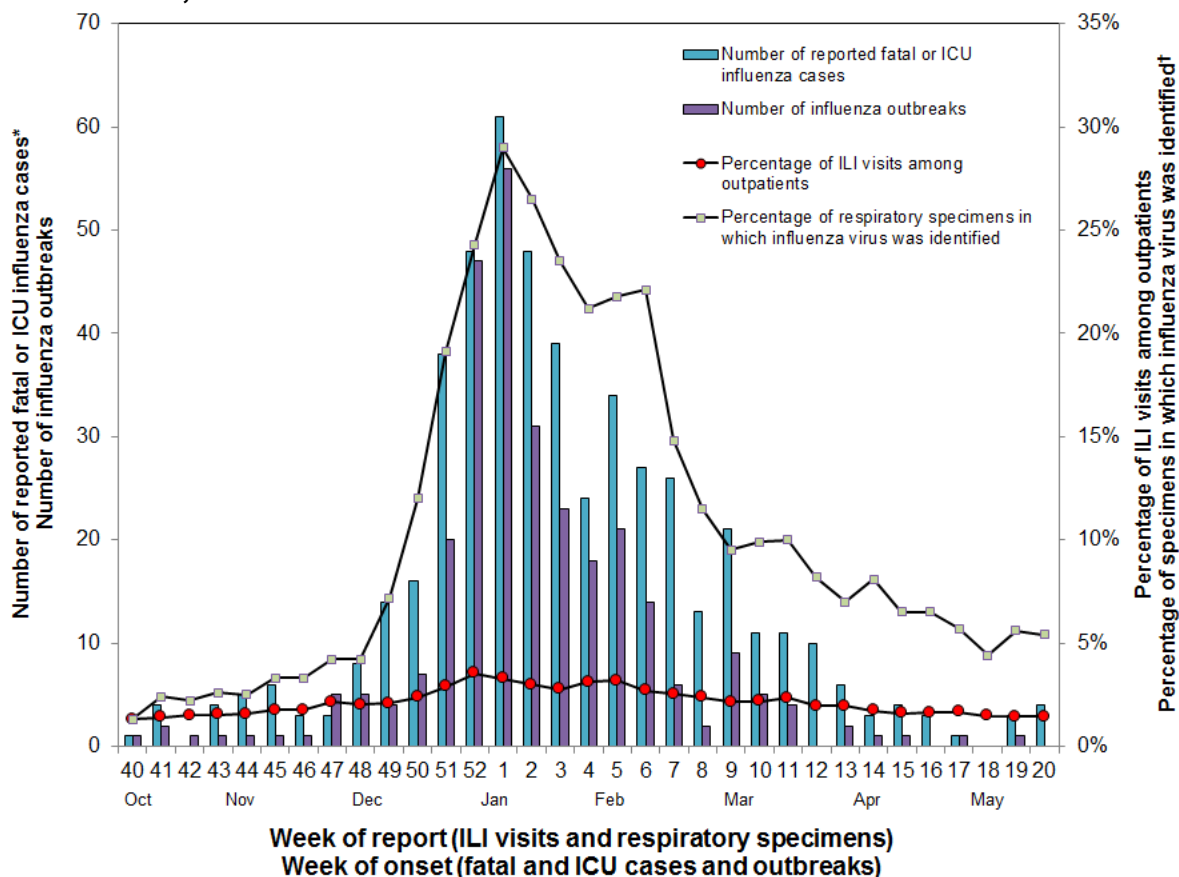
*Includes persons <65 years of age only
†Specimens tested at clinical sentinel laboratories only

The percentage of influenza-like illness (ILI) visits among outpatients peaked during the week ending December 31, 2016 (3.5%) and the percentage of laboratory detections for influenza at clinical sentinel laboratories peaked during the week ending January 7,

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2017 (29.0%). These levels of activity were similar to levels seen during the peak of the 2015–2016 influenza season, which was considered to be moderately severe. A total of 328 confirmed respiratory outbreaks were reported during the 2016–2017 season; 292 were associated with influenza. Among the 292 influenza-associated outbreaks, influenza A was the most commonly identified influenza virus. The majority of influenza-associated outbreaks occurred in residential healthcare facilities.

Nine laboratory-confirmed influenza-associated pediatric deaths were reported to the California Department of Public Health (CDPH) during October 2, 2016–September 30, 2017. This number is within the range (5 [reported during the 2007–2008 season] to 37 [reported during the 2008–2009 season]) of past influenza seasons since fatal pediatric influenza surveillance began in 2003. During the 2016–2017 season, CDPH had 524 cases of influenza-associated severe illness or death reported among persons less than 65 years of age compared to 512 cases reported in 2015–2016. However, these data may be incomplete because reporting of non-fatal intensive care unit (ICU) cases is voluntary.

Surveillance Data

A. CDPH Virologic Surveillance

The CDPH obtains data on laboratory-confirmed influenza and other respiratory viruses from a number of laboratories throughout the state. These laboratories include the CDPH Viral and Rickettsial Diseases Laboratory (VRDL) and 27 local public health laboratories, collectively known as the Respiratory Laboratory Network (RLN), and 29 clinical, academic, and hospital laboratories, which are referred to as clinical sentinel laboratories.

During the 2016–2017 influenza season, influenza A viruses were the most commonly identified influenza viruses identified by RLN and clinical sentinel laboratories, and influenza A (H3N2) was the predominant influenza strain circulating in California. The proportion of influenza B viruses identified by RLN and clinical sentinel laboratories began increasing in February and were more frequently identified than influenza A viruses in April and May. These virologic surveillance data are similar to national findings.[1,2]

The proportion of specimens testing positive at clinical sentinel laboratories for all types of influenza first exceeded 10% – an indication that higher than normal levels of influenza virus were circulating – during the week ending December 17, 2016. The proportion of influenza-positive specimens peaked at 29.0% during the week ending January 7, 2017, and declined to less than 10% during the week ending March 4, 2017. In contrast, national influenza activity peaked in February.[1,2]

1. Respiratory Laboratory Network (RLN) Surveillance

The RLN laboratories offer polymerase chain reaction (PCR) testing for influenza A and influenza B, including influenza A subtyping and influenza B lineage typing, and testing for respiratory syncytial virus (RSV), a common respiratory virus. RLN laboratories often receive specimens that have already tested positive for influenza at a clinical laboratory; therefore, the percentage of specimens testing positive for influenza at RLN laboratories is not an indicator of influenza activity.

Of 10,478 specimens tested by RLN laboratories from October 2, 2016 through May 20, 2017, 4,853 (46.3%) were positive for influenza; of these, 4,656 (95.9%) were influenza A and 197 (4.1%) were influenza B (Table 1). Of the 4,656 positive influenza A specimens, 4,393 (94.4%) were A (H3N2), 153 (3.3%) were 2009 A (H1N1), and 110 (2.4%) were not subtyped. Of the 197 positive influenza B specimens, 103 (52.3%) were B/Yamagata lineage, 15 (7.6%) were B/Victoria lineage, and 79 (40.1%) were not lineage typed. In addition to influenza testing, 2,825 specimens were tested for RSV by RLN laboratories; 335 (11.9%) were positive.

Table 1. RLN influenza and respiratory syncytial virus (RSV) surveillance results, October 2, 2016–May 20, 2017

	Total*		Northern CA		Central CA		Southern CA	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Specimens tested for influenza	**10,478**		**5,172**		**782**		**4,524**	
Positive for influenza	4,853	(46.3)[†]	1,930	(37.3)[†]	470	(60.1)[†]	2,453	(54.2)[†]
Influenza A	4,656	(95.9)[‡]	1,851	(95.9)[‡]	462	(98.3)[‡]	2,343	(95.5)[‡]
2009 A (H1N1)	153	(3.3)[§]	49	(2.6)[§]	29	(6.3)[§]	75	(3.2)[§]
A (H3N2)	4,393	(94.4)[§]	1,726	(93.2)[§]	432	(93.5)[§]	2,235	(95.4)[§]
Subtyping not performed	110	(2.4)[§]	76	(4.1)[§]	1	(0.2)[§]	33	(1.4)[§]
Influenza B	197	(4.1)[‡]	79	(4.1)[‡]	8	(1.7)[‡]	110	(4.5)[‡]
Yamagata	103	(52.3)[¥]	25	(31.6)[¥]	4	(50.0)[¥]	74	(67.3)[¥]
Victoria	15	(7.6)[¥]	4	(5.1)[¥]	0	(0.0)[¥]	11	(10.0)[¥]
Lineage typing not performed	79	(40.1)[¥]	50	(63.3)[¥]	4	(50.0)[¥]	25	(22.7)[¥]
Specimens tested for RSV	**2,825**		**1,420**		**206**		**1,199**	
Positive for RSV	335	(11.9)	101	(7.1)	57	(27.7)	177	(14.8)

