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Update: Influenza Activity — United States, October 1, 2017–February 3, 2018

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Influenza activity in the United States began to increase in early November 2017 and rose sharply from December through February 3, 2018; elevated influenza activity is expected to continue for several more weeks. Influenza A viruses have been most commonly identified, with influenza A(H3N2) viruses predominating, but influenza A(H1N1)pdm09 and influenza B viruses were also reported. This report summarizes U.S. influenza activity* during October 1, 2017–February 3, 2018,† and updates the previous summary (*1*).

Viral Surveillance

U.S. World Health Organization (WHO) and National Respiratory and Enteric Virus Surveillance System laboratories, which include both public health and clinical laboratories throughout the 50 U.S. states, Puerto Rico, and the District of Columbia, contribute to virologic surveillance for influenza. During October 1, 2017–February 3, 2018, clinical laboratories tested 666,493 specimens for influenza virus, 124,316 (18.7%) of which tested positive (Figure 1). During this period, the percentage of specimens testing positive for any influenza virus increased to 26.4% during the week ending January 13 and remained at approximately that level (26.3%–26.7%) through the week ending February 3, 2018. The percentage of specimens testing positive for influenza A viruses peaked at 21.8% during the week ending January 13; however, the percentage testing positive for influenza B viruses continued to increase through the week ending February 3, during which 8.1% of specimens tested were positive for influenza B. On a regional level, the percentage of specimens testing positive for any influenza virus has decreased for 2 or more consecutive weeks in U.S. Department of Health and Human Services

Continuing Education examination available at https://www.cdc.gov/mmwr/cme/conted_info.html#weekly.

*The CDC influenza surveillance system collects five categories of information from eight data sources: 1) viral surveillance (U.S. World Health Organization collaborating laboratories, the National Respiratory and Enteric Virus Surveillance System, and novel influenza A virus case reporting); 2) outpatient illness surveillance (U.S. Outpatient Influenza-Like Illness Surveillance Network); 3) mortality (National Center for Health Statistics Mortality Surveillance System and influenza-associated pediatric mortality reports); 4) hospitalizations (FluSurv-NET, which includes the Emerging Infections Program and surveillance in three additional states); and 5) summary of the geographic spread of influenza (state and territorial epidemiologist reports). https://www.cdc.gov/flu/weekly/fluactivitysurv.htm.

†Data as of February 9, 2018.

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(HHS) Regions[§] 6, 7, 9, and 10 but has continued to increase or remain level in the remaining regions (Regions 1, 2, 3, 4, 5, and 8) through the week ending February 3.

Public health laboratories tested 51,014 specimens collected during October 1, 2017–February 3, 2018. Among these, 27,669 tested positive for influenza virus, including 23,257 (84.1%) for influenza A and 4,412 (15.9%) for influenza B viruses (Figure 2). Among the 22,810 seasonal influenza A viruses subtyped, 20,512 (89.9%) were influenza A(H3N2) viruses, and 2,298 (10.1%) were influenza A(H1N1)pdm09 viruses; influenza A(H3N2) viruses accounted for 74.1% of all influenza viruses reported. Influenza B virus lineage information was available for 3,319 (75.2%) influenza B viruses; 3,010 (90.7%) belonged to the B/Yamagata lineage and 309 (9.3%) to the B/Victoria lineage. Whereas influenza A(H3N2) viruses accounted for the majority of circulating viruses in all HHS regions, the proportion of subtyped influenza A viruses that were identified as A(H1N1)pdm09 regionally ranged from 5% (Region 7) to 21% (Region 6), and the proportion of circulating viruses reported to be influenza B ranged from 9% (Region 5) to 28% (Region 10).

Data on age were available for 23,578 influenza-positive patients whose specimens were tested by public health laboratories. Overall, 1,863 (7.9%) were aged 0–4 years, 5,208 (22.1%) were aged 5–24 years, 7,576 (32.1%) were aged 25–64 years, and 8,931 (37.9%) were aged ≥65 years. Influenza A(H3N2) viruses were predominant among all age groups, accounting for 68%–72% of viruses identified among persons aged 0–4 years, 5–24 years, and 25–64 years and 84% of viruses reported among persons aged ≥65 years. The largest proportion of reported influenza B virus infections occurred in persons aged 5–24 years; influenza B viruses accounted for 21.9% of the viruses reported in this age group.

Novel Influenza A Viruses

Six human infections with novel influenza A viruses were reported to CDC during October 1, 2017–February 3, 2018. All of these were variant[¶] virus infections (human infections with influenza viruses that normally circulate in swine). Five of these infections were previously described (*1*). The sixth human

[§] The 10 regions include the following jurisdictions. *Region 1*: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont; *Region 2*: New Jersey, New York, Puerto Rico, and the U.S. Virgin Islands; *Region 3*: Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, and West Virginia; *Region 4*: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee; *Region 5*: Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin; *Region 6*: Arkansas, Louisiana, New Mexico, Oklahoma, and Texas; *Region 7*: Iowa, Kansas, Missouri, and Nebraska; *Region 8*: Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming; *Region 9*: Arizona, California, Hawaii, Nevada, American Samoa, Commonwealth of the Northern Mariana Islands, Federated States of Micronesia, Guam, Marshall Islands, and Republic of Palau; *Region 10*: Alaska, Idaho, Oregon, and Washington.

[¶] Influenza viruses that circulate in swine are called swine influenza viruses when isolated from swine but are called variant influenza viruses when isolated from humans. Seasonal influenza viruses that circulate worldwide in the human population have important antigenic and genetic differences from influenza viruses circulating in swine.

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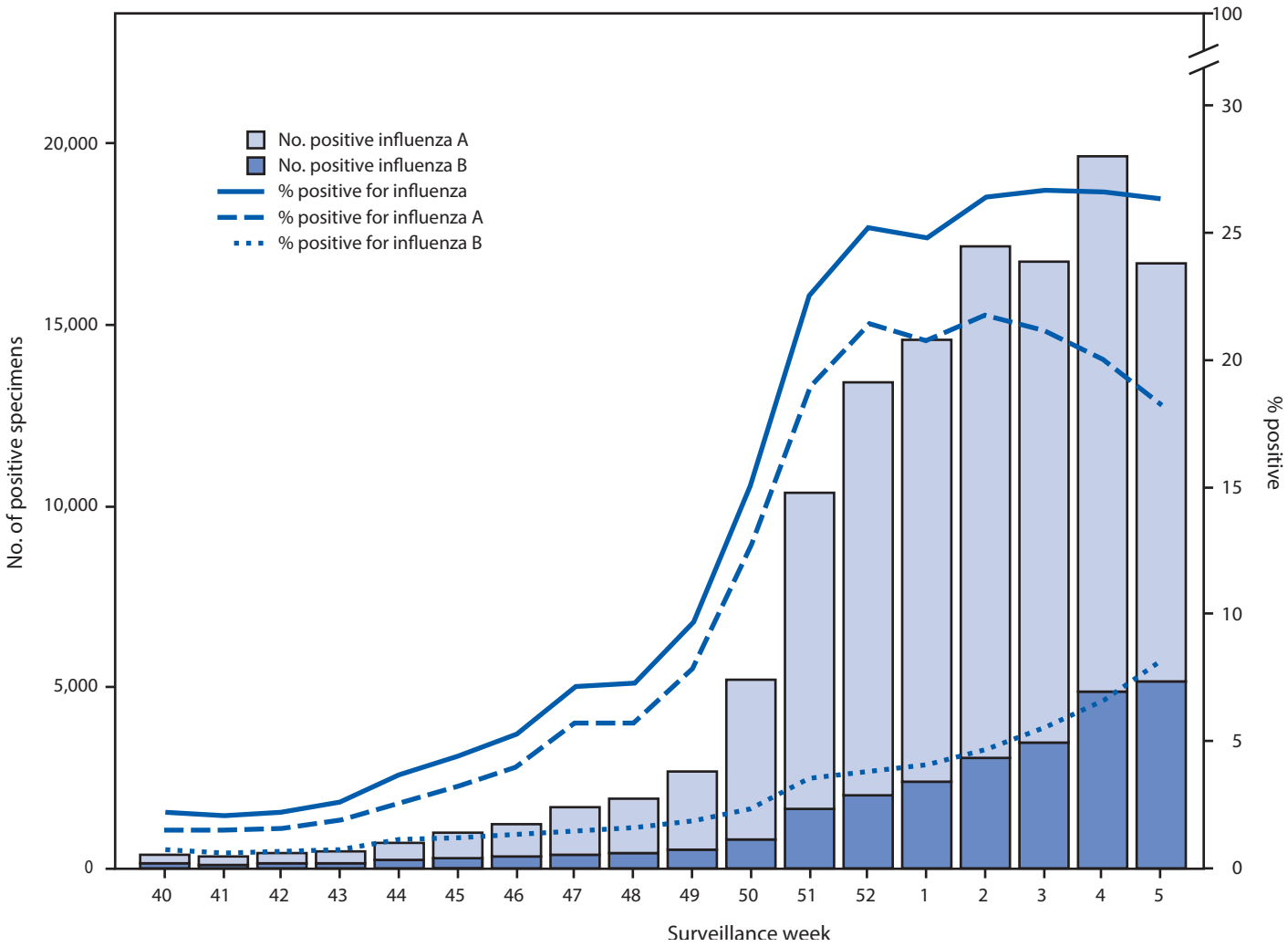
FIGURE 1. Number* and percentage of respiratory specimens testing positive for influenza reported by clinical laboratories, by influenza virus type and surveillance week — United States, October 1, 2017–February 3, 2018†



* A total of 124,316 (18.7%) of 666,493 specimens tested were positive during October 1, 2017–February 3, 2018.
† As of February 9, 2018.

infection with a novel influenza A virus was caused by an influenza A(H3N2) variant (A[H3N2]v) virus in Iowa in an adult patient with onset of respiratory symptoms in November 2017. This patient reported exposure to swine during the week preceding illness onset, was not hospitalized, and has fully recovered. No sustained human-to-human transmission was identified.

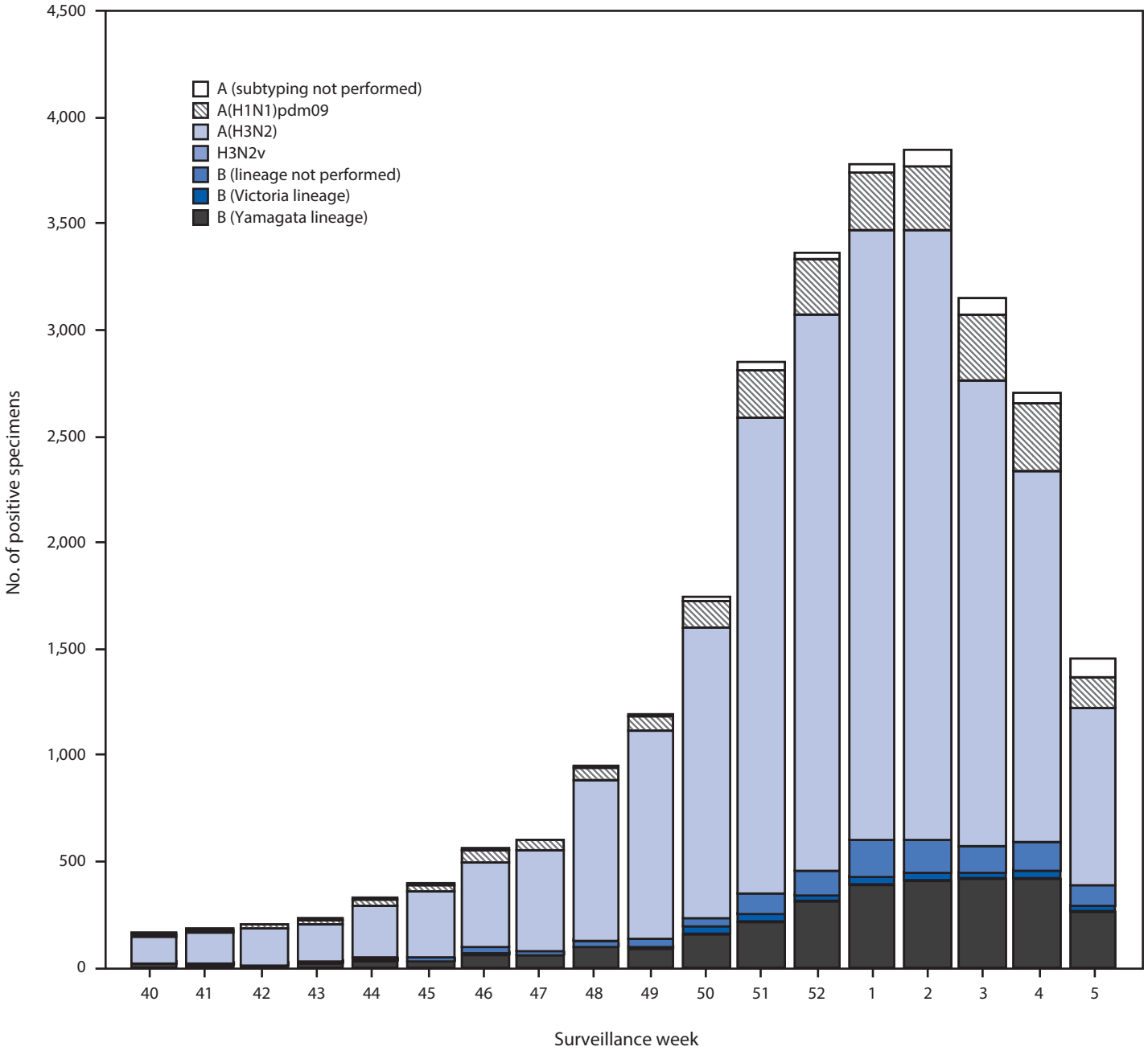
The A(H3N2)v virus detected in Iowa had a hemagglutinin (HA) gene segment derived from a seasonal human H3N2 virus that was likely introduced into swine by reverse zoonosis (i.e., human infection of swine) in 2010. This virus was closely related to H3N2 viruses known to circulate in the U.S. swine population (*2*), as well as to variant virus infections detected in Delaware, Maryland, Michigan, Nebraska, North Dakota, Ohio, and Pennsylvania during May–December 2017 (*1*,*2*).

Antigenic and Genetic Characterization of Influenza Viruses

In the United States, public health laboratories participating in influenza surveillance as WHO collaborating laboratories are asked to submit a subset of influenza-positive respiratory specimens to CDC for virus characterization according to specific guidelines.** CDC characterizes influenza viruses through one or more laboratory tests, including genomic sequencing,

** Association of Public Health Laboratories. Influenza Virologic Surveillance Right Size Roadmap. https://www.aphl.org/AboutAPHL/publications/Documents/ID_July2013_Influenza-Virologic-Surveillance-Right-Size-Roadmap.pdf.