* Participating laboratories:
Statewide: CDPH Viral and Rickettsial Diseases Laboratory
Northern California: Alameda, Contra Costa, El Dorado, Humboldt, Placer, Sacramento, San Francisco, San Mateo, Santa Clara, Shasta, Solano, and Sonoma county public health laboratories
Central California: Fresno, Monterey, San Joaquin, Stanislaus, and Tulare county public health laboratories
Southern California: Kern, Long Beach, Los Angeles, Orange, Riverside, San Bernardino, San Diego, San Luis Obispo, Santa Barbara, and Ventura county public health laboratories
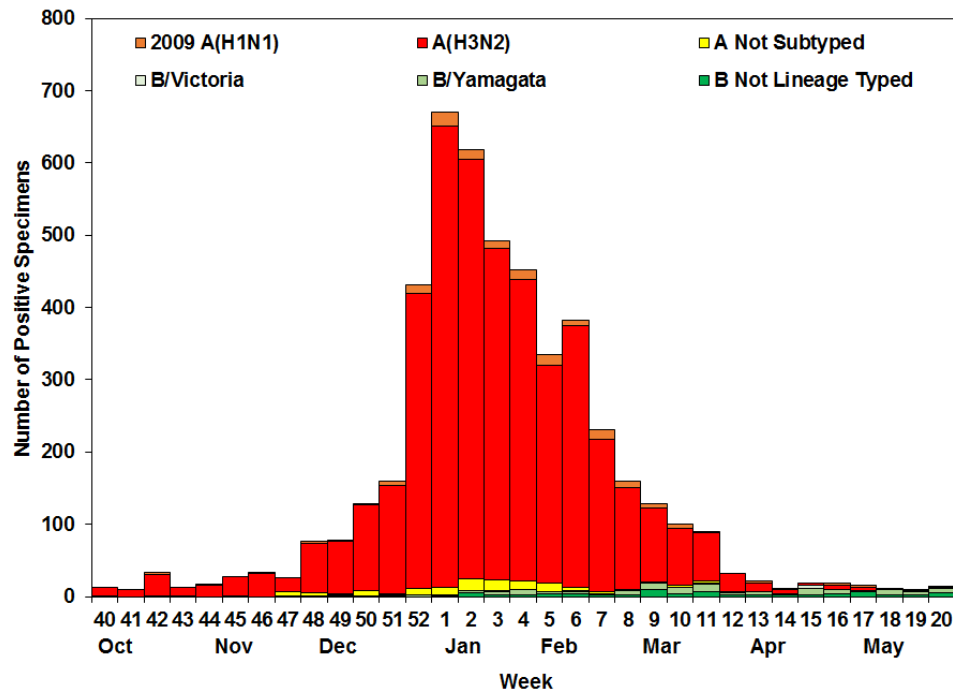† Percent is of the total specimens tested for influenza by PCR
‡ Percent is of the specimens positive for influenza
§ Percent is of the influenza A positive specimens
¥ Percent is of the influenza B positive specimens

Figure 2. Influenza positive specimens by type and subtype, Respiratory Laboratory Network Laboratories, 2016–2017

2. Clinical Sentinel Laboratory Surveillance

The clinical sentinel laboratories use various methods to test for influenza, including rapid test, direct fluorescent assay, viral culture, and PCR.

From October 2, 2016 through May 20, 2017, clinical sentinel laboratories tested a total of 117,782 specimens for influenza, of which 16,554 (14.1%) were positive for influenza. Of the 16,554 specimens that tested positive, 14,963 (90.4%) were positive for influenza A and 1,591 (9.6%) were positive for influenza B (Table 2). In addition to influenza specimens, 102,195 specimens were tested for RSV by clinical sentinel laboratories; 11,360 (11.1%) were positive.

The overall level of activity seen during the 2016–2017 season was similar to the activity of previous seasons; however, the peak of activity during the 2016–2017 season was 1 to 6 weeks earlier than the previous four seasons (Figure 3). In addition, the percentage of specimens testing positive for influenza was significantly higher in the Northern (19.0%) and Central (18.6%) California regions than in Southern California (10.2%) (p-values <0.001). RSV activity was coincident with influenza activity and was higher than activity during the 2015–2016 season (Figure 4). Rhinoviruses and enteroviruses were the most frequently detected viruses among other tested respiratory viruses (Figure 5).

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Table 2. Influenza and respiratory syncytial virus (RSV) detections in clinical sentinel laboratories*, October 2, 2016–May 20, 2017

	Total*		Northern CA		Central CA		Southern CA	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Influenza								
Specimens tested for influenza	**117,782**		**42,685**		**9,200**		**65,897**	
Positive for influenza	**16,554**	(14.1)†	**8,120**	(19.0)†	1,714	(18.6)†	**6,720**	(10.2)†
Influenza A	14,963	(90.4)‡	7,330	(90.3)‡	1,547	(90.3)‡	6,086	(90.6)‡
Influenza B	1,591	(9.6)‡	790	(9.7)‡	167	(9.7)‡	634	(9.4)‡
RSV								
Specimens tested for RSV	**102,195**		**38,463**		**8,216**		**55,516**	
Positive for RSV	11,360	(11.1)	4,324	(11.2)	1,540	(18.7)	5,496	(9.9)

*   Number of participating laboratories by county:
Northern California: Alameda(1), Butte(1), Marin(1), and San Francisco(1). In addition, Northern California Kaiser Permanente has facilities in multiple counties within the Northern California region.
Central California: Madera(1). In addition, Northern California Kaiser Permanente has facilities in multiple counties within the Central California region.
Southern California: Imperial(5), Long Beach(1), Los Angeles(5), San Bernardino(1), and San Diego(10). In addition, Southern California Kaiser Permanente has facilities in multiple counties within the Southern California region.
†   Percent is of the total specimens tested for influenza
‡   Percent is of the specimens positive for influenza

Figure 3. Percentage of specimens from which influenza was detected in clinical sentinel laboratories, 2012–2017*
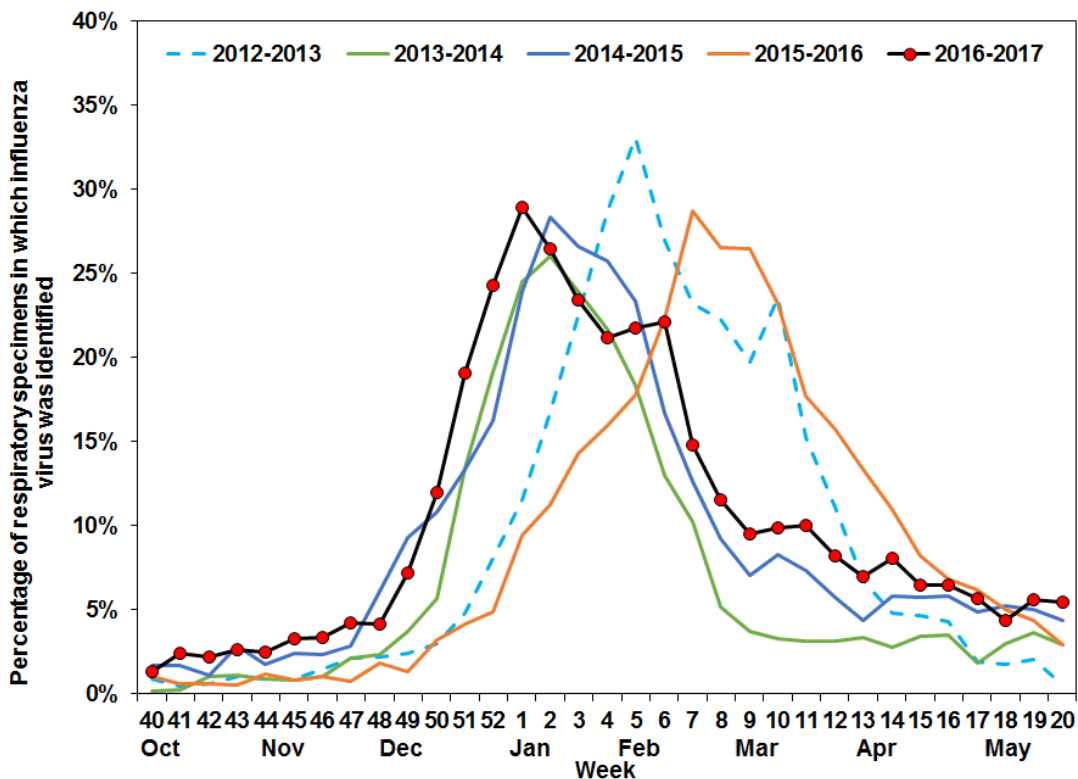
*Percentages presented in this graph differ from those presented in a similar appearing graph in the 2016–2017 influenza season weekly reports because the weekly report graphs combined RLN and clinical sentinel laboratory data. This graph includes data from sentinel clinical laboratories only.

Figure 4. Percentage of specimens from which RSV was detected in clinical sentinel laboratories, 2012–2017
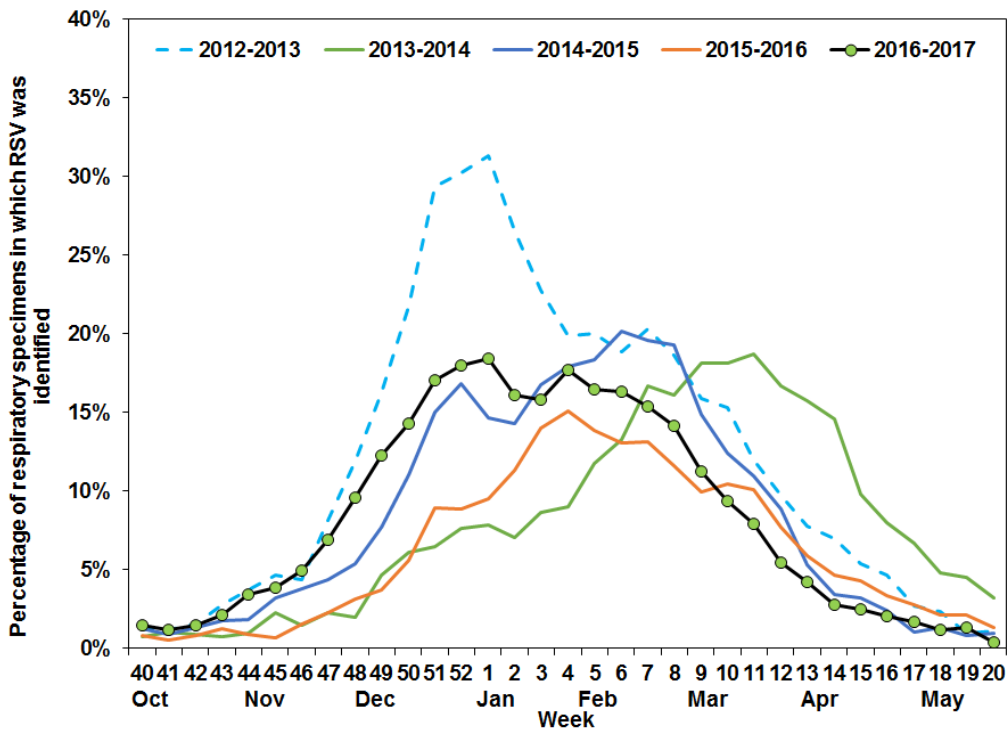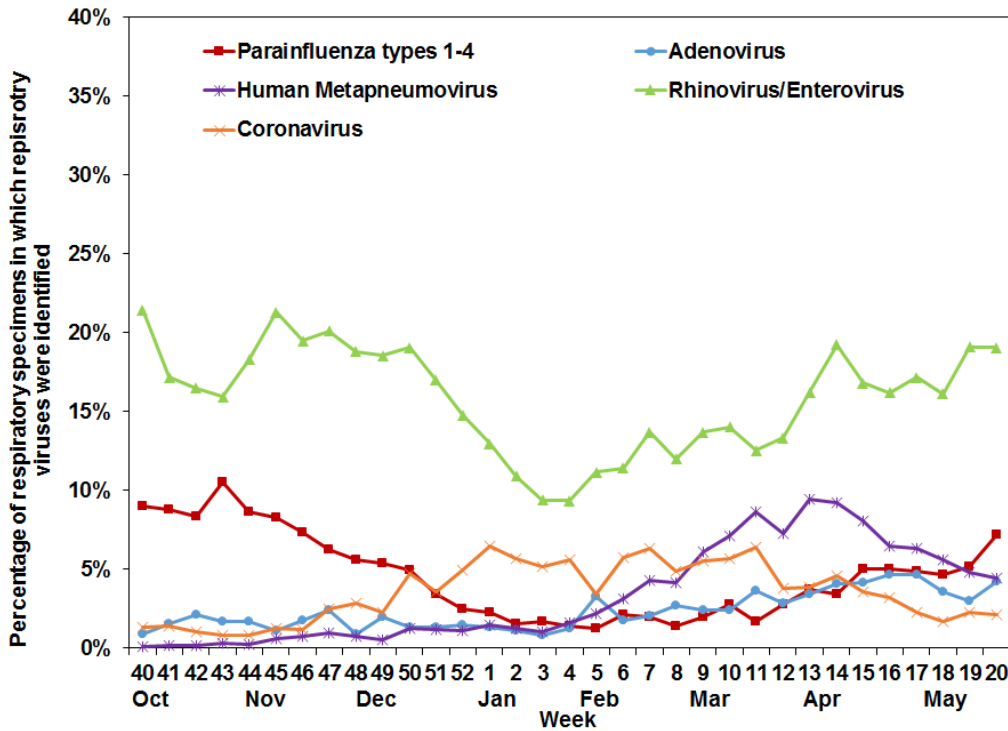

Figure 5. Percentage of specimens from which other respiratory viruses were detected in clinical sentinel laboratories, 2016–2017

3. Influenza Virus Strain Characterization

A total of 143 influenza viruses isolated from influenza positive samples collected throughout California were antigenically characterized (strain typing) by the Centers for Disease Control and Prevention (CDC) during the 2016–2017 influenza season (Table 3). Thirty-one of 33 (94%) 2009 A (H1N1) viruses and 74 of 74 (100%) A (H3N2) viruses were characterized as A/California/07/2009-like (H1N1) and A/Hong Kong/4801/2014-like (H3N2), respectively, the 2009 H1N1 and H3N2 components included in the 2016–2017 influenza vaccine for the Northern Hemisphere. Nationally, 99.3% of influenza 2009 A (H1N1) viruses and 94.6% of influenza A (H3N2) viruses submitted to CDC from U.S. laboratories were antigenically similar to the influenza A components of the trivalent and quadrivalent vaccines.

Among viruses submitted to CDC from California, all 12 (100.0%) B/Victoria lineage viruses were antigenically characterized as B/Brisbane/60/2008-like (Victoria lineage), the influenza B component of the trivalent and quadrivalent influenza vaccines for the Northern Hemisphere. In addition, all 24 (100.0%) B/Yamagata lineage viruses were antigenically characterized as B/Phuket/3073/2013-like (Yamagata lineage), the additional influenza B component included in the quadrivalent vaccine for the Northern Hemisphere. Nationally, 86.5% of influenza B/Victoria viruses and 100% of influenza B/Yamagata viruses submitted to CDC from U.S. laboratories were antigenically similar to the influenza B component(s) of the trivalent (B/Victoria only) and quadrivalent (B/Victoria and B/Yamagata) vaccines.