FIGURE 2. Number* of respiratory specimens testing positive for influenza reported by public health laboratories, by influenza virus type, subtype/lineage, and surveillance week — United States, October 1, 2017–February 3, 2018†



* N = 27,669.
† As of February 9, 2018.

antigenic characterization by hemagglutination inhibition (HI), or neutralization assays. Circulating viruses that have been isolated and propagated in mammalian cell culture are evaluated for antigenic similarity to cell culture–propagated reference viruses representing the recommended vaccine components of the Northern Hemisphere 2017–18 vaccine.††

†† 2017–2018 U.S. trivalent influenza vaccines contain an A/Michigan/45/2015 (H1N1)pdm09–like virus, an A/Hong Kong/4801/2014 (H3N2)–like virus and a B/Brisbane/60/2008–like virus (Victoria lineage). Quadrivalent vaccines will include an additional vaccine virus strain, a B/Phuket/3073/2013–like virus (Yamagata lineage).

This process is used to assess whether antigenic drift from the vaccine reference viruses has occurred.

All influenza-positive specimens submitted for surveillance and received by CDC are sequenced by next generation sequencing (NGS), using previously described genomic enrichment practices (*3*,*4*) adapted by CDC. NGS uses advanced molecular detection to identify gene sequences from each virus in a sample and thus reveals the genetic variations among many different influenza virus particles in a single sample; these methods also reveal the entire coding region of the genomes. The genomic data are analyzed to determine the genetic identity of circulating viruses and submitted to public databases (GenBank or GISAID EpiFlu). Data obtained from antigenic characterization are important in the assessment of the similarity between reference vaccine viruses and circulating viruses. In vitro antigenic characterization data generated through HI assays or virus neutralization assays are used to assess whether genetic changes in circulating viruses affect antigenicity, which might subsequently affect vaccine effectiveness.

Since the 2014–15 season, many influenza A(H3N2) viruses propagated in tissue culture have lacked sufficient hemagglutination titers for antigenic characterization using HI assays. Therefore, a subset of influenza A(H3N2) viruses are selected for antigenic characterization using the virus neutralization focus reduction assay to assess the ability of various antisera to neutralize infectivity of the test viruses. CDC has antigenically or genetically characterized 1,365 influenza viruses collected and submitted by laboratories in the United States since October 1, 2017, including 276 influenza A(H1N1)pdm09 viruses, 695 influenza A(H3N2) viruses, and 394 influenza B viruses.

Phylogenetic analysis of the HA gene segments from 276 A(H1N1)pdm09 viruses collected since October 1, 2017, showed that all belonged to subclade 6B.1 (Figure 3). Of the 205 A(H1N1)pdm09 viruses analyzed using HI assays with ferret antisera, 100% were antigenically similar to the cell culture–propagated 6B.1 virus A/Michigan/45/2015, the reference virus representing the A(H1N1)pdm09 vaccine virus for the 2017–18 Northern Hemisphere influenza season.

A total of 695 influenza A(H3N2) viruses were sequenced, and phylogenetic analysis of the HA gene segments illustrated that multiple clades/subclades were cocirculating (Figure 3). Circulating viruses possessed HA gene segments that belonged to clade 3C.2a, subclade 3C.2a1, or clade 3C.3a with 3C.2a predominating (Figure 3). Among the 262 representative A(H3N2) viruses that were antigenically characterized, 257 (98.1%) were well-inhibited (reacting at titers that were within fourfold of the homologous virus titer) by ferret antisera raised against A/Michigan/15/2014 (3C.2a), a cell-propagated A/Hong Kong/4801/2014–like reference virus representing the A(H3N2) component of the 2017–18 Northern Hemisphere influenza vaccines. Although considerable genetic diversity (i.e., multiple cocirculating genetic subgroups) has been observed among the HA gene segments of H3N2 viruses, there have been very few (1.9%) H3N2 viruses showing antigenic drift in the HA this season. In contrast to the 98.1% of viruses that were well-inhibited by ferret antisera raised against cell-propagated A/Michigan/15/2014, only 64.4% of viruses tested were well-inhibited by ferret antiserum raised against the egg-propagated A/Hong Kong/4801/2014 reference virus representing the A(H3N2) vaccine component. This is likely because of egg-adaptive amino acid changes in the HA of the egg-propagated virus. The majority of influenza vaccines used in the United States are produced with egg-based manufacturing.

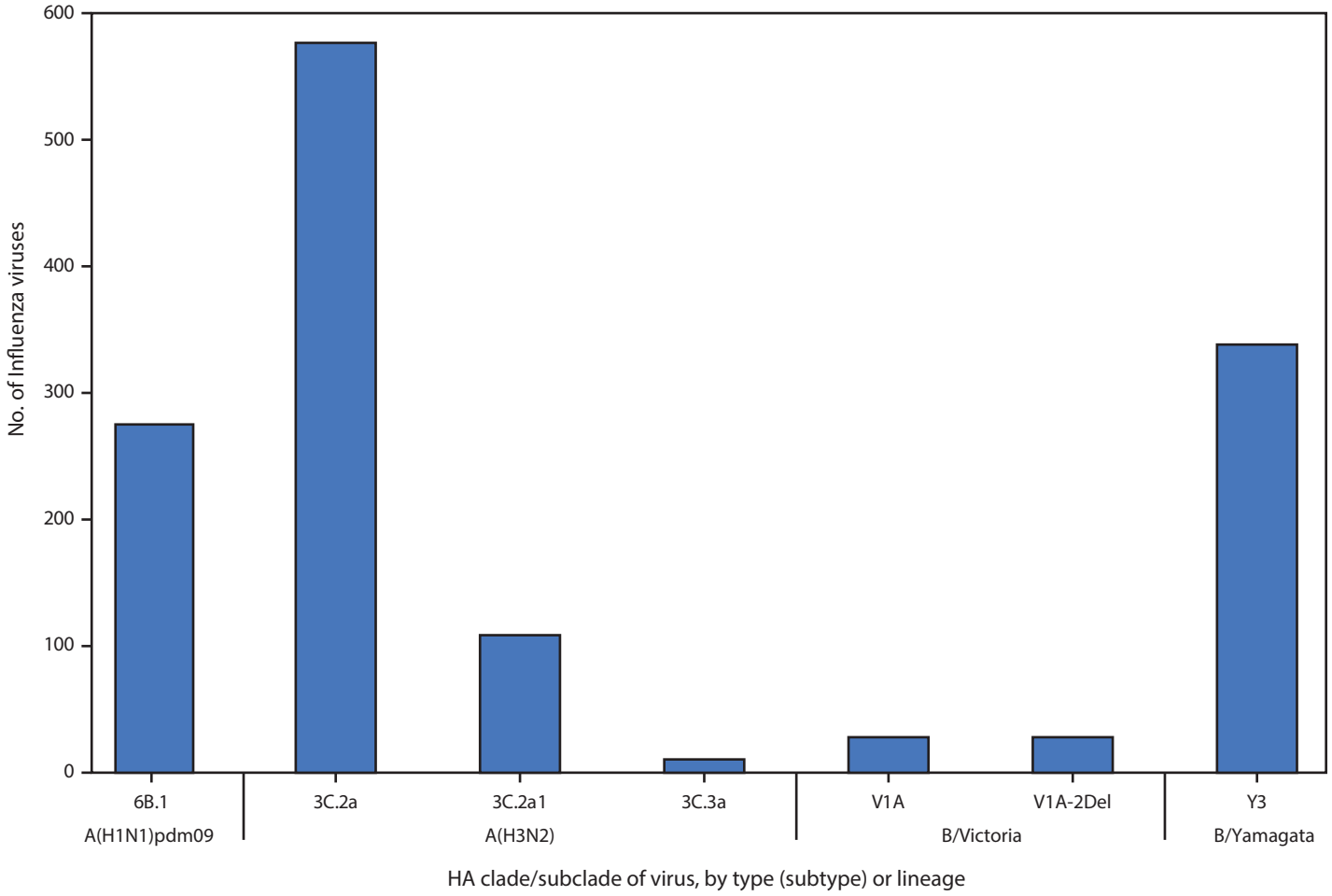
Among influenza B viruses, phylogenetic analysis of 338 influenza B/Yamagata-lineage viruses showed that all the HA gene segments belonged to clade Y3 (Figure 3). A total of 202 B/Yamagata lineage viruses were antigenically characterized, and all were antigenically similar to cell culture–propagated B/Phuket/3073/2013, the reference virus representing the B/Yamagata-lineage component of quadrivalent vaccines for the 2017–18 Northern Hemisphere influenza season.

Among the 56 influenza B/Victoria-lineage viruses sequenced and phylogenetically analyzed, the HA gene segment of all viruses belonged to genetic clade V1A, the same genetic clade as the vaccine reference virus, B/Brisbane/60/2008. However, the HA gene segment of 28 viruses (50.0%) had a six-nucleotide deletion (encoding amino acids 162 and 163), and viruses like these, abbreviated as V1A-2Del, were previously reported (*5*). Of the 29 influenza B/Victoria viruses that were antigenically characterized, 17 (58.6%) were antigenically similar to cell culture–propagated B/Brisbane/60/2008, the reference virus representing the B/Victoria lineage component of 2017–18 Northern Hemisphere vaccines. All 12 B/Victoria viruses that were poorly inhibited (reacting at titers that were eightfold or more reduced compared with the homologous virus titer) by antisera raised to cell culture–propagated B/Brisbane/60/2008 were V1A-2Del viruses.

Antiviral Resistance of Influenza Viruses

The WHO Collaborating Center for Surveillance, Epidemiology, and Control of Influenza at CDC tested 1,666 influenza virus specimens collected since October 1, 2017, from the United States for resistance to the influenza neuraminidase inhibitor antiviral medications currently approved for use against seasonal influenza: oseltamivir, peramivir, and zanamivir. Among 376 influenza A(H1N1)pdm09 viruses tested for oseltamivir and peramivir susceptibility, four (1.1%) were resistant to both drugs and contain H275Y, the

FIGURE 3. Genetic characterization of U.S. viruses collected October 1, 2017–February 3, 2018*



Abbreviation: HA = hemagglutinin.
* As of February 9, 2018.

established NA marker of resistance to oseltamivir. A total of 265 of those influenza A (H1N1)pdm09 viruses also were tested for zanamivir susceptibility, and all were susceptible. All 903 influenza A(H3N2) viruses tested for oseltamivir and zanamivir susceptibility were susceptible to both of these medications. A total of 638 of those A(H3N2) viruses also were tested for peramivir susceptibility, and all were susceptible. All 387 influenza B viruses tested for oseltamivir, peramivir, and zanamivir susceptibility were sensitive to all three recommended antiviral medications. High levels of resistance to the adamantanes (amantadine and rimantadine) persist among influenza A(H1N1)pdm09 and A(H3N2) viruses. Adamantane drugs are not recommended for use against influenza at this time.

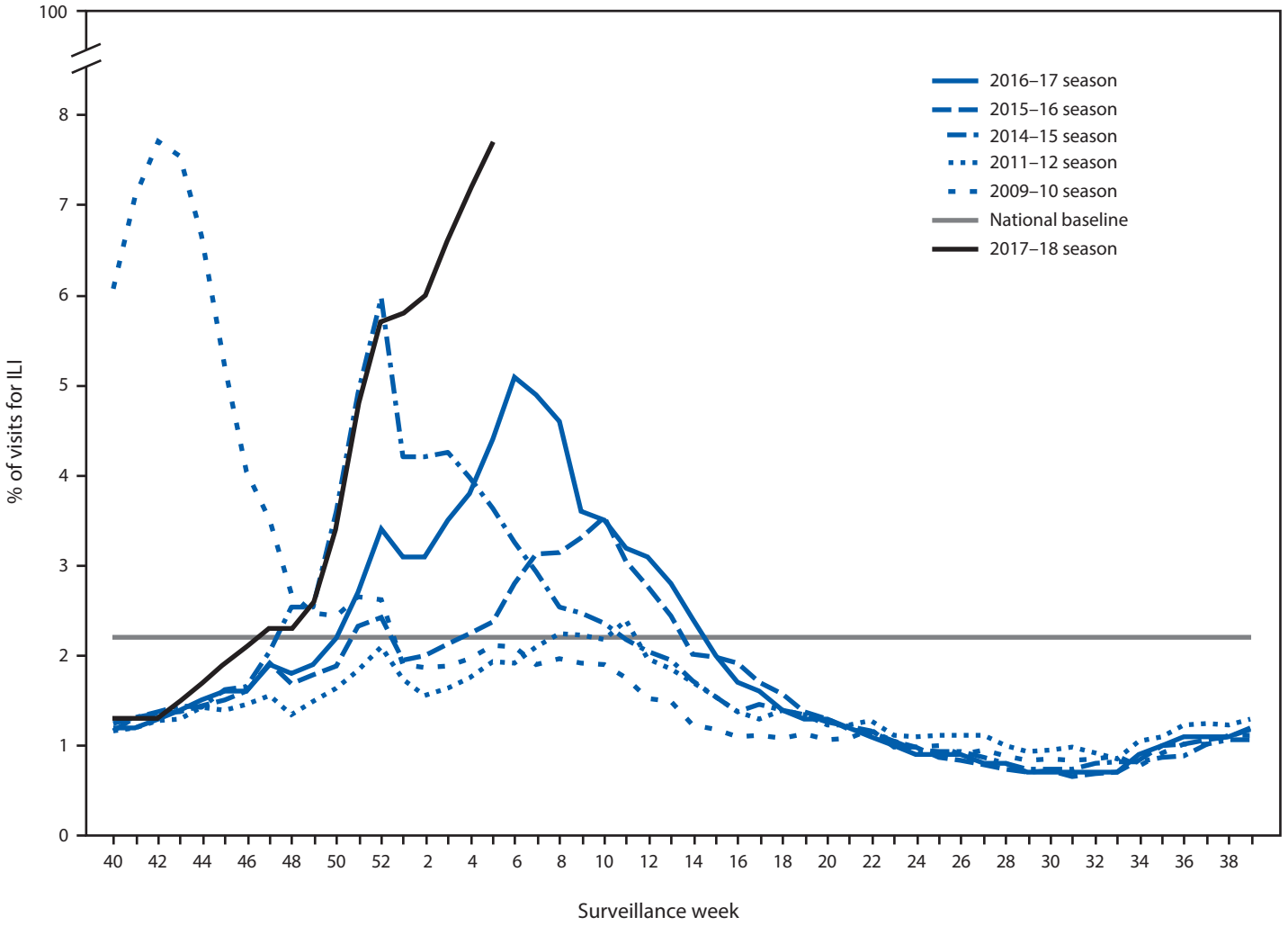
Outpatient Illness Surveillance

During October 1, 2017–February 3, 2018, the weekly percentage of outpatient visits to heath care providers participating in the U.S. Outpatient Influenza-like Illness Surveillance Network (ILINet) for influenza-like illness[§§] (ILI) ranged from 1.3% to 7.7% (Figure 4). The percentage first exceeded the national baseline[¶¶] level of 2.2% during the week ending November 25, 2017 (week 47) and has remained at or above the baseline for 11 consecutive weeks so far this season. From the week ending December 23, 2017, (week 51), through the week ending February 3, 2018, (week 5), all 10 HHS regions reported a percentage of outpatient visits for ILI

[§§] Defined as a fever (temperature ≥100°F [≥37.8°C], oral or equivalent) and cough or sore throat, without a known cause other than influenza.