Table 3. Influenza virus antigenic characterization, 2016–2017 season

Influenza Subtype/Lineage	Vaccine Strain	California*	United States*
Influenza A (H1)	A/California/7/2009-like (H1N1)	31/33[†]	294/296
Influenza A (H3)	A/Hong Kong/4801/2014-like	74/74	730/772
Influenza B Victoria[‡]	B/Brisbane/60/2008-like	12/12	283/327
Influenza B Yamagata[§]	B/Phuket/3073/2013-like	24/24	429/429

* California data are for viruses characterized through September 21, 2017; CDC data are for viruses characterized through May 20, 2017
† Two influenza 2009 A (H1N1) viruses were characterized as A/Michigan/45/2015-like, which is the recommended H1N1 component for the 2017–2018 influenza vaccine
‡ The influenza B Victoria lineage virus is included in both the 2016–2017 trivalent and quadrivalent influenza vaccines
§ The influenza B Yamagata lineage virus is included in only the 2016–2017 quadrivalent influenza vaccine

4. Antiviral Resistance Testing

The CDPH-VRDL monitors influenza viruses for antiviral resistance (AVR) using genetic and phenotypic analysis. All suitable selected influenza 2009 A (H1N1), A (H3N2), and B positive samples collected throughout California are simultaneously assessed genetically, by whole genome sequencing, and phenotypically, by the functional neuraminidase inhibition (NI) assay. The NI assay is performed on viral isolates and is the preferred method for the detection of viral resistance to the neuraminidase inhibitor

(NAI) class drugs (including oseltamivir, zanamivir, and peramivir) caused by established (e.g., H275Y) or novel mutations. Furthermore, increased AVR surveillance is also performed on additional influenza 2009 A (H1N1) and A (H3N2) positive clinical specimens by using the high throughput pyrosequencing assay to detect single mutations known to confer NAI resistance. Of the 232 influenza specimens tested by the CDPH-VRDL during the 2016–2017 influenza season, no specimens were found to be resistant to NAIs (Table 4).

Table 4. Number of specimens tested for antiviral resistance, California, 2016–2017 season

	Neuraminidase Inhibitor Resistance
Influenza 2009 A (H1N1)	0/40
Influenza A (H3N2)	0/153
Influenza B	0/39

CDC also performs antiviral resistance testing as part of its routine national surveillance. Influenza 2009 A (H1N1), influenza A (H3N2), and influenza B virus isolates were tested for resistance to oseltamivir, zanamivir, and peramivir (all NAIs). During the 2016–2017 influenza season, a total of 2,569 specimens were tested nationally. All viruses tested (2009 A (H1N1): 304 viruses, A (H3N2): 1,303 viruses, and B: 962 viruses) were sensitive to oseltamivir, zanamivir, and peramivir.

5. Novel Influenza A Viruses

No novel influenza viruses were detected in California by the CDPH-VRDL or RLN laboratories by real-time reverse transcription polymerase chain reaction (rRT-PCR) during the 2016–2017 season.

B. Case-Based Surveillance

1. Influenza-associated Severe Illness and Mortality in Californians <65 Years of Age

Laboratory-confirmed influenza-associated deaths among patients under 65 years of age are reportable in California [Title 17, California Code of Regulations (CCR) §2500]. Since the 2009 A (H1N1) influenza pandemic, local health jurisdictions (LHJs) have also voluntarily reported to the CDPH laboratory-confirmed influenza-associated hospitalizations requiring intensive care unit (ICU) admission for patients less than 65 years of age.

Epidemiologic Curve of ICU and Fatal Cases <65 Years of Age
During the 2016–2017 influenza season, CDPH received 524 reports of influenza-associated severe illness (ICU admissions) or deaths among persons less than 65 years of age; 499 (95.2%) had onset during weeks 40–20 (October 2, 2016 through May 20, 2017) and 25 (4.8%) had onset during the summer months (May 21, 2017 through September 30, 2017). Of the 524 influenza-associated severe and fatal cases

reported, 414 (79.0%) were non-fatal ICU cases and 110 (21.0%) were fatal cases. Figure 6 shows the number of fatal and non-fatal ICU cases by week of onset during 2016–2017. Fatal influenza case counts by local health jurisdiction for the 2012–2013 through the 2016–2017 influenza season can be found in Appendix I.

Figure 6. Number of influenza-associated fatal and non-fatal ICU cases (<65 years of age) reported to the California Department of Public Health, by week of symptom onset, October 2, 2016–September 30, 2017
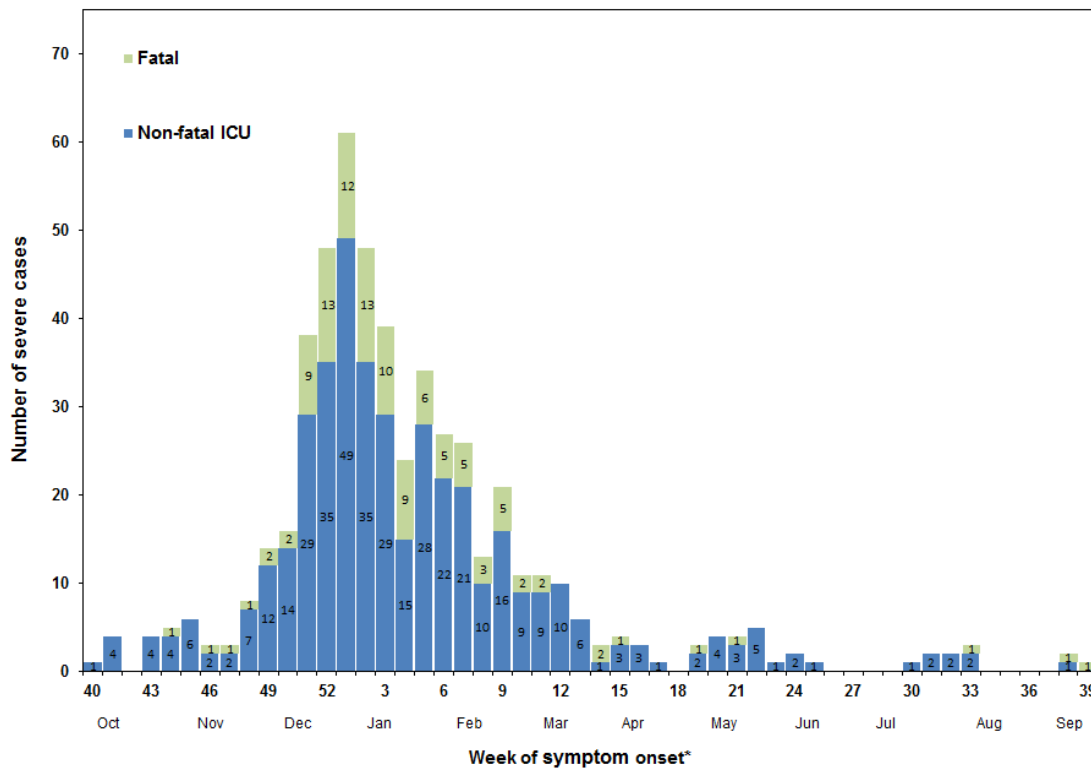
* If onset date was not available, then the earliest known date associated with the illness was used.

Demographic Characteristics and Clinical Features of ICU and Fatal Cases <65 Years of Age
The median age of onset for the 524 patients who had influenza-associated severe or fatal illness during the 2016–2017 season was 49 years (range: 1 week–64 years); 276 (52.7%) were male (Table 5). Fatal cases (median age: 55 years; range: 4 months–64 years) were significantly older than non-fatal ICU cases (median age: 47 years; range: 1 week–64 years) [p<0.001]. The majority of the 524 influenza-associated severe or fatal cases reported during the 2016–2017 influenza season occurred among adults aged 18–64 years of age (415; 79.2%). Pediatric cases under the age of 18 years accounted for 20.8% (n=109) of the severe and fatal cases.

The CDPH case-based surveillance data should be interpreted with caution due to the following limitations: exclusion of cases 65 years of age and older, voluntary reporting of ICU cases, differing degrees of participation by the LHJs, and biases in testing practices

(e.g., specimens may not be available for influenza testing). These data are also considered provisional as some cases may still be under investigation.

Table 5. Demographic characteristics of non-fatal ICU and fatal cases of laboratory-confirmed influenza reported to the California Department of Public Health, October 2, 2016–September 30, 2017

	Non-fatal ICU cases* No. (%)	Fatal cases No. (%)
Total	414	110
Sex		
Male	226 (54.6)	50 (45.5)
Median age, in years	47	55
Age group		
0–4	48 (11.6)	3 (2.7)
5–17	52 (12.6)	6 (5.5)
18–49	134 (32.4)	29 (26.4)
50–64	180 (43.5)	72 (65.5)

* Reporting of influenza-associated ICU admissions is voluntary and might not be complete for all local health jurisdictions.
ICU – intensive care unit

Information on underlying medical conditions, including those conditions defined by the Advisory Committee for Immunization Practices (ACIP) as being associated with severe influenza, was collected for severely ill and fatal influenza cases.[3] The most frequently reported underlying medical conditions among adults aged 18–64 years with available information were chronic lung disease (e.g., asthma, chronic obstructive pulmonary disease; 177/300; 59.0%), metabolic disease (e.g., diabetes mellitus, renal disease; 187/320; 58.4%), and cardiac disease (e.g., coronary artery disease; 116/286; 40.6%) [Figure 7]. There was one pregnant woman among the influenza-associated ICU admissions.