[¶¶] The national and regional baselines are the mean percentage of visits for ILI during noninfluenza weeks for the previous three seasons plus two standard deviations. Noninfluenza weeks are defined as periods of ≥2 consecutive weeks in which each week accounted for <2% of the season's total number of specimens that tested positive for influenza in public health laboratories. National and regional percentages of patient visits for ILI are weighted based on state population. Use of the national baseline for regional data is not appropriate.

FIGURE 4. Percentage of outpatient visits for influenza-like illness (ILI)* reported to CDC, by surveillance week — U.S. Outpatient Influenza-Like Illness Surveillance Network (ILINet), 2017–18 influenza season and selected previous influenza seasons†



* Defined as fever (temperature of ≥100°F [≥37.8°C], oral or equivalent) and cough or sore throat, without a known cause other than influenza.
† As of February 9, 2018.

at or above their region-specific baseline levels. ILINet data are also used to produce a weekly jurisdiction-level measure of ILI activity*** ranging from minimal to high. Since the week ending December 30, 2017, more than half of the 53 jurisdictions (50 states, District of Columbia, New York City, and Puerto Rico) experienced high ILI activity each week, with the largest number of jurisdictions (46, 87%) experiencing high ILI activity during the week ending February 3, 2018. During the past five seasons, the largest number of jurisdictions experiencing high ILI activity in a single week ranged from 16 (30%) during the 2015–16 season to 31 (58%) during the 2012–13 and 2014–15 seasons.

*** Activity levels are based on the percentage of outpatient visits in a jurisdiction attributed to ILI and are compared with the average percentage of ILI visits that occur during weeks with little or no influenza virus circulation. Activity levels range from minimal, corresponding to ILI activity from outpatient clinics at or below the average, to high, corresponding to ILI activity from outpatient clinics much higher than the average. Because the clinical definition of ILI is nonspecific, not all ILI is caused by influenza; however, when combined with laboratory data, the information on ILI activity provides a clearer picture of influenza activity in the United States.

Geographic Spread of Influenza Activity

Influenza activity levels reported by state and territorial epidemiologists indicate the geographic spread of influenza activity[†††] within their jurisdiction (50 states, District of Columbia, Guam, Puerto Rico, and U.S. Virgin Islands). During the 2017–18 season, the peak number of jurisdictions reporting widespread activity in a single week was 50 (93%); this occurred for the 3 consecutive weeks (weeks ending January 6, January 13, and January 20, 2018). During the previous five influenza seasons, the peak number of jurisdictions reporting widespread activity in a single week during each season has ranged from 41 (76%) in the 2015–16 season to 48 (89%) during the 2012–13 season.

Influenza-Associated Hospitalizations

CDC monitors hospitalizations associated with laboratory-confirmed influenza infections in adults and children through the Influenza Hospitalization Surveillance Network (FluSurv-NET),[§§§] which covers approximately 27 million persons (9% of the U.S. population). During October 1, 2017–February 3, 2018, 17,101 laboratory-confirmed influenza-related hospitalizations were reported, representing a cumulative incidence among all age groups of 59.9 per 100,000 population. The hospitalization rate was highest among persons aged ≥65 years, who accounted for 59% of reported influenza-associated hospitalizations.

The cumulative influenza hospitalization rates per 100,000 population during October 1, 2017–February 3, 2018, for persons aged 0–4 years, 5–17 years, 18–49 years, 50–64 years, and ≥65 years were 40.0, 10.3, 18.3, 63.1, and 263.6, respectively. Among all hospitalizations, 14,770 (86.4%) were associated with influenza A virus infection, 2,251 (13.2%) with influenza B virus infection, 43 (0.3%) with influenza A virus and influenza B virus coinfection, and 37 (0.2%) with influenza virus infection for which the type was not determined. Among the 3,841 patients for whom influenza A subtype information was available, 3,308 (86.1%) were infected with influenza A(H3N2) viruses and 533 (13.9%) with influenza A(H1N1)pdm09 viruses. Among hospitalized persons aged 0–64 years for whom influenza A subtype information was available, 23.6% were infected with influenza A(H1N1)pdm09 viruses, compared with only 7.0% of those aged ≥65 years.

Summary

What is already known about this topic?

CDC collects, compiles, and analyzes data on influenza activity year-round in the United States. Timing of influenza activity and predominant circulating influenza viruses vary by season.

What is added by this report?

Influenza activity in the United States began to increase in early November 2017 and rose sharply from December through February 3, 2018. Influenza A viruses have been most commonly identified, with influenza A(H3N2) viruses predominating, but influenza A(H1N1)pdm09 and influenza B viruses were also detected. Influenza illness this season has been substantial, with some of the highest levels of influenza-like illness and hospitalization rates in recent years, and elevated activity occurring in most of the country simultaneously. Elevated influenza activity is expected to continue for several more weeks.

What are the implications for public health practice?

With several more weeks of elevated influenza activity expected, the increasing proportion of influenza A(H1N1) pdm09 and influenza B viruses, and the potential to prevent significant illness through influenza vaccination, CDC continues to recommend influenza vaccination at this time. In influenza seasons with increased severity, influenza antiviral medications are an increasingly important adjunct to vaccination in the treatment of influenza. Early treatment with neuraminidase inhibitor antiviral medications is recommended for patients with severe, complicated, or progressive influenza illness and those at higher risk for influenza complications, including adults aged ≥65 years who develop influenza symptoms.

[†††] Levels of activity are 1) no activity; 2) sporadic: isolated laboratory-confirmed influenza cases or a laboratory-confirmed outbreak in one institution, with no increase in activity; 3) local: increased ILI or two or more institutional outbreaks (ILI or laboratory-confirmed influenza) in one region of the state, with recent laboratory evidence of influenza in that region; virus activity no greater than sporadic in other regions; 4) regional: increased ILI activity or institutional outbreaks (ILI or laboratory-confirmed influenza) in two or more outbreaks but less than half of the regions in the state with recent laboratory evidence of influenza in those regions; and 5) widespread: increased ILI activity or institutional outbreaks (ILI or laboratory-confirmed influenza) in at least half the regions in the state, with recent laboratory evidence of influenza in the state.

[§§§] FluSurv-NET conducts population-based surveillance for laboratory-confirmed, influenza-associated hospitalizations in children and adolescents aged <18 years (since the 2003–04 influenza season) and adults aged ≥18 years (since the 2005–06 influenza season). The FluSurv-NET covers approximately 70 counties in the 10 Emerging Infections Program states (California, Colorado, Connecticut, Georgia, Maryland, Minnesota, New Mexico, New York, Oregon, and Tennessee) and additional Influenza Hospitalization Surveillance Project (IHSP) states. IHSP began during the 2009–10 season to enhance surveillance during the 2009 H1N1 pandemic. IHSP sites included Idaho, Iowa, Michigan, Oklahoma, and South Dakota during the 2009–10 season; Idaho, Michigan, Ohio, Oklahoma, Rhode Island, and Utah during the 2010–11 season; Michigan, Ohio, Rhode Island, and Utah during the 2011–12 season; Iowa, Michigan, Ohio, Rhode Island, and Utah during the 2012–13 season; and Michigan, Ohio, and Utah during the 2013–14, 2014–15, 2015–16, 2016–17, and 2017–18 seasons. Cumulative unadjusted incidence rates are calculated using CDC's National Center for Health Statistics population estimates for the counties included in the surveillance catchment area. Laboratory confirmation is dependent on clinician-ordered influenza testing, and testing for influenza often is underused because of the poor reliability of rapid test results and greater reliance on clinical diagnosis for influenza. Therefore, cases identified as part of influenza hospitalization surveillance likely are an underestimation of the actual number of persons hospitalized with influenza.

Information on underlying medical conditions was available for 2,147 (12.6%) hospitalized patients with laboratory-confirmed influenza as of February 3, 2018. Among 1,955 hospitalized adults with information on underlying medical condition available, 1,325 (67.8%) had at least one underlying medical condition that placed them at high risk for influenza-associated complications. The most commonly reported medical conditions were cardiovascular disease (35.5%), metabolic disorders (33.0%), obesity (25.2%), and chronic lung disease (23.6%). Among 192 hospitalized children with information on underlying medical conditions available, 97 (50.5%) had at least one underlying medical condition, the most commonly reported being asthma (22.8%), neurologic disorders (14.4%), and obesity (10.1%). Among 151 hospitalized women aged 15–44 years with information on pregnancy status, 36 (23.8%) were pregnant.

Pneumonia and Influenza–Associated Mortality

CDC tracks pneumonia and influenza (P&I)–attributed deaths through the National Center for Health Statistics (NCHS) Mortality Reporting System. The percentages of deaths attributed to P&I are released 2 weeks after the week of death to allow for collection of sufficient data to produce a stable P&I mortality percentage. From October 1, 2017, to January 20, 2018, the weekly percentage of deaths attributed to P&I has ranged from 5.8% to 10.1% and has exceeded the epidemic threshold¶¶¶ for 5 consecutive weeks. P&I percentages for recent weeks are likely to be artificially low because of a delay in manual coding for deaths occurring in 2018, and the percentage of deaths caused by P&I is higher among manually coded death certificates than among machine-coded death certificates. The percentage of deaths caused by P&I will likely increase as more data become available.

Influenza-Associated Pediatric Mortality

As of February 3, 2018, (week 5), 63 laboratory-confirmed influenza-associated pediatric deaths occurring during the 2017–18 season were reported to CDC. Fifteen deaths were associated with an influenza A(H1N1)pdm09 virus infection, 16 were associated with an influenza A(H3N2) virus infection, 14 were associated with infection with an influenza A virus for which no subtyping was performed, and 18 were associated with an influenza B virus infection. Since influenza-associated pediatric mortality became a nationally notifiable condition in 2004, the number of influenza-associated pediatric deaths per season has ranged from 37 to 171, excluding the 2009 pandemic, when there were 358 pediatric deaths during April 15, 2009–October 2, 2010. The mean age of the reported pediatric deaths reported this season was 7.4 years (range 2 months to 17 years); 40 (63%) of the children died after admission to the hospital. Among the 56 children with a known medical history, 30 (54%) had at least one underlying medical condition recognized by ACIP as placing them at increased risk for influenza-related complications. Among the 54 children who were eligible for influenza vaccination (≥6 months of age at date of onset) and for whom vaccination status was known, 14 (26%) had received at least 1 dose of influenza vaccine before onset of illness (13 were fully vaccinated according to 2017 ACIP recommendations, and one had received 1 of 2 recommended doses).

¶¶¶ The seasonal baseline proportion of P&I deaths is projected using a robust regression procedure, in which a periodic regression model is applied to the observed percentage of deaths from P&I that were reported by the National Center for Health Statistics Mortality Surveillance System during the preceding 5 years. The epidemic threshold is set at 1.645 standard deviations above the seasonal baseline.

Discussion

Influenza illness this season has been substantial, with some of the highest levels of ILI and hospitalization rates in recent years and elevated activity occurring in most of the country simultaneously. Influenza A(H3N2) is the predominant influenza virus circulating this season. Past A(H3N2) virus–predominant seasons such as the 2012–13 and 2014–15 seasons had increased numbers of influenza related infections, hospitalizations, and deaths compared with A(H1N1)pdm09 virus-predominant seasons, and the 2017–18 season is on track to reach or exceed estimates from those seasons.

The percentage of outpatient visits to doctors' offices, urgent care centers, and emergency departments that were for ILI rose sharply in late 2017 to 7.7% in early February. This is the highest level of ILI activity since the pandemic in 2009 which peaked at 7.7%. During the previous five influenza seasons, the peak weekly percentages of outpatient visits for ILI ranged from 3.6% to 6.1% and remained above baseline levels for an average of 16 weeks (range = 11–20 weeks). The weekly percentage of outpatient visits for ILI this season has been above the national baseline for 11 weeks, suggesting that influenza activity is likely to continue for several more weeks.

The cumulative hospitalization rate attributed to laboratory-confirmed influenza for the week ending February 3, 2018, (59.9/100,000) exceeded the rate for the same week in 2014–15 (50.9/100,000), an A(H3N2) virus–predominant season categorized as high severity, and is the highest rate observed for this week since the system expanded to include adults during the 2005–06 season. Persons aged ≥65 years account for the majority of cases (59%); however, hospitalization rates for all adult age groups (18–49 years, 50–64 years, and ≥65 years) are higher than those observed during the same week in 2014–15. These hospitalization rates are not adjusted for testing practices,

which can vary from season to season; therefore, caution should be used when comparing hospitalization rates across seasons.

P&I-related deaths also rose sharply in the first weeks of 2018, accounting for 10.1% of all deaths recorded on death certificates during the week ending January 20, 2018. It is anticipated that the number of P&I-related deaths will continue to increase for several more weeks and might exceed the peaks in past recent A(H3N2) virus–predominant seasons (11.1% in 2012–13 and 10.8% in 2014–15). Through the week ending January 20, P&I-related mortality has been above the epidemic threshold for 5 consecutive weeks. During the past five seasons, the average number of weeks this indicator was above threshold was 11 (range of 7–15 weeks).

Sixty-three laboratory-confirmed influenza-associated pediatric deaths have been reported to CDC as of February 3, 2018; 46% of these children were otherwise healthy. Among those children who were eligible for vaccination and for whom vaccination status was known, only 14 (26%) had received any influenza vaccine this season before the onset of illness (13 were fully vaccinated, and one had received 1 of 2 recommended doses). In a previous analysis of pediatric deaths with a similar percentage of eligible children vaccinated (26%), influenza vaccination was associated with a 65% reduction in risk for laboratory-confirmed influenza-associated pediatric death (*6*).

With several more weeks of elevated influenza activity anticipated this season, it is too early to assess overall severity of the season. However, estimates of the burden of influenza disease from the 2012–13 and 2014–15 seasons provide an indication of what might be anticipated for the 2017–18 season. CDC estimated that during each of those seasons influenza accounted for as many as 35.6 million illnesses, 16.6 million medically attended visits, 710,000 hospitalizations and 56,000 deaths.****

Interim estimates of 2017–18 season vaccine effectiveness (VE) against influenza A and influenza B virus infection associated with medically attended acute respiratory illness in the United States was 36% (95% confidence interval [CI] = 27%–44%). VE was estimated to be 25% (95% CI = 13%–36%) against illness caused by influenza A(H3N2) virus, 67% (95% CI = 54%–76%) against A(H1N1) pdm09 virus and 42% (95% CI = 25%–56%) against influenza B virus (*7*). During the 2014–15 season, an A(H3N2) virus–predominant season with high severity and low vaccine effectiveness, influenza vaccine was estimated to have prevented millions of illnesses and tens of thousands of influenza-related hospitalizations. With several more weeks of elevated influenza activity expected, an increasing proportion of influenza A(H1N1)pdm09 and influenza B viruses, and the potential to prevent significant illness through influenza vaccination, CDC continues to recommend influenza vaccination at this time.