Among pediatric patients with available information, the most frequently reported underlying medical condition was chronic lung disease (29/66; 43.9%); 20 (69.0%) of the 29 children with chronic lung disease had asthma. Other frequently reported underlying medical conditions among pediatric patients include neurological disorders (e.g., seizure disorder, cerebral palsy; 23/59; 39.0%) and cardiac disease (13/62; 21.0%).

Thirty-seven (38.9%) of the pediatric patients and 17 (4.4%) of the adult patients with information available were reported to be previously healthy; however, 27 (73.0%) of the 37 previously healthy children were <5 years of age, which is associated with an increased risk of developing influenza-related complications even in the absence of other underlying medical conditions.

Influenza vaccination information was available for 219 (52.8%) of the 415 adult cases reported with severe or fatal influenza; 150 (68.5%) received the 2016–2017 influenza vaccine. Sixty-four (68.8%) of the 93 reported pediatric cases ≥6 months of age had

influenza vaccination information available; 41 (64.1%) received the 2016–2017 influenza vaccine.

Figure 7. Selected underlying medical conditions in non-fatal ICU and fatal cases of laboratory-confirmed influenza reported to the California Department of Public Health, October 2, 2016–September 30, 2017
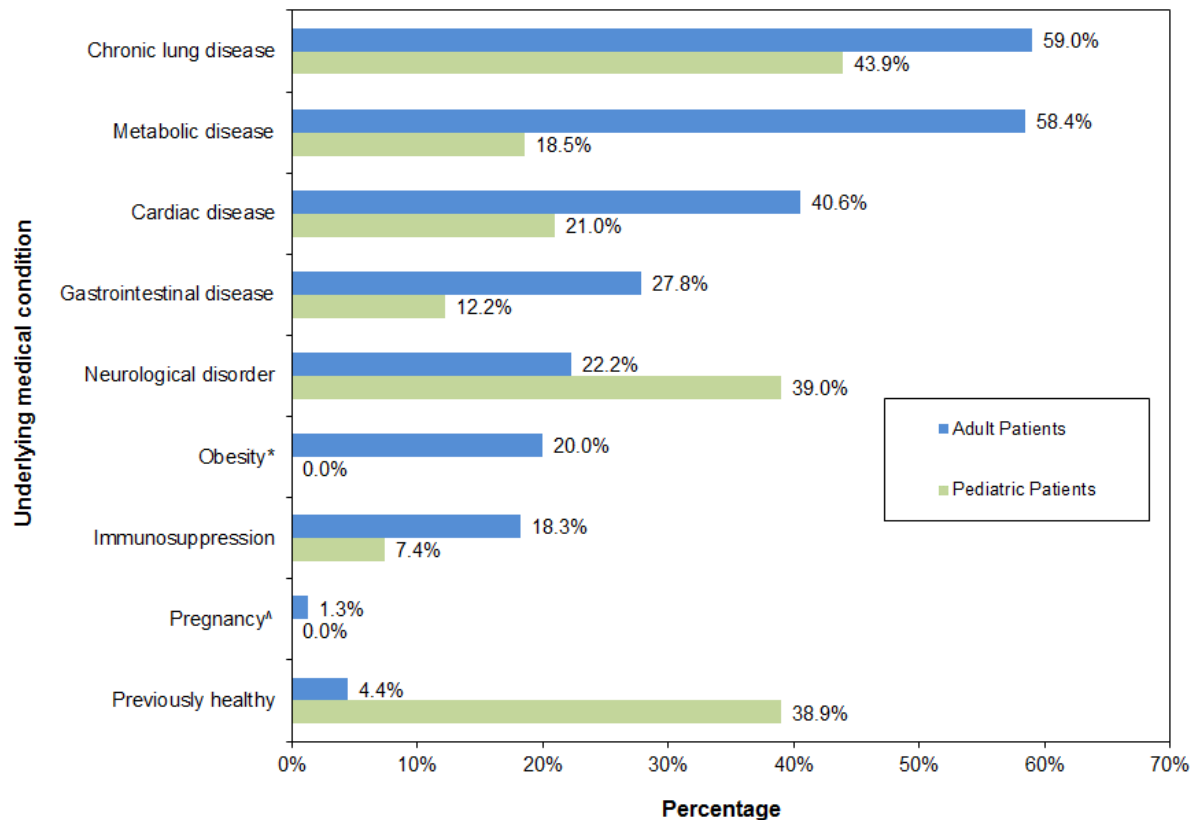
* Excludes pediatric patiens <2 years of age and pregnant women
^ Among females 12–49 years of age

Influenza Types and Subtypes

Of the 524 severely ill and fatal influenza cases reported, 459 (87.6%) tested positive for influenza A, 61 (11.6%) tested positive influenza B, one (0.2%) tested positive for influenza A and B, and three (0.6%) tested positive for influenza, but the influenza type was not known (Table 5). Of the 459 influenza A infections, 192 (41.8%) were A (H3N2), 20 (4.4%) were 2009 A (H1N1), one (0.2%) was A (H3N2) and 2009 A (H1N1), and 246 (53.6%) were not subtyped. Of the 61 influenza B infections, two (3.3%) were B/Yamagata lineage, one (1.6%) was B/Victoria lineage, and 58 (95.1%) were not lineage-typed. Influenza subtype and lineage type were not known for the influenza A and B co-infection.

Table 6. Influenza subtyping and lineage typing among laboratory-confirmed influenza non-fatal ICU and fatal cases reported to the California Department of Public Health, October 2, 2016–September 30, 2017

	Total	
	No.	**(%)**
Influenza A	**459**	**(87.6)***
2009 A (H1N1)	20	(4.4)[†]
A (H3N2)	192	(41.8)[†]
2009 A (H1N1) and A (H3N2)	1	(0.2)[†]
Subtyping not performed	246	(53.6)[†]
Influenza B	**61**	**(11.6)***
Yamagata	2	(3.3)[§]
Victoria	1	(1.6)[§]
Lineage typing not performed	58	(95.1)
Influenza A and B	**1**	**(0.2)***
Flu type unknown	**3**	**(0.6)***

* Percent of all influenza positive patients
[†] Percent of influenza A positive specimens
[§] Percent of influenza B positive specimens

2. California Emerging Infections Program Data: Influenza-associated Hospitalizations

The California Emerging Infections Program (CEIP), Influenza Surveillance Network (FluSurv-NET) conducts population-based surveillance for laboratory-confirmed influenza-associated hospitalizations in all ages in Alameda, Contra Costa and San Francisco counties. FluSurv-NET is a national network which covers over 70 counties in the 10 Emerging Infections Program (EIP) states (CA, CO, CT, GA, MD, MN, NM, NY, OR, and TN) and three additional states (MI, OH, and UT).

During the 2016–2017 season, the incidence of influenza-associated hospitalizations per 100,000 population began increasing in early December and peaked during the week ending January 7, 2017 with an incidence of 12.2 influenza hospitalizations per 100,000 population (Figure 8). This rate was substantially higher than the peak rate during the 2014–2015 and 2015–2016 influenza seasons (6.4 and 2.5 influenza hospitalizations per 100,000, respectively). Of the 2,588 patients hospitalized for influenza 2,376 (91.8%) had influenza A infections, 205 (7.9%) had influenza B infections, and 6 (0.2%) had influenza A and B co-infections. One patient had an influenza infection but the influenza type was not known. The highest cumulative rate of hospitalization was among adults aged >64 years, followed by the 50–64 year and 0–4 year age groups (Figure 9). Patients >64 years of age accounted for 69% of the total reported hospitalized cases.