During influenza seasons with increased severity, influenza antiviral medications are an increasingly important adjunct to vaccination in the treatment of influenza. Three neuraminidase inhibitor antiviral medications are approved and recommended for use in the United States during the 2017–18 influenza season: oral oseltamivir (available as a generic or under the trade name Tamiflu [Genentech, South San Francisco, California]), inhaled zanamivir (Relenza [GlaxoSmithKline, London, England]) and intravenous peramivir (Rapivab [Seqirus, Summit, New Jersey]). Resistance to these medications is not a concern at this time because only four influenza viruses (all A[H1N1]pdm09 viruses) collected in the United States since October 1, 2017, were identified as not being sensitive to oseltamivir and peramivir.

Treatment with neuraminidase inhibitors has been shown to reduce illness duration and severe outcomes of influenza based on evidence from randomized controlled trials, meta-analyses of randomized controlled trials, and observational studies (*8*,*9*). Treatment with influenza antiviral medications initiated as close to the onset of illness as possible is recommended for patients with confirmed or suspected influenza who have severe, complicated, or progressive illness; who require hospitalization; or who are not hospitalized but who are at high risk for developing serious influenza complications. Treatment should not be delayed while waiting for results of testing or even if rapid antigen-detection influenza diagnostic test results are negative. Clinical benefit of antiviral treatment is greatest when treatment begins within 48 hours after symptom onset; however, antiviral treatment initiated later than 48 hours after illness onset can still be beneficial for some patients (*8*,*10*). A CDC health advisory released on December 27, 2017, regarding treatment with antiviral medications is available at https://emergency.cdc.gov/han/han00409.asp.

Influenza surveillance reports for the United States are posted online weekly (https://www.cdc.gov/flu/weekly). Additional information regarding influenza viruses, influenza surveillance, influenza vaccine, influenza antiviral medications, and novel influenza A infections in humans is available online (https://www.cdc.gov/flu).

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**** Estimates of influenza disease burden and burden of disease averted by influenza vaccination can be found at https://www.cdc.gov/flu/about/disease/burden.htm.

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Conflict of Interest

No conflicts of interest were reported.

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Interim Estimates of 2017–18 Seasonal Influenza Vaccine Effectiveness — United States, February 2018

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In the United States, annual vaccination against seasonal influenza is recommended for all persons aged ≥6 months (*1*). During each influenza season since 2004–05, CDC has estimated the effectiveness of seasonal influenza vaccine to prevent laboratory-confirmed influenza associated with medically attended acute respiratory illness (ARI). This report uses data from 4,562 children and adults enrolled in the U.S. Influenza Vaccine Effectiveness Network (U.S. Flu VE Network) during November 2, 2017–February 3, 2018. During this period, overall adjusted vaccine effectiveness (VE) against influenza A and influenza B virus infection associated with medically attended ARI was 36% (95% confidence interval [CI] = 27%–44%). Most (69%) influenza infections were caused by A(H3N2) viruses. VE was estimated to be 25% (CI = 13% to 36%) against illness caused by influenza A(H3N2) virus, 67% (CI = 54%–76%) against A(H1N1)pdm09 viruses, and 42% (CI = 25%–56%) against influenza B viruses. These early VE estimates underscore the need for ongoing influenza prevention and treatment measures. CDC continues to recommend influenza vaccination because the vaccine can still prevent some infections with currently circulating influenza viruses, which are expected to continue circulating for several weeks. Even with current vaccine effectiveness estimates, vaccination will still prevent influenza illness, including thousands of hospitalizations and deaths. Persons aged ≥6 months who have not yet been vaccinated this season should be vaccinated.

Methods used by the U.S. Flu VE Network have been published previously (*2*). At five study sites,* patients aged ≥6 months seeking outpatient medical care for an ARI with cough within 7 days of illness onset were enrolled. Study enrollment began after local surveillance identified increasing weekly influenza activity or one or more laboratory-confirmed cases of influenza per week for 2 consecutive weeks. Patients were eligible for enrollment if they 1) were aged ≥6 months on September 1, 2017, and thus were eligible for vaccination; 2) reported an ARI with cough with onset ≤7 days earlier; and 3) had not been treated with influenza antiviral medication (e.g., oseltamivir) during this illness. After obtaining informed consent from patients or from parents or guardians for their children, participants or their proxies were interviewed to collect demographic data, information on general and current health status and symptoms, and 2017–18 influenza vaccination status. Nasal and oropharyngeal swabs (or nasal swabs alone for children aged <2 years) were collected to obtain respiratory specimens; nasal and oropharyngeal swabs were placed together in a single cryovial with viral transport medium. Specimens were tested at U.S. Flu VE Network laboratories using CDC's real-time reverse transcription polymerase–chain reaction (rRT-PCR) protocol for detection and identification of influenza viruses. Participants (including children aged <9 years, who require 2 vaccine doses during their first vaccination season) were considered vaccinated if they received ≥1 dose of any seasonal influenza vaccine ≥14 days before illness onset, according to medical records and registries (at the Wisconsin site); medical records and self-report (at the Washington site); or self-report only (at the Michigan, Pennsylvania, and Texas sites). VE against all influenza virus types combined and against viruses by type/subtype was estimated as 100% x (1 - odds ratio).† Estimates were adjusted for study site, age group, sex, race/ethnicity, self-rated general health, number of days from illness onset to enrollment, and week of illness (3-week intervals) using logistic regression. Interim VE estimates for the 2017–18 season were based on patients enrolled through February 3, 2018.

Among the 4,562 children and adults with ARI enrolled at the five study sites from November 2, 2017, through February 3, 2018, a total of 1,712 (38%) tested positive for influenza virus by rRT-PCR, including 1,392 (81%) influenza A viruses and 323 (19%) influenza B viruses (Table 1). Among 1,340 subtyped influenza A viruses, 1,143 (85%) were A(H3N2) viruses and 208 (16%) were A(H1N1)pdm09

* The U.S. Flu VE Network sites and the dates enrollment began are as follows: Kaiser Permanente Washington (Seattle, Washington) (November 27, 2017); Marshfield Clinic Research Institute (Marshfield, Wisconsin) (December 26, 2017); University of Michigan School of Public Health (the School of Public Health partnered with the University of Michigan Health System, Ann Arbor, and the Henry Ford Health System, Detroit, Michigan) (December 4, 2017); University of Pittsburgh Schools of the Health Sciences (the Schools of the Health Sciences partnered with the University of Pittsburgh Medical Center, Pittsburgh, Pennsylvania) (November 29, 2017); and Baylor Scott & White Health, Texas A&M University Health Science Center College of Medicine (Temple, Texas) (November 2, 2017).

† 100% x (1 - odds ratio [ratio of odds of being vaccinated among outpatients with influenza-positive test results to the odds of being vaccinated among outpatients with influenza-negative test results]).

viruses. Most (98%) influenza B viruses belonged to the B/Yamagata lineage. The proportion of patients with influenza differed by study site, sex, age group, race/ethnicity, self-rated health status, and interval from illness onset to enrollment (Table 1). The percentage of patients who were vaccinated ranged from 45% to 59% among study sites and differed by sex, age group, race/ethnicity, and self-rated health status.

Among ARI patient participants, 43% of those with influenza had received the 2017–18 seasonal influenza vaccine, compared with 53% of influenza-negative participants (Table 2). After adjusting for study site, age group, sex, race/ethnicity, self-rated general health, number of days from illness onset to enrollment, and week of illness onset (3-week intervals), VE against medically attended ARI caused by all influenza virus types combined was 36% (CI = 27%–44%). VE for all ages was 25% (CI = 13% to 36%) against medically attended ARI caused by A(H3N2) virus infection, 67% (CI = 54%–76%) against influenza A(H1N1)pdm09 virus infection, and 42% (CI = 25%–56%) against influenza B virus infection. VE point estimates against medically attended influenza for all virus types varied by age group; statistically significant protection against medically attended influenza was found among children aged 6 months through 8 years (VE = 59%; CI = 44%–69%) and adults aged 18–49 years (VE = 33%; CI = 16%–47%), whereas no statistically significant protection was observed in other age groups.

As of February 3, 2018, a total of 257 influenza A(H3N2) viruses from U.S. Flu VE Network participants had been characterized by CDC; 240 (93%) belonged to either genetic group 3C.2a (226 viruses) or the related subgroup 3C.2a1 (14), whereas 17 (7%) belonged to group 3C.3a. Genetic group 3C.2a includes the A/Hong Kong/4801/2014 reference virus representing the A(H3N2) component of the 2017–18 Northern Hemisphere influenza vaccines (*3*).

Discussion

Early and widespread influenza activity during the 2017–18 influenza season provided the opportunity to estimate interim VE against several circulating influenza viruses, including the predominant A(H3N2) virus. These interim estimates reflect ongoing challenges with the A(H3N2) vaccine component since the 2011–12 season. The interim estimate of 25% VE against A(H3N2) viruses this season indicates that vaccination provided some protection, in contrast to recently reported, nonsignificant interim estimates of 17% from Canada and 10% from Australia (*4*,*5*) and is similar to final (32%) VE estimates in the United States against A(H3N2) viruses during 2016–17[§] (*6*). However, among children aged 6 months through 8 years, the interim estimates against any influenza and A(H3N2) virus infection were higher; the risk for A(H3N2) associated medically-attended influenza illness was reduced by more than half (59%) among vaccinated children. Also, with interim VE estimates of 67% and 42% against influenza A(H1N1)pdm09 and B viruses, respectively, vaccination provided substantial protection against circulating A(H1N1)pdm09 viruses, as well as moderate protection against influenza B viruses predominantly belonging to the B/Yamagata lineage, the second influenza type B component included in quadrivalent vaccines. CDC continues to recommend influenza vaccination while influenza viruses are circulating in the community; several more weeks of influenza activity are likely. Influenza vaccination has prevented thousands of hospitalizations during previous seasons when influenza A(H3N2) viruses were predominant, including during the 2014–15 season when interim VE estimates were similar to those reported here. Appropriate use of influenza antiviral medications for treatment of severely ill persons or persons at high risk for complications from influenza who develop influenza symptoms is important, especially among older adults, who currently have the highest hospitalization rates (*3*).

VE estimates against A(H3N2) viruses have been lower than estimates against A(H1N1)pdm09 and B viruses for several years (*7*). Although there is no definitive evidence for antigenic drift of viruses circulating this season compared with cell culture–propagated reference viruses representing the A(H3N2) vaccine component (*3*), challenges with antigenic characterization of recent A(H3N2) viruses, many of which could not be characterized using traditional hemagglutination inhibition assays, have required the use of additional virus neutralization assays to assess antigenic characteristics. Multiple factors might be contributing to the reported VE against A(H3N2) viruses this season. Immune responses to vaccination differ by age and previous infection or vaccination history and can affect vaccine protection; higher VE against A(H3N2) viruses among young children suggests that vaccination might provide better protection against circulating A(H3N2) viruses to this age group. Also, genetic changes in the vaccine virus hemagglutinin protein that arise during passage in eggs might result in a vaccine immune response that is less effective against circulating viruses (*8*,*9*). Human serologic data indicate decreased inhibition of circulating cell culture–propagated A(H3N2) viruses compared with egg-propagated viruses among persons vaccinated with egg-based vaccines.[¶] Additional studies are needed to assess whether VE against circulating A(H3N2) viruses varies by vaccine type, including comparisons between egg-based and

[§] https://www.cdc.gov/vaccines/acip/meetings/downloads/slides-2017-06/flu-03-ferdinands.pdf.

[¶] http://apps.who.int/iris/bitstream/10665/259275/1/WER9242.pdf?ua=1.

TABLE 1. Selected characteristics for 4,562 enrolled outpatients with medically attended acute respiratory illness and cough, by influenza test result status and seasonal influenza vaccination status — U.S. Influenza Vaccine Effectiveness Network, United States, November 2, 2017–February 3, 2018

	Test result status			Vaccination status*		
	Influenza-positive	Influenza-negative		Vaccinated		
Characteristic	No. (%)	No. (%)	p-value†	No. enrolled	No. (%) vaccinated	p-value†
Overall	**1,712 (38)**	**2,850 (62)**	—	**4,562**	**2,259 (50)**	—
Study site						
Michigan	264 (35)	491 (65)		755	422 (56)	<0.001
Pennsylvania	330 (41)	480 (59)		810	376 (46)	
Texas	572 (42)	806 (58)	<0.001	1,378	614 (45)	
Washington	195 (27)	518 (73)		713	420 (59)	
Wisconsin	351 (39)	555 (61)		906	427 (47)	
Sex						
Male	735 (39)	1,133 (61)	0.03	1,868	865 (46)	<0.001
Female	977 (36)	1,717 (64)		2,694	1,394 (52)	
Age group (yrs)						
6 mos–8	359 (33)	739 (67)		1,098	535 (49)	<0.001
9–17	288 (49)	300 (51)		588	204 (35)	
18–49	561 (36)	989 (64)	<0.001	1,550	642 (41)	
50–64	288 (39)	454 (61)		742	436 (59)	
≥65	216 (37)	368 (63)		584	442 (76)	
Race/Ethnicity§						
White	1,169 (37)	2,020 (63)		3,189	1,659 (52)	<0.001
Black	161 (43)	218 (58)	0.004	379	150 (40)	
Other race	144 (33)	287 (67)		431	217 (50)	
Hispanic	231 (42)	317 (58)		548	225 (41)	
Self-rated health status						
Fair or poor	75 (31)	168 (69)		243	135 (56)	<0.001
Good	377 (35)	695 (65)	<0.001	1,072	559 (52)	
Very good	618 (36)	1,087 (64)		1,705	875 (51)	
Excellent	639 (42)	898 (58)		1,537	687 (45)	
Illness onset to enrollment (days)						
<3	856 (48)	940 (52)		1,796	866 (48)	0.23
3–4	589 (35)	1,082 (65)	<0.001	1,671	829 (50)	
5–7	267 (24)	828 (76)		1,095	564 (52)	
Influenza test result¶						
Negative	—	2,850	—	2,850	1,518 (53)	—
Influenza B positive	323	—	—	323	132 (41)	—
B/Yamagata	260	—	—	260	112 (43)	—
B/Victoria	5	—	—	5	2 (40)	—
B lineage pending	58	—	—	58	18 (31)	—
Influenza A positive	1,392	—	—	1,392	610 (44)	—
A(H1N1)pdm09	208	—	—	208	60 (29)	—
A(H3N2)	1,143	—	—	1,143	530 (46)	—
A subtype pending	52	—	—	52	23 (44)	—

* Defined as having received ≥1 dose of influenza vaccine ≥14 days before illness onset. A total of 102 participants who received the vaccine ≤13 days before illness onset were excluded from the study sample.