Figure 8. Incidence of influenza-associated hospitalizations in CEIP counties, 2014–2017
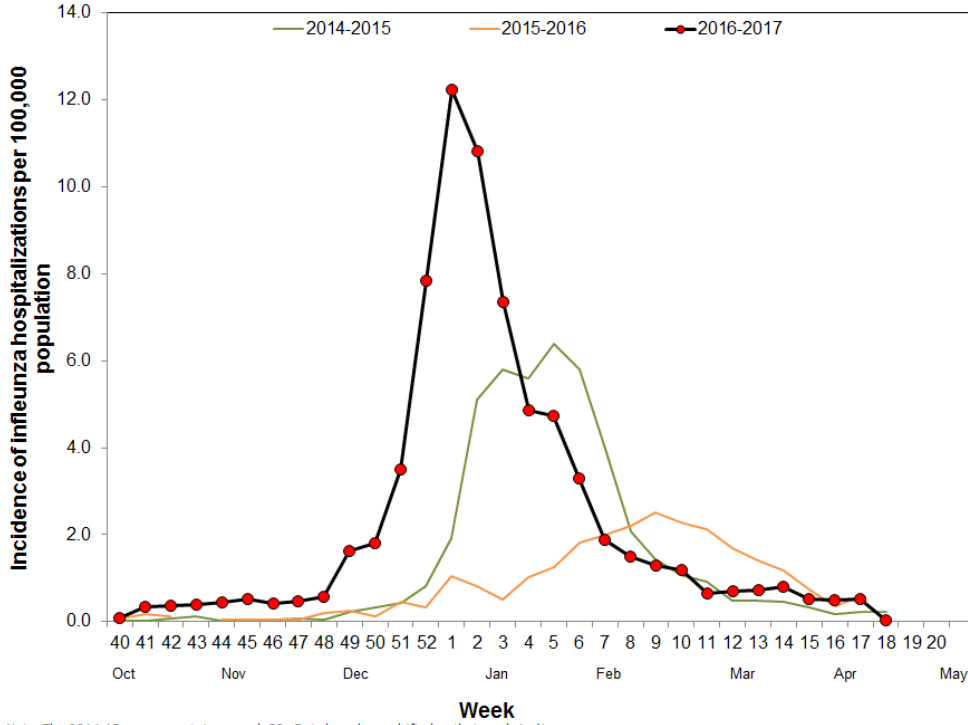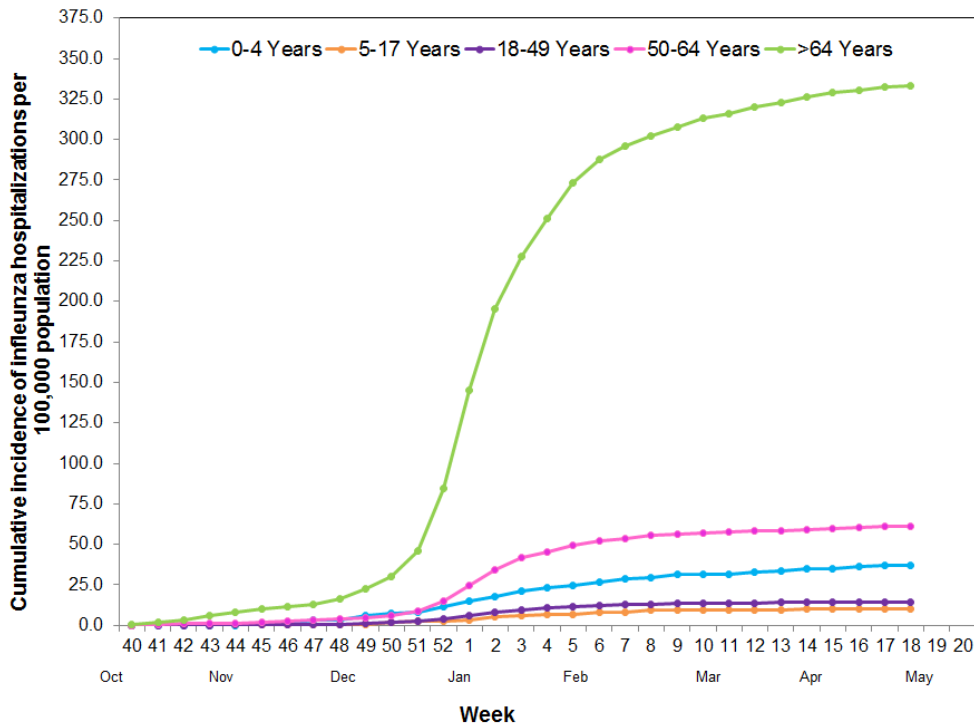

Note: The 2014-15 season contains a week 53. Data have been shifted so that week 1 aligns across years.

Figure 9. Cumulative incidence of influenza hospitalizations in CEIP counties by age group, 2016–2017

C. Syndromic Surveillance

1. Influenza-like Illness Outpatient Surveillance (Sentinel Providers)

In collaboration with CDC, the CDPH works with volunteer sentinel providers throughout the state to conduct year-round surveillance for ILI in outpatients. Sentinel providers may be individual practitioners or represent whole healthcare systems in a variety of outpatient settings including, but not limited to, hospital outpatient clinics, emergency departments, and student health services. Sentinel providers report on a weekly basis the number of patients with ILI and the total number of patients seen for any reason. Influenza-like illness is defined as any illness with (1) fever (≥100°F or 37.8°C) and (2) cough and/or sore throat, in the absence of a known cause other than influenza.

In California, 130 sentinel providers reported ILI activity on a regular basis (i.e. at least 17 of the 33 weeks from October 2, 2016 to May 20, 2017). There was minimal ILI activity until mid-December, when sentinel providers began reporting increases in patients with ILI (Figure 10). Influenza-like illness activity peaked at 3.5% during the week ending December 31, 2016 and remained elevated through early February, returning to seasonal baseline levels during mid-February. The percentage of visits for ILI exceeded two standard deviations above baseline levels between the weeks ending December 18, 2016 and February 4, 2017, with the exception of the week ending January 21, 2017 when the percentage of outpatient visits for ILI was within two standard deviations of baseline levels.

**Figure 10. Percentage of influenza-like illness visits among patients seen by California Sentinel Providers, 2012–2017***
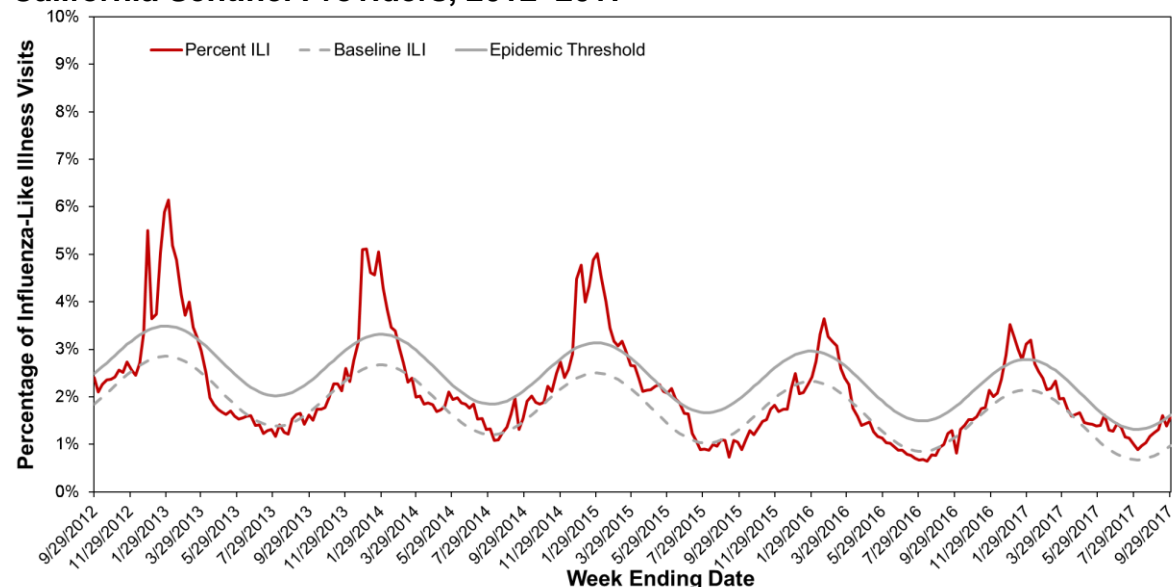
* The seasonal baseline was calculated using a regression model applied to data from the previous five years. Two standard deviations above the seasonal baseline is the point at which the observed percentage of ILI is significantly higher than would be expected at that time of the year.

Sentinel providers voluntarily submit specimens from patients with ILI to the CDPH-VRDL for influenza testing. Many of these specimens are sent to CDC for further characterization, providing important information about what influenza virus strains are circulating in the community. From October 2, 2016 through May 20, 2017, sentinel providers submitted 202 respiratory specimens; 94 (46.5%) were positive for influenza. Of these, 86 (91.5%) were influenza A and eight (8.5%) were influenza B. Of the 84 positive influenza A specimens, 82 (97.6%) were A (H3N2) and two (2.4%) were 2009 A (H1N1). All eight influenza B positive specimens were lineage-typed as B Yamagata. The number of specimens submitted by sentinel providers that tested positive for influenza peaked during the week ending February 4, 2017 coinciding with the secondary peak in ILI activity (Figure 11). The primary peak in ILI activity during the week ending December 31, 2016 coincided with a drop in submitted specimens, which was likely due to the Christmas and New Year's holidays.