† The chi-square statistic was used to assess differences between the numbers of persons with influenza-negative and influenza-positive test results, in the distribution of enrolled patient and illness characteristics, and in differences between groups in the percentage vaccinated.

§ Enrollees were categorized into one of four mutually exclusive racial/ethnic populations: white, black, other race, and Hispanic. Persons identifying as Hispanic might have been of any race. Persons identifying as white, black, or other race were non-Hispanic. Race/ethnicity data were missing for 15 enrollees.

¶ Fourteen patients had coinfection with influenza A and influenza B, making the sum 1,726, or 14 greater than the total number of influenza-positive patients.

non–egg-based vaccines. CDC will continue to monitor VE through the remainder of the season and is investigating these factors. In addition, many efforts are under way to improve selection and development of candidate vaccine viruses that are optimal for vaccine production and provide protection against a majority of circulating viruses.

These interim VE estimates underscore the need for influenza antiviral treatment for any patient with suspected or confirmed influenza who is hospitalized, has severe or progressive illness, or is at high risk for complications from influenza, regardless of vaccination status or results of rapid, point-of-care influenza

TABLE 2. Number and percentage receiving 2017–18 seasonal influenza vaccine among 4,562 enrolled outpatients with medically attended acute respiratory illness and cough, by influenza test result status, age group, and vaccine effectiveness against all influenza A and B and against virus types A(H3N2), A(H1N1)pdm09 and B — U.S. Influenza Vaccine Effectiveness Network, United States, November 2, 2017–February 3, 2018

	Test result status				Vaccine effectiveness*	
	Influenza-positive		Influenza-negative		Unadjusted	Adjusted
Influenza type/Age group	Total	No. (%) vaccinated	Total	No. (%) vaccinated	% (95% CI)	% (95% CI)
Influenza A and B						
Overall	**1,712**	**741 (43)**	**2,850**	**1,518 (53)**	**33 (24 to 41)**	**36 (27 to 44)†**
Age group (yrs)						
6 mos–8	359	127 (35)	739	408 (55)	56 (42 to 66)	59 (44 to 69)†
9–17	288	100 (35)	300	104 (35)	0 (-41 to 29)	5 (-38 to 34)
18–49	561	198 (35)	989	444 (45)	33 (17 to 46)	33 (16 to 47)†
50–64	288	159 (55)	454	277 (61)	21 (-6 to 42)	17 (-15 to 40)
≥65	216	157 (73)	368	285 (78)	23 (-14 to 47)	18 (-25 to 47)
Influenza A(H3N2)						
Overall	**1,143**	**530 (46)**	**2,850**	**1,518 (53)**	**24 (13 to 34)**	**25 (13 to 36)†**
Age group (yrs)						
6 mos–8	200	79 (40)	739	408 (55)	47 (27 to 61)	51 (29 to 66)†
9–17	203	75 (37)	300	104 (35)	-10 (-60 to 24)	-8 (-62 to 29)
18–49	395	155 (39)	989	444 (45)	21 (-1 to 37)	20 (-4 to 38)
50–64	198	115 (58)	454	277 (61)	11 (-24 to 37)	12 (-26 to 39)
≥65	147	106 (72)	368	285 (78)	25 (-16 to 51)	17 (-35 to 49)
Influenza A(H1N1)pdm09						
Overall	**208**	**60 (29)**	**2,850**	**1,518 (53)**	**64 (52 to 74)**	**67 (54 to 76)†**
Age group (yrs)						
<18	105	22 (21)	1,039	512 (49)	73 (56 to 83)	78 (63 to 87)†
18–64	84	26 (31)	1,443	721 (50)	55 (28 to 72)	51 (20 to 70)†
≥65	19	12 (63)	368	285 (78)	50 (-31 to 81)	34 (-96 to 78)
Influenza B						
Overall	**323**	**132 (41)**	**2,850**	**1,518 (53)**	**39 (23 to 52)**	**42 (25 to 56)†**
Age group (yrs)						
<18	127	46 (36)	1,039	512 (49)	42 (14 to 60)	36 (1 to 58)†
18–64	151	53 (35)	1,443	721 (50)	46 (23 to 62)	50 (28 to 66)†
≥65	45	33 (73)	368	285 (78)	20 (-62 to 60)	25 (-62 to 66)

Abbreviation: CI = confidence interval.

* Vaccine effectiveness was estimated as 100% x (1 - odds ratio [ratio of odds of being vaccinated among outpatients with influenza-positive test results to the odds of being vaccinated among outpatients with influenza-negative test results]); odds ratios were estimated using logistic regression.

† Statistically significant at the p<0.05 level.

diagnostic tests.** CDC recommends antiviral medications as an adjunct to vaccination, and their potential public health benefit is increased in the context of low VE. A CDC health update issued December 27, 2017, regarding treatment with antiviral medications is available at https://emergency.cdc.gov/han/han00409.asp. Clinicians should be aware that influenza activity is widespread, and influenza should be considered as a possible diagnosis in all patients with acute respiratory illness.

The findings in this report are subject to at least four limitations. First, vaccination status included self-report at four of five sites. End-of-season VE estimates based on updated documentation of vaccination status might differ from interim estimates. Second, information from medical records and immunization registries is needed to evaluate VE by vaccine type and for fully vaccinated versus partially vaccinated children, as well as to evaluate the effects of previous season vaccination and timing of vaccination; end-of-season analysis of VE by vaccine type and effects of partial or previous season vaccination is planned. Third, an observational study design

** A complete summary of guidance for antiviral use is available at https://www.cdc.gov/flu/professionals/antivirals/summary-clinicians.htm. Groups at high risk for influenza complications include the following: children aged <2 years; adults aged ≥65 years; persons with chronic pulmonary conditions (including asthma); persons with cardiovascular disease (except hypertension alone); persons with renal, hepatic, or hematologic (including sickle cell) disease; persons with metabolic disorders (including diabetes mellitus); persons with neurologic and neurodevelopmental conditions (including disorders of the brain, spinal cord, peripheral nerves and muscles, such as cerebral palsy, epilepsy [seizure disorders], stroke, intellectual disability [mental retardation], moderate to severe developmental delay, muscular dystrophy, or spinal cord injury); persons with immunosuppression, including that caused by medications or by human immunodeficiency virus infection; women who are pregnant or ≤2 weeks postpartum; persons aged <19 years who are receiving long-term aspirin therapy; American Indian/Alaska Natives; persons with morbid obesity (i.e., body-mass index ≥40); and residents of nursing homes and other chronic-care facilities.

Summary

What is already known about this topic?

Effectiveness of seasonal influenza vaccine can vary by season and has generally been higher against influenza A(H1N1)pdm09 and B viruses than against A(H3N2) viruses.

What is added by this report?

So far this season, influenza A(H3N2) viruses have predominated, but other influenza viruses are also circulating. Based on data from 4,562 children and adults with acute respiratory illness enrolled during November 2, 2017–February 3, 2018, at five study sites with outpatient medical facilities in the United States, the overall estimated effectiveness of the 2017–18 seasonal influenza vaccine for preventing medically attended, laboratory-confirmed influenza virus infection was 36%.

What are the implications for public health practice?

CDC continues to monitor influenza vaccine effectiveness. Influenza vaccination is still recommended; vaccination reduces the risk for influenza illnesses and serious complications. Treatment with influenza antiviral medications, where appropriate, is especially important this season.

has greater potential for confounding and bias relative to randomized clinical trials. However, the test-negative design is widely used in VE studies and has been used by the U.S. Flu VE Network to estimate VE for previous influenza seasons. Finally, small sample sizes in some age groups resulted in wide confidence intervals, and end-of-season VE estimates could change as additional patient data become available or if there is a change in circulating viruses late in the season. It is also important to note that the VE estimates in this report are limited to the prevention of outpatient medical visits rather than more severe illness outcomes, such as hospitalization or death; data from studies measuring VE against more severe outcomes will be available at a later date.

Annual monitoring of VE supports ongoing efforts to improve influenza vaccines. Although more effective vaccines are needed, vaccination prevents a substantial burden of influenza-related illness annually. During the 2014–15 season, when VE against medically attended illness caused by any influenza virus was less than 20%, vaccination was estimated to prevent 11,000–144,000 influenza-associated hospitalizations and 300–4,000 influenza-associated deaths (https://www.cdc.gov/flu/about/disease/2014-15.htm). Small increases in VE can substantially affect the number of hospitalizations prevented during a severe season (*10*). Although interim estimates suggest that vaccination has prevented some influenza-related illness this season, influenza vaccines with improved effectiveness are needed to substantially reduce the incidence of disease.

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Conflict of Interest

No conflicts of interest were reported.

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Prevalence of Obesity Among Youths by Household Income and Education Level of Head of Household — United States 2011–2014

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Obesity prevalence varies by income and education level, although patterns might differ among adults and youths (*1*–*3*). Previous analyses of national data showed that the prevalence of childhood obesity by income and education of household head varied across race/Hispanic origin groups (*4*). CDC analyzed 2011–2014 data from the National Health and Nutrition Examination Survey (NHANES) to obtain estimates of childhood obesity prevalence by household income (≤130%, >130% to ≤350%, and >350% of the federal poverty level [FPL]) and head of household education level (high school graduate or less, some college, and college graduate). During 2011–2014 the prevalence of obesity among U.S. youths (persons aged 2–19 years) was 17.0%, and was lower in the highest income group (10.9%) than in the other groups (19.9% and 18.9%) and also lower in the highest education group (9.6%) than in the other groups (18.3% and 21.6%). Continued progress is needed to reduce disparities, a goal of *Healthy People 2020*. The overall *Healthy People 2020* target for childhood obesity prevalence is <14.5% (*5*).

NHANES is a cross-sectional survey designed to monitor the health and nutritional status of the civilian noninstitutionalized U.S. population (*6*). The survey consists of in-home interviews and standardized physical examinations conducted in mobile examination centers. The NHANES sample is selected using a complex, multistage probability design. During 2011–2014, non-Hispanic black, non-Hispanic Asian, and Hispanic persons, among other groups, were oversampled. Any non-Hispanic person reporting more than one race was included in an "other" category and included in the total estimates but not reported separately. The NHANES response rate for youths aged <20 years was 77.6% during 2011–2012 and 76.1% during 2013–2014. During the physical examination, standardized measurements of weight and height were obtained. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared, rounded to the nearest 10th. Obesity among youths was defined as a BMI at or above the age- and sex-specific 95th percentile of the 2000 CDC growth charts (https://www.cdc.gov/growthcharts/cdc_charts.htm).

Household income was defined using FPL information, which accounts for inflation and family size (https://aspe.hhs.gov/prior-hhs-poverty-guidelines-and-federal-register-references) and categorized as ≤130%, >130% to ≤350%, and >350% of FPL. The cut-off point for participation in the Supplemental Nutrition Assistance Program is 130% of FPL, and 350% provides relatively equal sample sizes for each income group. Education was defined using education level of head of household and was categorized as a high school graduate or less, some college, and college graduate.

All estimates accounted for the complex survey design including examination sample weights. Confidence intervals for estimates were constructed using the Korn and Graubard method (*7*). Differences between groups were tested using a 2-sided univariate t statistic ($p<0.05$). Linear and quadratic trends from 1999–2002 to 2011–2014 were conducted using 4-year survey cycles. Pregnant females and persons with missing weight or height were excluded (139) for a total sample size of 6,878 during 2011–2014. For estimates by FPL another 517 persons were missing data and were excluded from analyses of FPL; for estimates by education level, 224 persons were missing data and were excluded from analyses of education.

Overall, 17.0% of youths aged 2–19 years had obesity during 2011–2014 (Table). The prevalence was 18.9% among those in the lowest income group, 19.9% among those in the middle group, and 10.9% among those in the highest income group. Among females, patterns in non-Hispanic white, non-Hispanic Asian, and Hispanic youths were similar, with the prevalence of obesity lower in the highest income group than in both other groups, but the differences by income were statistically significant only among non-Hispanic white females. Obesity prevalence did not differ by income among non-Hispanic black females. Among males, there was a lower obesity prevalence in the highest income group only in non-Hispanic Asian youths (compared with the lowest income group) and Hispanic youths (compared with both other income groups).

Among youths, the prevalence of obesity decreased with increasing level of education of the head of household: 21.6% (high school graduate or less), 18.3% (some college), and 9.6% (college graduate). The same pattern was seen overall and in females and males in all race-Hispanic origin groups, but differences were not significant for non-Hispanic black youths (total, male, or female) or non-Hispanic Asian males or females.

From 1999–2002 to 2011–2014 the prevalence of obesity increased among females in the two lowest income groups (Figure 1). There was a nonsignificant decrease in obesity

TABLE. Prevalence of obesity among youths (persons aged 2–19 years), by race/Hispanic origin, sex, household income, and education of household head — National Health and Nutrition Examination Survey, United States, 2011–2014