Figure 11. Sentinel Provider specimens tested that were positive for influenza by week of collection, and percentage of influenza-like illness visits by week of visit, October 2, 2016–May 20, 2017
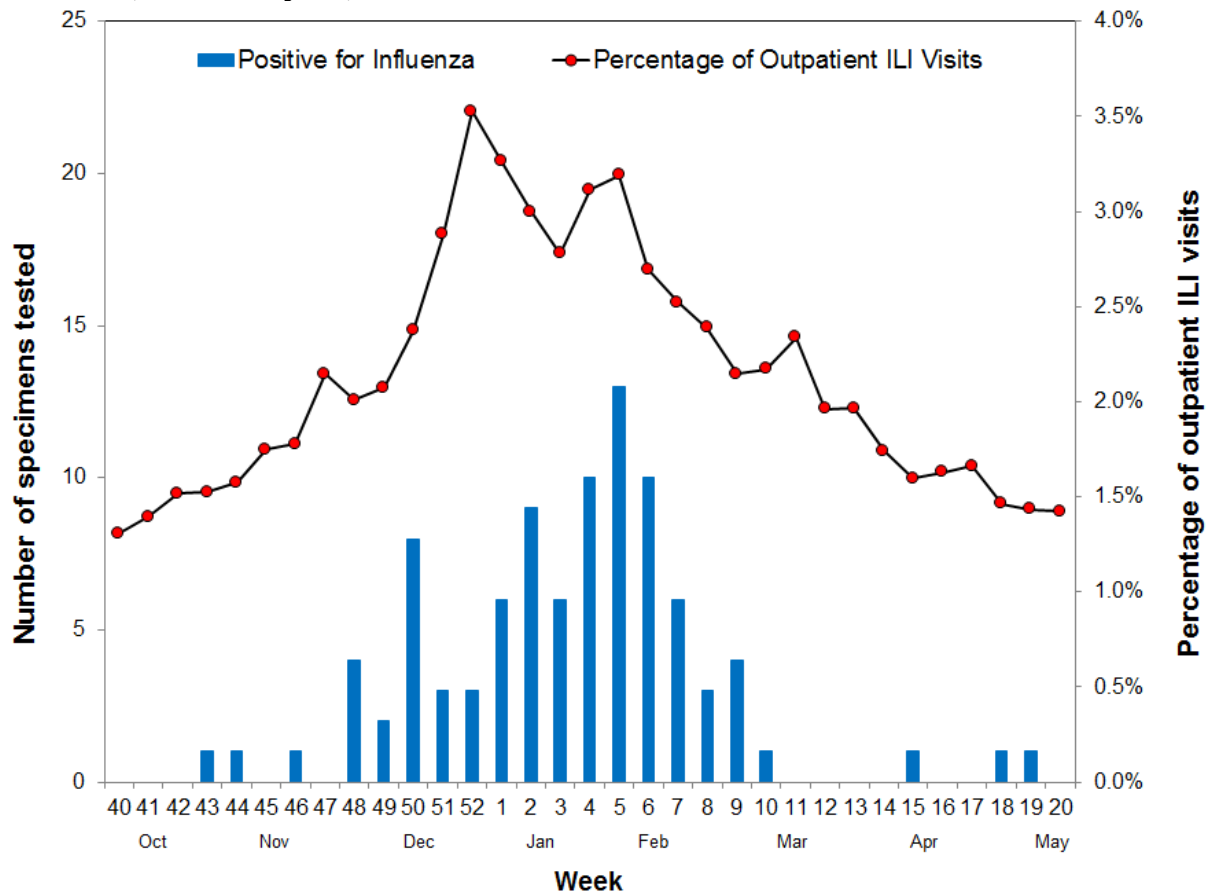
2. Kaiser Permanente Northern California Pneumonia and Influenza Admission Data

The CDPH collaborates with Northern California Kaiser Permanente to monitor trends in pneumonia and influenza-related hospitalizations. Patients with admission diagnoses of "flu," "pneumonia," or "influenza" are defined as pneumonia and influenza (P&I) admissions. The number of P&I admissions is divided by the total number of hospital admissions occurring in the same time period to estimate the percentage of P&I admissions. Admissions for pregnancy, labor and delivery, birth, and outpatient procedures are excluded from the denominator.

During the 2016–2017 influenza season, the percentage of P&I hospitalizations in Northern California Kaiser Permanente hospitals increased sharply in late December, peaking at 10.2% during the week ending January 7, 2017. This was the highest percentage of P&I hospitalizations reported since the CPDH collaboration with Northern California Kaiser Permanente began in 2006. The percentage of P&I hospitalizations remained elevated through mid-February, exceeding two standard deviations above baseline levels for a total of 10 weeks during the 2016–2017 influenza season.

Figure 12. Percentage of pneumonia and influenza admissions in Northern California Kaiser Permanente hospitals, 2012–2017*
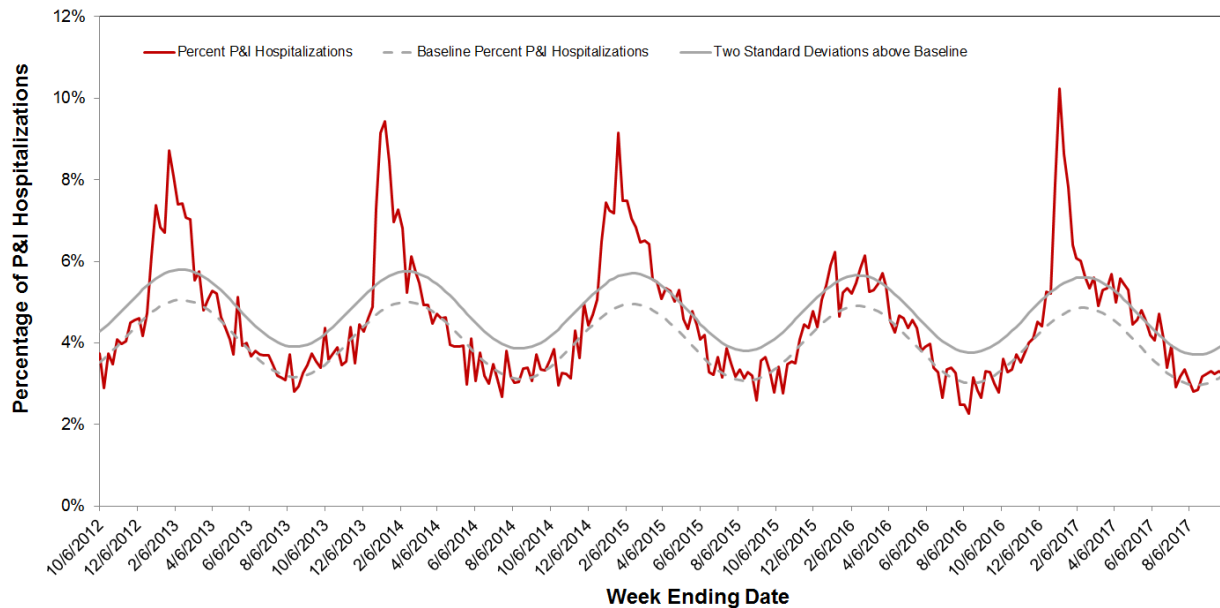
* The seasonal baseline was calculated using a regression model applied to data from the previous five years. Two standard deviations above the seasonal baseline is the point at which the observed percentage of pneumonia and influenza hospitalizations in Kaiser Permanente hospitals in Northern California is significantly higher than would be expected at that time of the year.

D. Outbreaks of Respiratory Illness, Including Influenza

Outbreaks are required to be reported to the local health authority under Title 17, CCR 2500; however, outbreaks occurring in residential care facilities are more likely to be identified and reported to CDPH than other respiratory outbreaks. In general, respiratory, non-tuberculosis outbreaks are defined as a sudden increase of acute respiratory illnesses over the normal background rate.