		% (95% CI)				
			Race/Hispanic origin			
Characteristic	No.	All	White, non-Hispanic	Black, non-Hispanic	Asian, non-Hispanic	Hispanic
Total	**6,878**	**17.0 (15.5–18.6)**	**14.7 (12.3–17.3)**	**19.5 (17.1–22.2)**	**8.6 (6.4–11.2)**	**21.9 (20.0–23.9)**
Females	3,371	17.1 (15.1–19.3)	15.1 (11.7–19.1)	20.7 (17.1–24.6)	5.3 (2.9–8.6)	21.4 (18.8–24.1)
Males	3,507	16.9 (15.1–19.0)	14.3 (11.2–17.9)	18.4 (16.1–21.0)	11.8 (8.3–16.1)	22.4 (19.9–24.9)
Household income relative to federal poverty level						
Total						
≤130%	3,131	18.9 (17.3–20.6)	15.5 (12.8–18.5)	19.4 (17.0–22.0)	13.2 (8.2–19.7)	22.8 (19.4–26.5)
>130% to ≤350%	1,974	19.9 (16.8–23.3)	18.0 (12.6–24.6)	19.9 (15.5–25.0)	8.9 (4.9–14.6)	23.7 (19.4–28.5)
>350%	1,256	10.9 (8.0–14.4)*,†	11.0 (7.3–15.7)	19.8 (12.2–29.4)	4.4 (1.9–8.4)*,§	11.8 (7.5–17.4)*,†
Females						
≤130%	1,539	19.7 (17.4–22.1)	17.8 (13.3–23.1)	19.9 (15.7–24.6)	8.4 (2.6–19.1)¶	22.5 (18.9–26.3)
>130% to ≤350%	969	21.5 (16.9–26.8)	21.2 (13.0–31.6)	21.6 (16.3–27.6)	8.2 (2.4–19.0)¶	22.7 (17.0–29.2)
>350%	613	8.0 (5.0–12.0)*,†	7.2 (3.5–12.8)*,†	21.1 (9.6–37.2)	1.3 (0.1–4.8)¶	13.8 (6.3–25.2)
Males						
≤130%	1,592	18.1 (15.5–21.0)	13.5 (9.2–18.7)	19.0 (15.7–22.6)	18.0 (10.1–28.6)	23.1 (18.0–28.9)
>130% to ≤350%	1,005	18.4 (15.6–21.4)	15.0 (10.0–21.2)	18.1 (12.1–25.5)	9.5 (3.9–18.7)§	24.6 (20.0–29.7)
>350%	643	13.7 (9.5–18.8)	14.7 (9.2–21.9)	18.7 (12.1–26.9)	7.6 (2.8–16.0)*,§	10.0 (4.8–17.9)*,†
Education level of head of household						
Total						
High school graduate or less	3,254	21.6 (20.0–23.3)	19.6 (16.2–23.3)	21.1 (17.5–25.0)	13.2 (8.5–19.3)	24.2 (20.9–27.7)
Some college	1,936	18.3 (15.4–21.5)**	17.6 (12.4–23.9)	19.7 (16.3–23.4)	12.0 (6.0–20.7)	19.9 (16.2–23.9)
College graduate	1,464	9.6 (7.3–12.5)**,††	8.5 (5.8–12.1)**,††	15.4 (9.8–22.5)	5.5 (3.1–8.9)**	13.5 (6.9–22.8)**
Females						
High school graduate or less	1,583	22.7 (20.7–24.9)	22.5 (17.5–28.1)	21.0 (16.0–26.7)	9.2 (4.4–16.5)	23.9 (20.1–28.0)
Some college	938	18.3 (14.6–22.6)**	18.0 (11.8–25.7)	22.1 (17.4–27.4)	8.0 (1.3–23.7)¶	17.3 (12.5–23.0)**
College graduate	739	8.5 (5.5–12.4)**,††	7.5 (3.9–12.8)**,††	16.3 (10.2–24.1)	3.3 (0.7–9.2)¶	14.0 (6.8–24.3)**
Males						
High school graduate or less	1,671	20.6 (18.1–23.2)	16.9 (11.6–23.3)	21.1 (17.5–25.1)	16.9 (9.0–27.7)	24.4 (20.5–28.7)
Some college	998	18.3 (14.7–22.4)	17.3 (11.0–25.3)	17.2 (13.4–21.6)	14.6 (6.7–26.4)	22.3 (15.9–29.8)
College graduate	725	10.7 (7.6–14.7)**,††	9.6 (5.5–15.2)**	14.5 (6.9–25.4)	7.9 (3.8–14.0)	12.9 (5.8–23.9) §,**

Abbreviation: CI = confidence interval.
* Significantly different from ≤130% of FPL, p<0.05.
† Significantly different from >130% to ≤350% of FPL, p<0.05.
§ Estimate might be unreliable because relative standard error is between 30% and 40%.
¶ Estimate might be unreliable because relative standard error is >40%.
** Significantly different from high school graduate or less, p<0.05.
†† Significantly different from some college, p<0.05.

prevalence among females in the highest income group, and the difference in childhood obesity prevalence between the lowest and highest income groups increased over time. Among males, a quadratic trend was observed in the lowest income group: obesity prevalence was 16.9% during 1999–2002, increased to 21.0% during 2007–2010, and then declined to 18.1% during 2011–2014. The difference in prevalence between the lowest and highest income groups did not change over time for males.

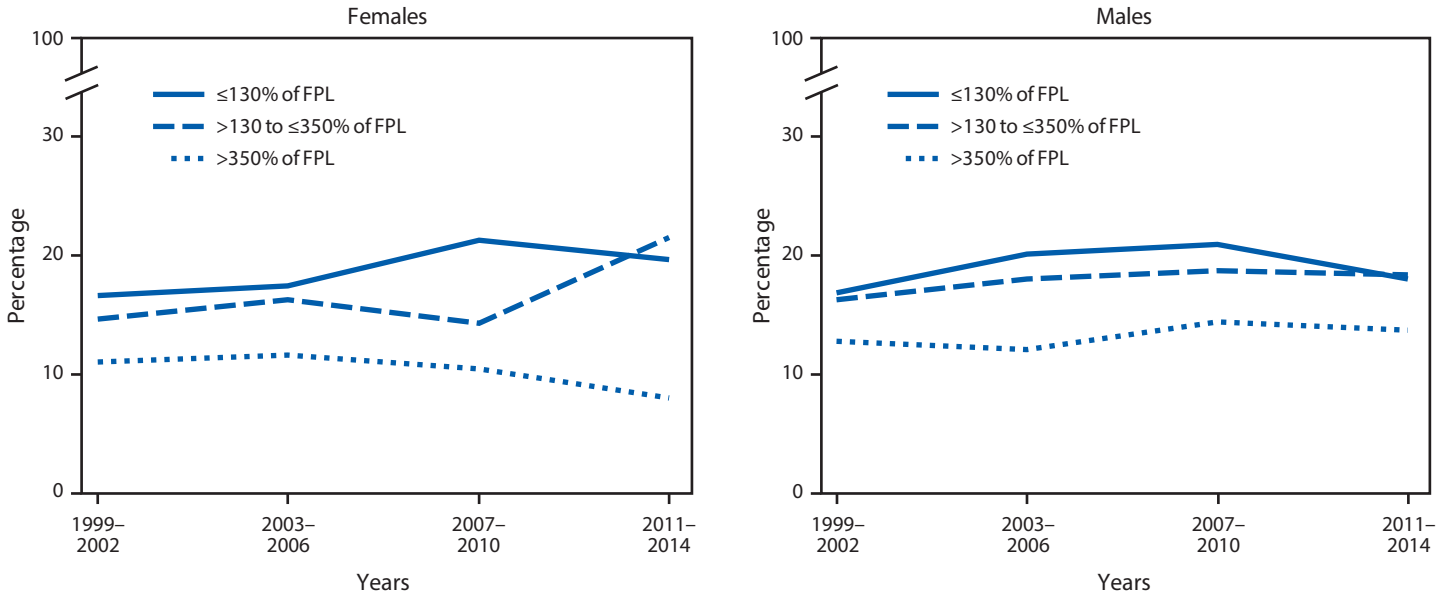
Obesity prevalence among youths increased from 1999–2002 to 2011–2014 among females and males in households headed by persons with the least education (high school graduate or less) and among females in households headed by persons with some college education. There were no other significant trends. In addition, the difference in childhood obesity prevalence between the lowest and highest head of household education groups increased over time for females but not for males (Figure 2).

Discussion

During 2011–2014, the relationships between childhood obesity and income and childhood obesity and education of household head were complex, differing depending upon the subgroup of the population. The prevalence of obesity among youths living in households headed by college graduates was lower than that among those living in households headed by less educated persons for each race-Hispanic origin group. The same was not true for those living in the highest income group. Moreover, differences by income and education of household head are widening among females.

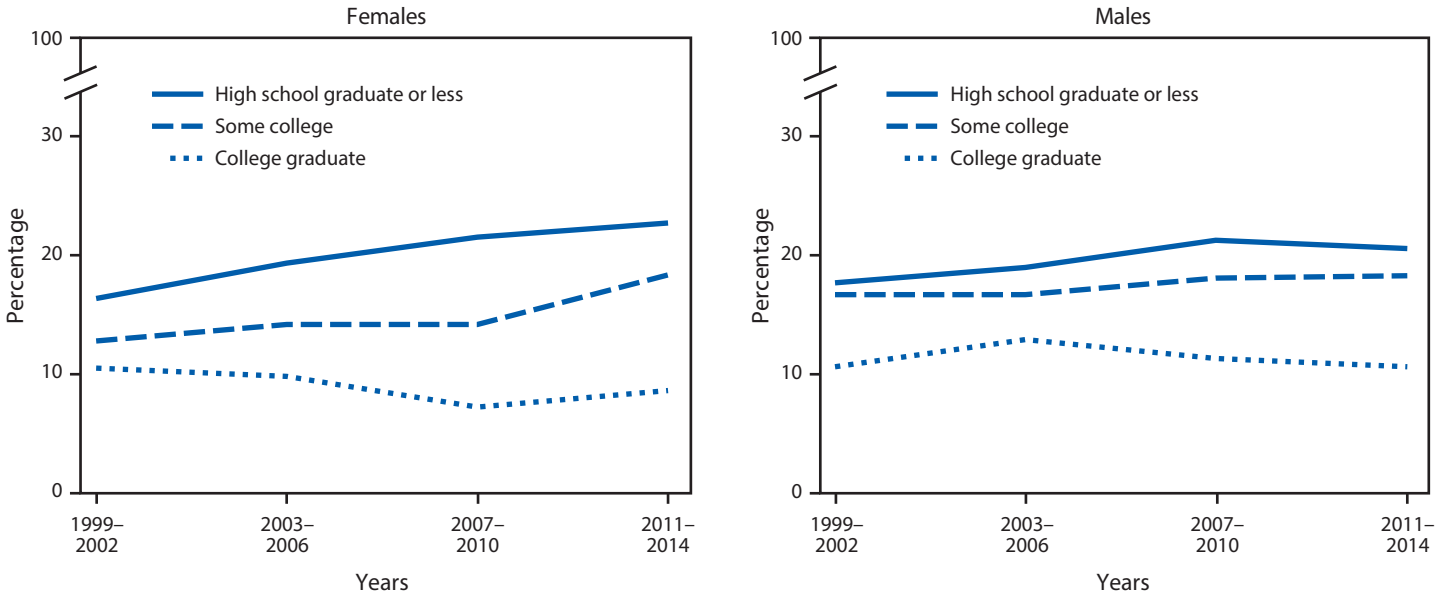
Similar to results based on data from 2005 to 2008 (*4*), during 2011–2014 childhood obesity prevalence was lower among

FIGURE 1. Trends*,† in obesity prevalence among youths (persons aged 2–19 years), by household income — National Health and Nutrition Examination Survey, United States, 1999–2002 through 2011–2014



Abbreviation: FPL = federal poverty level.
* Linear trend ($p<0.05$) for females ≤130% of FPL, >130% to ≤350% of FPL.
† Quadratic trend ($p<0.05$) for males ≤130% of FPL.

FIGURE 2. Trends* in prevalence of obesity among youths (persons aged 2–19 years), by education level of head of household — National Health and Nutrition Examination Survey, United States, 1999–2002 through 2011–2014



* Linear trend ($p<0.05$) for females, high school graduate or less and some college, and males, high school graduate or less.

youths living in households in the highest income group. However, this was not the pattern seen in all subgroups. For example, obesity prevalence was lower in the highest income group compared with the other groups among non-Hispanic white females, but not among non-Hispanic black females, non-Hispanic white males, or non-Hispanic black males. Obesity prevalence decreased as head of household education increased in all subgroups examined. The prevalence of obesity

Summary

What is already known about this topic?

Studies have suggested that childhood obesity prevalence varies by income and education, although patterns might differ between adults and youths.

What is added by this report?

Analysis of data from the 2011–2014 National Health and Nutrition Examination Survey (NHANES) demonstrates that childhood obesity prevalence patterns among persons aged 2–19 years by household income are less consistent by race and Hispanic origin than are the patterns by level of education attained by the head of household. Moreover, the differences in childhood obesity prevalence by income and education of household head are widening among females while differences among males have remained relatively constant over time.

What are the implications for public health practice?

NHANES will continue to be an important source of data for monitoring disparities in childhood obesity. These data will help track the *Healthy People 2020* objective of reducing disparities and might inform obesity prevention programs at the federal, state, and local levels.

was consistently lowest among children in households headed by college graduates, which differed from the pattern seen by income level. This difference in the relationship between obesity and income versus education has been observed in at least one other study (*8*). In addition, some relationships changed since 2005–2008. For example, there was a significant decreasing trend in obesity prevalence by income among non-Hispanic white males during 2005–2008 (*4*) but there were no differences during 2011–2014.

This report also presents differences in childhood obesity prevalence by income and education among non-Hispanic Asian youths in the United States. It has been suggested that the cut-off point that typically defines obesity might underestimate associated health risks among Asian persons (*9*).

The findings in this report are subject to at least one limitation. The sample size was small among some subgroups, such as non-Hispanic Asian females living in households with income above 350% of the FPL, where the prevalence of obesity is very low (1.3%) and the sample size is small (138). Additional years of data might provide more information about obesity prevalence by income, especially among non-Hispanic Asian youths.

Trends in childhood obesity prevalence by income and education level of head of household indicate that disparities have existed at least since NHANES III, 1988–1994 (*10*). These differences have widened since 1999–2002 among females but not among males, where differences in obesity prevalence by income and education of the head of household have remained relatively constant from 1999–2002 to 2011–2014.

These findings demonstrate that lower levels of income are not universally associated with childhood obesity. The association is complex and differs by sex, race, and Hispanic origin, and possibly over time. Differences by education are more consistent across subgroups than differences by income. More progress is needed to reduce disparities in childhood obesity prevalence, an important *Healthy People 2020* objective.

Conflict of Interest

No conflicts of interest were reported.

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Health-Risk Behaviors and Chronic Conditions Among Adults with Inflammatory Bowel Disease — United States, 2015 and 2016

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Inflammatory bowel disease (IBD), which includes Crohn's disease and ulcerative colitis, involves chronic inflammation of the gastrointestinal tract. In 2015, an estimated 3.1 million adults in the United States had ever received a diagnosis of IBD (*1*). Nationally representative samples of adults with IBD have been unavailable or too small to assess relationships between IBD and other chronic conditions and health-risk behaviors (*2*). To assess the prevalence of health-risk behaviors and chronic conditions among adults with and without IBD, CDC aggregated survey data from the 2015 and 2016 National Health Interview Survey (NHIS). An estimated 3.1 million (unadjusted lifetime prevalence = 1.3%) U.S. adults had ever received a diagnosis of IBD. Adults with IBD had a significantly lower prevalence of having never smoked cigarettes than did adults without the disease (55.9% versus 63.5%). Adults with IBD had significantly higher prevalences than did those without the disease in the following categories: having smoked and quit (26.0% versus 21.0%; having met neither aerobic nor muscle-strengthening activity guidelines (50.4% versus 45.2%); reporting <7 hours of sleep, on average, during a 24-hour period (38.2% versus 32.2%); and having serious psychological distress (7.4% versus 3.4%). In addition, nearly all of the chronic conditions evaluated were more common among adults with IBD than among adults without IBD. Understanding the health-risk behaviors and prevalence of certain chronic conditions among adults with IBD could inform clinical practice and lead to better disease management.

The NHIS is a cross-sectional household health survey of the civilian noninstitutionalized population. The survey provides nationally representative data on a broad range of topics, including health status, health behaviors, and access to and use of health care.* Data on diagnosed IBD (hereafter referred to as IBD) were collected with the Sample Adult Core questionnaire using the following question: "Have you ever been told by a doctor or other health professional that you had Crohn's disease or ulcerative colitis?" The sample adult is randomly selected from all adults aged ≥18 years in the family and answers for himself/herself (unless physically or mentally unable to do so, in which case a knowledgeable adult serves as a proxy respondent). Interviews are conducted in respondents' homes, although follow-ups by telephone to complete missing sections are permitted. To ensure more precise estimates of IBD status, the 2015 and 2016 Sample Adult data files were combined with the 2-year response rate of 54.7%.†

The prevalence of IBD, with 95% confidence intervals, was estimated for the civilian, noninstitutionalized U.S. adult population overall and by various sociodemographic characteristics. These characteristics, collected with the Household Composition and Family Core questionnaires, included age, sex, race/ethnicity, education level, marital status, current employment status, nativity, health insurance coverage type (reported separately for adults aged <65 and ≥65 years), urbanicity, and region of residence. Next, the prevalence of five health-risk behaviors§ (cigarette smoking status, binge drinking, body mass index [BMI] category, meeting of federal physical activity guidelines, and short sleep duration), serious psychological distress¶ (a proxy for mental health symptoms),

* https://www.cdc.gov/nchs/nhis/index.htm.

† ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NHIS/2015/srvydesc.pdf; ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NHIS/2016/srvydesc.pdf.

§ Cigarette smoking status was defined as current, former, or never smoker. Current smokers reported having smoked ≥100 cigarettes in their lifetime and currently smoking cigarettes some days or every day. Former smokers reported having smoked ≥100 cigarettes in their lifetime but were not current smokers at the time of the survey. Never smokers reported they had not smoked ≥100 cigarettes in their lifetime. Binge drinking was defined as ≥12 heavy drinking days (five or more alcoholic drinks for men and four or more alcoholic drinks for women) in the past year. BMI (kg/m^2) was categorized as underweight (<18.5), normal weight (≥18.5 and <25.0), overweight (≥25.0 and <30.0), or obese (≥30.0). The definition of physical activity categories followed the *2008 Physical Activity Guidelines for Americans* (https://health.gov/paguidelines/pdf/paguide.pdf). Both aerobic and muscle-strengthening guidelines are met if participants reported ≥150 minutes of moderate or ≥75 minutes of vigorous equivalent aerobic activity per week and muscle strengthening activities on ≥2 days per week. Short sleep duration was defined as reporting <7 hours of sleep, on average, in a 24-hour period.

¶ Serious psychological distress is based on responses to six questions that ask how often a respondent experienced certain symptoms (feeling so sad nothing could cheer you up; nervous; restless or fidgety; hopeless; that everything was an effort; or worthless) of psychological distress during the past 30 days. The response codes (0–4) of the six items for each person are summed to yield a scale with a 0–24 range. A value of ≥13 for this scale is used here to define serious psychological distress.

and several chronic conditions** (cardiovascular disease, respiratory disease, cancer, diabetes, arthritis, weak or failing kidneys, any liver condition, and ulcer) were estimated separately for adults with and without IBD. All prevalence estimates met the reliability standard of relative standard errors <30%†† and were age-adjusted to the projected 2000 U.S. population§§ (unless otherwise noted). For comparison of IBD prevalence by subgroup and prevalence of health-risk behaviors and chronic conditions by IBD status, differences were considered significant if two-tailed Z-tests yielded p-values <0.05. All comparisons described in the results were statistically significant. All analyses were conducted using statistical software to account for the stratified, complex cluster sampling design of the survey. Estimates incorporated the final sample adult weights adjusted for nonresponse and calibrated to population control totals to generalize the estimates to the civilian noninstitutionalized population aged ≥18 years.

In 2015 and 2016, 3.1 million (unadjusted lifetime prevalence of 1.3%; age-adjusted lifetime prevalence of 1.2%) U.S. adults had ever received a diagnosis of IBD (Table 1). The age-specific prevalence of IBD was higher among adults aged 45–64 and ≥65 years (both 1.7%) than among those aged 18–24 (0.5%) or 25–44 (1.0%) years. The prevalence of IBD was higher among women (1.5%) than among men (1.0%); among non-Hispanic white adults (1.4%) than among non-Hispanic black adults (0.6%) or other non-Hispanic adults (0.8%); among those with less than a high school education (1.6%) than among those with at least a bachelor's degree (1.1%); among those who were divorced, separated, or widowed (2.3%) than among persons who were married or cohabitating (1.1%); among currently unemployed (1.6%) or U.S.-born (1.3%) adults than their employed (1.1%) and non–U.S.-born (0.8%) counterparts; and among adults living in small metropolitan statistical areas (MSAs) (1.4%) than among those living in large MSAs (1.1%). The prevalence of IBD did not differ significantly among groups defined by health insurance coverage type or region of residence.

Being a former smoker was more prevalent among adults with IBD (26.0%) than among adults without IBD (21.0%), and having never smoked was less prevalent among adults with IBD (55.9%) than among those without IBD (63.5%) (Table 2). In addition, adults with IBD had higher prevalences than those without IBD of sleeping <7 hours per day (38.2% versus 32.2%) and meeting neither aerobic nor muscle-strengthening physical activity guidelines (50.4% versus 45.2%). No statistically significant difference was detected in the prevalence of binge drinking or BMI category between the two groups. The prevalence of experiencing serious psychological distress was reported twice as frequently by adults with IBD (7.4%) than by those without IBD (3.4%). Among the selected chronic conditions, with the exception of diabetes, all were significantly more prevalent among adults with IBD than among those without IBD (Table 2). The prevalence of ulcer was nearly five times higher among adults with IBD (26.0%) than among those without IBD (5.5%).

Discussion

Based on a nationally representative sample, during 2015–2016, an estimated 3.1 million U.S. adults had ever received a diagnosis of IBD. IBD might require lifelong disease management, including a combination of prescription medications, surgery, and medical treatment in outpatient, inpatient, emergency department, or ambulatory care settings. The symptoms and complications of IBD are associated with substantially impaired health-related quality of life (*3*). The total direct and indirect costs from loss of earnings or productivity attributable to IBD in the United States were estimated in 2014 to be $14.6 billion–$31.6 billion¶¶; however, because this estimate was based on a lower prevalence of IBD than that presented in this report, and given the impact of inflation, the current costs might be substantially higher.

In this study, the prevalence of IBD was higher among women, non-Hispanic whites, and older, less educated, and unemployed adults, which is consistent with the findings of previous studies (*1*,*4*,*5*). For example, in a previous study using insurance claims data, the prevalence of Crohn's disease and ulcerative colitis was higher among older adults, and although

** Cardiovascular disease included a history of any of the following conditions: coronary heart disease, angina, myocardial infarction, stroke, or any heart disease. Respiratory disease included a history of any of the following conditions: emphysema, chronic bronchitis, chronic obstructive pulmonary disease, or asthma. Cancer included cancer or a malignancy of any kind. Diabetes was defined as an affirmative response to the question "Other than during pregnancy, have you ever been told by a doctor or other health professional that you have diabetes or sugar diabetes?" Arthritis was defined as an affirmative response to the question "Have you ever been told by a doctor or other health professional that you have some form of arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia?" Weak or failing kidneys was defined as an affirmative response to the question "During the past 12 months, have you been told by a doctor or other health professional that you had weak or failing kidneys? Do not include kidney stones, bladder infections or incontinence." Any liver condition was defined as an affirmative response to the question "During the past 12 months, have you been told by a doctor or other health professional that you had any kind of liver condition?" Ulcer was defined as an affirmative response to the question "Have you ever been told by a doctor or other health professional that you had an ulcer?"

†† The relative standard error is equal to the standard error divided by the estimate, then multiplied by 100.

§§ Age-adjusted prevalence analysis used the projected 2000 U.S. population distribution #8 (18–24 years, 25–44 years, 45–64 years, and ≥65 years). https://www.cdc.gov/nchs/data/statnt/statnt20.pdf.

¶¶ http://www.crohnscolitisfoundation.org/assets/pdfs/ibdfactbook.pdf.

TABLE 1. Prevalence of inflammatory bowel disease* among U.S. adults aged ≥18 years, by sociodemographic characteristics — National Health Interview Survey, 2015–2016

Characteristic	Estimated no.†	Age-adjusted§ % (95% CI)
Total (unadjusted)	**3,121,000**	**1.3 (1.2–1.4)**
Total (age-adjusted)	**3,121,000**	**1.2 (1.1–1.3)**
Age group (yrs)		
18–24	152,000	0.5 (0.3–0.8)
25–44	798,000	1.0 (0.8–1.1)
45–64	1,394,000	1.7 (1.5–1.9)
≥65	777,000	1.7 (1.4–1.9)
Sex		
Men	1,219,000	1.0 (0.9–1.2)
Women	1,902,000	1.5 (1.3–1.6)
Race/Ethnicity		
Non-Hispanic white	2,363,000	1.4 (1.3–1.6)
Non-Hispanic black	174,000	0.6 (0.4–0.8)
Hispanic	427,000	1.2 (0.9–1.6)
Non-Hispanic other¶	157,000	0.8 (0.6–1.2)
Education level		
Less than high school	491,000	1.6 (1.2–2.0)
High school diploma/GED	748,000	1.2 (1.0–1.4)
Some college	971,000	1.3 (1.1–1.5)
Bachelor's degree or higher	906,000	1.1 (1.0–1.3)
Current marital status		
Married/Cohabitating	1,823,000	1.1 (1.0–1.3)
Never married	484,000	1.3 (1.0–1.6)
Divorced/Separated/Widowed	814,000	2.3 (1.4–3.7)
Current employment		
Yes	1,538,000	1.1 (1.0–1.3)
No	1,583,000	1.6 (1.4–1.8)
U.S.-born**		
Yes	2,741,000	1.3 (1.2–1.4)
No	381,000	0.8 (0.6–1.1)
Health insurance coverage††		
Age <65 years		
Private	1,578,000	1.1 (1.0–1.3)
Medicaid and other public coverage	354,000	1.4 (1.1–1.8)
Other	179,000	1.3 (0.9–1.7)
Uninsured	231,000	1.0 (0.8–1.4)
Age ≥65 years		
Private	338,000	1.7 (1.4–2.2)
Medicare and/or Medicaid	64,000	2.0 (1.2–3.1)
Medicare Advantage	215,000	1.8 (1.4–2.5)
Medicare only, excluding Medicare Advantage	104,000	1.3 (0.8–2.0)
Other	55,000	1.4 (0.9–2.4)
Uninsured§§	NA	NA
Urbanicity¶¶		
Large MSA	1,542,000	1.1 (1.0–1.3)
Small MSA	1,366,000	1.4 (1.2–1.6)
Not in MSA	213,000	1.4 (1.0–1.8)
Region***		
Northeast	591,000	1.3 (1.1–1.6)
Midwest	752,000	1.3 (1.1–1.6)
South	1,092,000	1.2 (1.0–1.4)
West	686,000	1.2 (1.0–1.4)

Abbreviations: CI = confidence interval; GED = General Educational Development certificate; MSA = metropolitan statistical area; NA = not applicable.

* Respondents who had ever been told by a doctor or other health professional that they had Crohn's disease or ulcerative colitis.

† The estimated annual numbers, rounded to 1,000s, were calculated based on 2015 and 2016 data. Counts for adults of unknown status (responses coded as "refused," "don't know," or "not ascertained") with respect to inflammatory bowel disease status are not shown separately in the table, nor are they included in the calculation of percentages (as part of either denominator or the numerator), to provide a more straightforward presentation of the data. In addition, frequencies presented in the table might be underestimated because of item nonresponse and unknowns.

§ Estimates (except for age groups and crude total) are age-adjusted using the projected 2000 U.S. population distribution #8 as the standard population and four age groups: 18–24, 25–44, 45–64, and ≥65 years. https://www.cdc.gov/nchs/data/statnt/statnt20.pdf.

¶ Non-Hispanic other includes non-Hispanic American Indian and Alaska Native only, non-Hispanic Asian only, non-Hispanic Native Hawaiian and Pacific Islander only, and non-Hispanic multiple race.

** U.S.-born includes all persons born in the United States or a United States territory.

†† Based on a hierarchy of mutually exclusive categories. Adults with more than one type of health insurance were assigned to the first category in the hierarchy. "Uninsured" includes adults who had no coverage as well as those who had only Indian Health Service coverage or had only a private plan that paid for one type of service such as accidents or dental care.

§§ In the survey sample, zero adults aged ≥65 years and uninsured had ever been told by a doctor or other health professional that they had Crohn's disease or ulcerative colitis.

¶¶ Large MSAs have a population size of ≥1 million; small MSAs have a population size of <1 million. Persons "Not in MSA" do not live in a metropolitan statistical area.

*** *Northeast*: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. *Midwest*: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. *South*: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia. *West*: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

the prevalence of ulcerative colitis did not differ significantly by sex, women were more likely than men to have Crohn's disease (*4*). In this study, however, the survey question did not differentiate Crohn's disease from ulcerative colitis. This study also found IBD to be more prevalent among unemployed adults, reinforcing previous findings on the employment burden of the disease (*5*). However, unlike other studies (*4*,*6*), no evidence was found of a difference in IBD prevalence by region of residence, which might be a result of different data collection modes and target populations in different studies.

Adults with IBD were more frequently former smokers and less frequently never smokers than were those without IBD. Some smokers might possibly have quit smoking because of a diagnosis of IBD. The role of smoking in the development of IBD is not fully understood. Smoking among persons with Crohn's disease, however, has been found to be associated with

TABLE 2. Age-adjusted prevalence of selected health-risk behaviors and chronic conditions by inflammatory bowel disease* status among U.S. adults aged ≥18 years — National Health Interview Survey, 2015–2016

Characteristic	Adults with IBD		Adults without IBD	
	Estimated no.†	Age-adjusted§ % (95% CI)	Estimated no.	Age-adjusted§ % (95% CI)
Cigarette smoking status¶				
Current smoker	557,000	18.0 (14.9–21.7)	36,561,000	15.5 (15.0–15.9)
Former smoker	949,000	26.0 (22.2–30.2)**	52,541,000	21.0 (20.6–21.5)
Never smoker	1,608,000	55.9 (51.3–60.5)**	150,357,000	63.5 (63.0–64.0)
Drinking status††				
Binge drinking (≥12 days) in the past year	250,000	9.8 (6.9–13.6)	22,207,000	9.9 (9.5–10.2)
BMI groups (kg/m^2)§§				
Underweight (<18.5)	71,000	2.4 (1.4–4.0)	4,286,000	1.9 (1.7–2.0)
Normal (≥18.5 and <25.0)	1,007,000	35.9 (31.1–41.0)	78,296,000	34.2 (33.7–34.8)
Overweight (≥25.0 and <30.0)	995,000	31.0 (26.9–35.5)	79,812,000	34.2 (33.7–34.7)
Obese (≥30)	954,000	30.7 (26.2–35.6)	69,410,000	29.7 (29.2–30.3)
Met physical activity guidelines¶¶				
Neither aerobic nor muscle-strengthening activity	1,680,000	50.4 (45.6–55.2)**	108,231,000	45.2 (44.6–45.8)
Aerobic activity only	770,000	25.4 (21.7–29.5)	68,340,000	29.2 (28.7–29.7)
Muscle-strengthening activity only	116,000	3.4 (2.0–5.5)	8,360,000	3.5 (3.3–3.7)
Both aerobic and muscle-strengthening activities	509,000	20.9 (16.9–25.5)	50,666,000	22.1 (21.7–22.6)
Less than 7 hours of sleep, on average* **	1,138,000	38.2 (33.4–43.3)**	74,316,000	32.2 (31.6–32.7)
Serious psychological distress†††	259,000	7.4 (5.4–10.0)**	8,161,000	3.4 (3.2–3.6)
Chronic conditions§§§				
Cardiovascular disease	748,000	19.2 (16.3–22.5)**	31,229,000	12.0 (11.7–12.4)
Respiratory disease	870,000	27.3 (23.3–31.7)**	40,284,000	16.6 (16.2–17.0)
Cancer	547,000	13.7 (10.9–17.0)**	21,430,000	8.1 (7.9–8.3)
Diabetes	448,000	10.1 (8.2–12.4)	22,647,000	8.6 (8.4–8.9)
Arthritis	1,415,000	36.3 (32.8–40.0)**	55,114,000	21.1 (20.8–21.5)
Weak or failing kidneys	171,000	4.5 (3.2–6.3)**	4,703,000	1.8 (1.7–1.9)
Any liver condition	192,000	5.2 (3.7–7.2)**	4,207,000	1.7 (1.6–1.8)
Ulcer	800,000	26.0 (22.2–30.3)**	13,888,000	5.5 (5.3–5.7)

Abbreviations: BMI = body mass index; CI = confidence interval; IBD = inflammatory bowel disease.