From October 2, 2016 to May 20, 2017 local health departments reported a total of 328 confirmed non-tuberculosis respiratory outbreaks to the CDPH. The outbreaks were reported from 38 local health jurisdictions throughout the state. There was a substantial increase in the number of outbreaks reported during the 2016–2017 season compared to the 2015–2016 influenza season (n=143). Of the 328 confirmed respiratory outbreaks, influenza was the most commonly identified pathogen (292; 89.0%, including four outbreaks where both influenza and RSV were identified). Nineteen (5.8%) confirmed respiratory outbreaks had no identified etiology. The remaining 17 (5.2%) outbreaks identified RSV (6), pertussis (1), rhinovirus (2), coronavirus (1), human metapneumovirus (1), and unspecified streptococcal infection (6).

The first influenza-associated outbreak identified during the 2016–2017 influenza season occurred in early October 2016 (Figure 13). Influenza outbreaks continued to occur through the end of the season, with peak activity occurring in early January 2017. Ten confirmed influenza outbreaks were reported to the CDPH with initial case onset during the weeks ending May 27, 2017 through September 30, 2017. Eight of these occurred in residential healthcare facilities, one in a school, and one in a correctional facility.

Of the 292 influenza-associated outbreaks, 280 (95.9%) were associated with influenza A and four (1.4%) were associated with influenza B. An additional three (1.0%) outbreaks were associated with both influenza A and influenza B, and five (1.7%) were associated with influenza, but the influenza type was not known. Of the 280 outbreaks where influenza A viruses were identified, 84 had subtyping information available; 79 (94.0%) were A (H3N2), three (3.6%) were 2009 A (H1N1), and two (2.4%) were both A (H3N2) and 2009 A (H1N1). Of the four outbreaks where influenza B viruses were identified, one had lineage typing performed; one (100.0%) was B/Victoria lineage. Most influenza A (196; 70.0%) and influenza B (3; 75.0%) specimens were not subtyped or lineage typed.

Of the 292 influenza-associated outbreaks, 208 (71.2%) occurred in residential healthcare facilities, such as skilled nursing facilities, and 56 (19.2%) occurred in assisted or independent living facilities (congregate residential facilities not providing routine healthcare). Local health departments also reported influenza outbreaks in correctional facilities (10; 3.4%), schools (7; 2.4%), acute care facilities (3; 1.0%), and other congregate settings (8; 2.7%).

Figure 13. Reported respiratory outbreaks by week of earliest onset, October 2, 2016–May 20, 2017
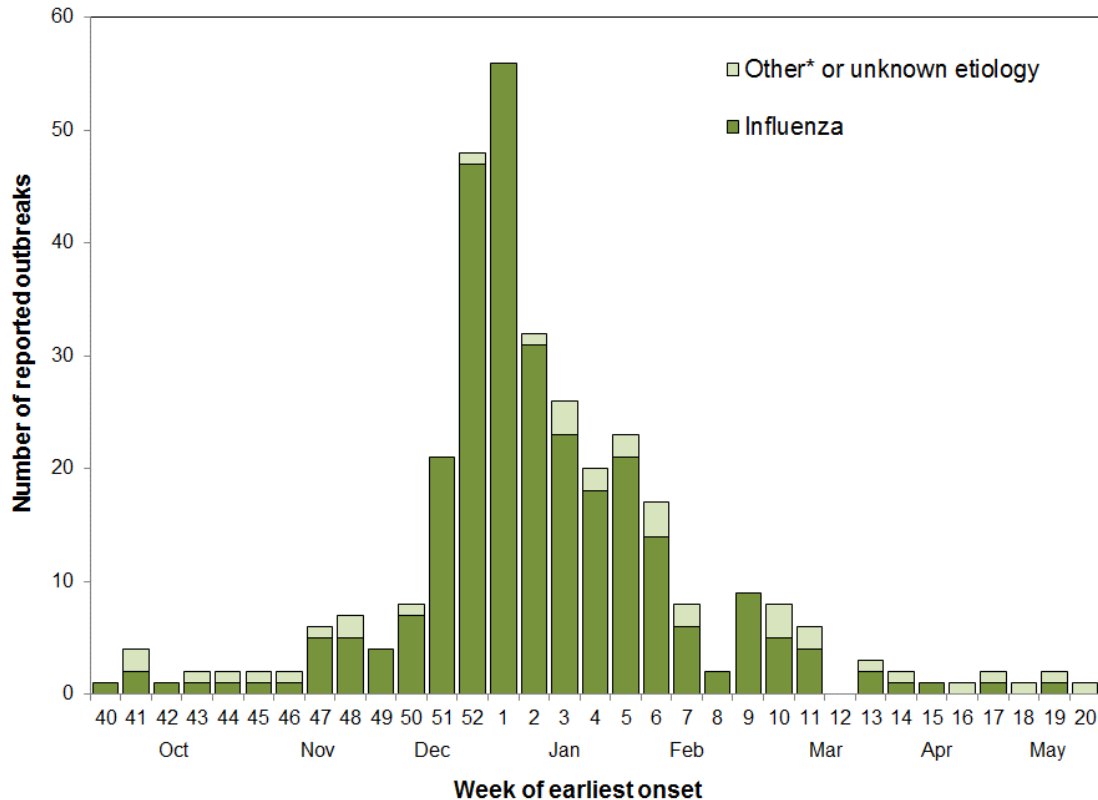
* Other etiologies identified by laboratory confirmation included RSV (6), rhinovirus (2), pertussis (1), coronavirus (1), human metapneumo virus (1), and unspecified streptococcal infection (6). Additionally, there were four influenza outbreaks (three with influenza A and one with influenza B) that also identified RSV.

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Appendix I. Number of influenza-associated fatal cases in persons <65 years of age reported to the California Department of Public Health, by local health jurisdiction, 2012–2013 influenza season through 2016–2017 influenza season

Jurisdiction	2012–2013* Season	2013–2014* Season	2014–2015* Season	2015–2016* Season	2016–2017* Season
CALIFORNIA	116	419	83	155	110
Alameda[†]	3	12	2	7	5
Berkeley City	0	0	0	0	0
Alpine	0	0	0	0	0
Amador	0	0	0	0	1
Butte	0	3	0	0	0
Calaveras	0	2	0	0	1
Colusa	0	0	0	0	0
Contra Costa	1	9	1	3	4
Del Norte	1	0	0	0	0
El Dorado	0	3	0	0	1
Fresno	7	22	4	5	2
Glenn	0	1	0	0	0
Humboldt	0	1	1	1	0
Imperial	0	2	0	0	0
Inyo	0	0	0	0	0
Kern	2	11	0	1	2
Kings	0	7	0	1	1
Lake	0	1	0	0	1
Lassen	0	1	0	0	0
Los Angeles[†]	32	76	16	42	19
Long Beach City	1	8	1	1	0
Pasadena City	0	0	0	0	0
Madera	2	3	1	1	0
Marin	0	2	0	0	0
Mariposa	0	0	0	0	0
Mendocino	0	4	0	0	1
Merced	0	5	0	0	0
Modoc	0	0	0	0	0
Mono	0	0	0	0	0
Monterey	0	7	2	1	4
Napa	0	0	1	0	3
Nevada	0	1	0	0	0
Orange	6	22	11	14	4
Placer	0	1	1	1	2
Plumas	0	0	0	0	0
Riverside	7	24	3	9	2
Sacramento	10	29	4	8	10
San Benito	0	0	0	0	0
San Bernardino	7	32	4	6	2
San Diego	16	44	9	28	14
San Francisco	2	4	1	0	2
San Joaquin	0	8	3	2	7
San Luis Obispo	2	1	0	0	1
San Mateo	1	6	5	2	0
Santa Barbara	1	3	2	4	1
Santa Clara	8	20	2	6	2
Santa Cruz	0	5	0	0	2
Shasta	0	3	1	0	1
Sierra	0	0	0	0	0
Siskiyou	0	2	0	0	0
Solano	0	3	2	2	5
Sonoma	0	7	1	5	0
Stanislaus	2	13	2	1	3
Sutter	0	1	0	0	0
Tehama	1	0	0	0	0
Trinity	0	0	1	0	0
Tulare	1	5	1	1	1
Tuolumne	0	1	0	0	0
Ventura	3	3	1	3	2
Yolo	0	1	0	0	4
Yuba	0	0	0	0	0

* 2012–2013: September 30, 2012–September 28, 2013; 2013–2014: September 29, 2013–September 27, 2014; 2014–2015: September 28, 2014–October 3, 2015; 2015–2016: October 4, 2015–October 2, 2016; 2016–2017: October 3, 2016–September 30, 2017

[†] Does not include city counts