* Respondents who had ever been told by a doctor or other health professional that they had Crohn's disease or ulcerative colitis.

† The estimated annual numbers, rounded to 1,000s, were calculated based on the 2015 and 2016 data. Counts for adults of unknown status (responses coded as "refused," "don't know," or "not ascertained") with respect to IBD status are not shown separately in the table, nor are they included in the calculation of percentages (as part of either denominator or the numerator), to provide a more straightforward presentation of the data. In addition, frequencies presented in the table might be underestimated because of item nonresponse and unknowns.

§ Estimates are age-adjusted using the projected 2000 U.S. population as the standard population and four age groups: 18–24, 25–44, 45–64, and ≥65 years.

¶ Cigarette smoking status was defined as current, former, or never smoker. Current smokers reported having smoked ≥100 cigarettes in their lifetime and currently smoking cigarettes some days or every day. Former smokers reported having smoked ≥100 cigarettes in their lifetime but were not current smokers at the time of the survey. Never smokers reported they had not smoked ≥100 cigarettes in their lifetime.

** Statistically significant (p<0.05).difference between adults with IBD and adults without IBD.

†† Binge drinking ≥12 days in the past year was defined according to a response of the number of days to the question "In the past year, on how many days did you have 5 or more [for men]/4 or more drinks [for women] of any alcoholic beverage?"

§§ BMI was calculated as weight (kg)/height (m^2) based on responses to the questions "How tall are you without shoes?" and "How much do you weigh without shoes?" BMI (kg/m^2) was categorized as underweight (<18.5), normal weight (≥18.5 and <25.0), overweight (≥25.0 and <30.0), or obese (≥30.0).

¶¶ The definition of physical activity categories followed 2008 Physical Activity Guidelines for Americans (https://health.gov/paguidelines/pdf/paguide.pdf). Both aerobic and muscle-strengthening guidelines are met if participants reported ≥150 minutes of moderate or ≥75 minutes of vigorous equivalent aerobic activity per week and muscle strengthening activities on ≥2 days per week.

*** Short sleep duration was defined as <7 hours in response to the question "On average, how many hours of sleep do you get in a 24-hour period?"

††† Serious psychological distress is based on responses to six questions that ask how often a respondent experienced certain symptoms (feeling so sad nothing could cheer you up; nervous; restless or fidgety; hopeless; that everything was an effort; worthless) of psychological distress during the past 30 days. The response codes (0–4) of the six items for each person are summed to yield a scale with a 0–24 range. A value of ≥13 for this scale is used here to define serious psychological distress.

§§§ Cardiovascular disease included a history of any of the following conditions: coronary heart disease, angina, myocardial infarction, stroke, or any heart disease. Respiratory disease included a history of any of the following conditions: emphysema, chronic bronchitis, chronic obstructive pulmonary disease, or asthma. Cancer included cancer or a malignancy of any kind. Diabetes was defined as an affirmative response to the question "Other than during pregnancy, have you ever been told by a doctor or other health professional that you have diabetes or sugar diabetes?" Arthritis was defined as an affirmative response to the question "Have you ever been told by a doctor or other health professional that you have some form of arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia?" Weak or failing kidneys was defined as an affirmative response to the question "During the past 12 months, have you been told by a doctor or other health professional that you had weak or failing kidneys? Do not include kidney stones, bladder infections or incontinence." Any liver condition was defined as an affirmative response to the question "During the past 12 months, have you been told by a doctor or other health professional that you had any kind of liver condition?" Ulcer was defined as an affirmative response to the question "Have you ever been told by a doctor or other health professional that you had an ulcer?"

disease development, progression, and inferior treatment outcomes (*7*). Smoking cessation, therefore, is particularly recommended among patients with diagnosed Crohn's disease (*7*). Many chronic conditions are more common among adults who report a short sleep duration.*** Similarly, this study found that short sleep duration was more prevalent among adults with IBD. In addition, the prevalence of meeting neither aerobic nor muscle-strengthening physical activity guidelines was higher among adults with IBD, which might be an indication of severity of symptoms. Although there is no current exercise recommendation to adults with IBD, mild exercise in those with mild or moderate symptoms might not worsen disease symptoms (*8*). Furthermore, exercise might help build muscle mass, bone density, and improve sleep quality, and its benefits outweigh the risks for almost everyone. Adults with IBD who have mild to moderate disease activity should be encouraged to consult their clinicians about their exercise engagement.

Several chronic conditions were more prevalent among adults with IBD than among those without IBD. Although few comprehensive studies of IBD comorbidities exist, the disease has been found to be associated with multiple diseases, only some of which were gastrointestinal-related (*9*). For example, adults with IBD are at increased risk for certain cancers and osteoporosis (*7*). In this study, the prevalence of having experienced serious psychological distress in the last 30 days was higher among adults with IBD. This is consistent with past research that found adults with IBD have an increased prevalence of psychological or psychosocial disorders, including depression, anxiety, and impaired social interactions (*10*). Psychological disorders were also predictive of poor health-related quality of life, regardless of the severity of IBD (*10*). The presence of certain chronic conditions in addition to IBD might impair health-related quality of life among affected persons and further complicate disease progression and care management (*9*).

The findings in this study are subject to at least six limitations. First, because NHIS responses are self-reported and not corroborated by medical records, they are subject to reporting bias. Second, diagnosis of Crohn's disease and ulcerative colitis could not be assessed separately as they are combined in a single survey question of IBD. Third, questions on other chronic conditions likely to be associated with IBD, such as anemia and osteoporosis, are not asked in the NHIS. Fourth, a short-term measure of serious psychological distress (within the last 30 days) was used as a proxy measure for mental health symptoms; therefore, the prevalence of serious psychological distress among adults with IBD could be underestimated. Fifth, although the sample weights include adjustments for survey nonresponse, the potential for nonresponse bias in the IBD estimates remains, given the Sample Adult Core response rate of 54.7% for the 2 years under analysis. Finally, the NHIS survey excluded active duty military personnel and institutionalized adults; therefore, the results cannot be generalized to the entire U.S. adult population.

Understanding the extent to which adults with IBD experience comorbidities helps further elucidate the impact of IBD. Further, assessing the health-risk behaviors of persons with IBD might aid in identifying opportunities to improve their overall health, quality of life, and disease management. Given the disease's complexity and the effects of chronic conditions and symptoms, optimal IBD care might require a multidisciplinary approach that includes gastroenterologists, preventive medicine specialists, and other medical practitioners.

Summary

What is already known about this topic?

In 2015, an estimated 3 million U.S. adults had inflammatory bowel disease (IBD). The prevalence of IBD was higher among adults who were aged ≥45 years, white, U.S.-born, unemployed, and who had less than a high school education.

What is added by this report?

Based on 2015 and 2016 National Health Interview Survey data, being a former smoker was more prevalent and having never smoked was less prevalent among adults with IBD than among adults without IBD. In addition, meeting neither aerobic nor muscle-strengthening physical activity guidelines, sleeping <7 hours, on average during a 24-hour period, and experiencing serious psychological distress were more prevalent among adults with IBD than among those without IBD, as were several chronic conditions, including cardiovascular disease, respiratory disease, cancer, arthritis, weak or failing kidneys, any liver condition, and ulcer.

What are the implications for public health practice?

Adults with IBD who have mild to moderate disease activity should be encouraged to consult their clinicians about their exercise engagement. Clinicians should be aware of potential adverse health consequences of the health-risk behaviors that are more prevalent among adults with IBD, such as having insufficient sleep. Because certain chronic conditions are more prevalent among adults with IBD, disease management might involve multidisciplinary clinical care.

Conflict of Interest

No conflicts of interest were reported.

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*** https://www.cdc.gov/sleep/data_statistics.html.

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Reasons for Electronic Cigarette Use Among Middle and High School Students — National Youth Tobacco Survey, United States, 2016

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Electronic cigarettes (e-cigarettes) were the most commonly used tobacco product among U.S. middle school and high school students in 2016 (*1*). CDC and the Food and Drug Administration (FDA) analyzed data from the 2016 National Youth Tobacco Survey (NYTS) to assess self-reported reasons for e-cigarette use among U.S. middle school (grades 6–8) and high school (grades 9–12) student e-cigarette users. Among students who reported ever using e-cigarettes in 2016, the most commonly selected reasons for use were 1) use by "friend or family member" (39.0%); 2) availability of "flavors such as mint, candy, fruit, or chocolate" (31.0%); and 3) the belief that "they are less harmful than other forms of tobacco such as cigarettes" (17.1%). The least commonly selected reasons were 1) "they are easier to get than other tobacco products, such as cigarettes" (4.8%); 2) "they cost less than other tobacco products such as cigarettes" (3.2%); and 3) "famous people on TV or in movies use them" (1.5%). Availability of flavors as a reason for use was more commonly selected by high school users (32.3%) than by middle school users (26.8%). Efforts to prevent middle school and high school students from initiating the use of any tobacco product, including e-cigarettes, are important to reduce tobacco product use among U.S. youths (*2*).

NYTS is a school-based, pencil-and-paper questionnaire, self-administered to a cross-sectional, nationally representative sample of students in grades 6–12 in the United States (*3*). In 2016, 20,675 students completed the NYTS; the overall survey response rate was 71.6%. Reasons for e-cigarette use were assessed among both ever and current e-cigarette users. Ever users were defined as participants who responded "yes" to the question, "Have you ever used an electronic cigarette or e-cigarette, even once or twice?" Among ever users, current users were those who reported using e-cigarettes on ≥1 day during the past 30 days, based on responses to the question, "During the past 30 days, on how many days did you use electronic cigarettes or e-cigarettes?" Current e-cigarette users were further classified into four mutually exclusive group based on tobacco products used: e-cigarettes only; e-cigarettes and combustible tobacco (e.g., cigarettes, cigars, pipes, bidis, or hookah); e-cigarettes and noncombustible tobacco (e.g., smokeless tobacco, snus, or dissolvable tobacco); and e-cigarettes with combustible and noncombustible tobacco. Data for the group that used e-cigarettes and noncombustible tobacco products are not presented because of small sample size.

Participants were asked, "What are the reasons why you have used electronic cigarettes or e-cigarettes?" Response options were "I have never tried an electronic cigarette," "friend or family member used them," "to try to quit using tobacco products, such as cigarettes," "they cost less than other tobacco products, such as cigarettes," "they are easier to get than other tobacco products, such as cigarettes," "famous people on TV or in movies use them," "they are less harmful than other forms of tobacco, such as cigarettes," "they are available in flavors, such as mint, candy, fruit, or chocolate," "they can be used in areas where other tobacco products, such as cigarettes, are not allowed," and "I used them for some other reason." Participants could select multiple reasons.

After excluding participants who had never tried an e-cigarette or had missing information on school level (middle or high), sex, or race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, and non-Hispanic other race), 4,049 ever users, including 1,281 current users, were included in the analysis. Data were weighted to account for the complex survey design and adjusted for nonresponse. Point estimates, 95% confidence intervals, and population totals corresponding to reasons for use were computed among ever and current e-cigarette users, both overall and by school level, sex, race/ethnicity, and current use of other tobacco products. Chi-square tests were used to assess statistically significant ($p<0.05$) differences across groups.

Among U.S. middle and high school e-cigarette ever users in 2016, the most commonly selected reasons for using e-cigarettes were "friend or family member used them" (39.0%), "they are available in flavors, such as mint, candy, fruit, or chocolate" (31.0%), and "they are less harmful than other forms of tobacco such as cigarettes" (17.1%). Reasons for use varied by school level and sex. For example, "friend or family member used them" was more commonly selected by middle school students (43.7%) than high school students (37.5%), and by females (46.7%) than males (32.2%) (Table 1). "They are available in flavors, such as mint, candy, fruit, or chocolate" was more commonly selected by high school students (32.3%) than by middle school students (26.8%). Among e-cigarette ever users, the least commonly selected reasons for use were

TABLE 1. Reasons for e-cigarette use among middle and high school students who reported ever using e-cigarettes by sex, race or ethnicity, and education level — National Youth Tobacco Survey, United States, 2016

	Ever used e-cigarettes*											
					Middle and high school users (sample n = 4,049)							
							Sex		Race/Ethnicity			
	Middle school users only (sample n = 1,061)		High school users only (sample n = 2,988)		Overall		Male	Female	White, non-Hispanic	Black, non-Hispanic	Hispanic[§]	Other race, non-Hispanic
Reason for e-cigarette use[†]	No. of users[¶]	% (95% CI)	No. of users	% (95% CI)	No. of users	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Friend or family member used them	586,000	43.7** (40.5–46.9)	1,605,000	37.5** (35.3–39.8)	2,191,000	39.0 (37.4–40.6)	32.2** (30.1–34.2)	46.7** (44.0–49.5)	38.7 (36.0–41.4)	36.7 (31.2–42.6)	39.9 (36.3–43.6)	43.0 (34.7–51.7)
To try to quit using tobacco products such as cigarettes	—††	—††	372,000	8.7 (7.0–10.8)	440,000	7.8 (6.5–9.5)	8.7 (6.9–10.9)	6.8 (4.9–9.4)	10.0 (8.0–12.3)	—††	5.2 (3.8–7.0)	—††
They cost less than other tobacco products such as cigarettes	—††	—††	153,000	3.6 (2.9–4.4)	181,000	3.2 (2.6–3.9)	3.9 (2.9–5.2)	2.5 (1.8–3.4)	3.6 (2.9–4.5)	—††	—††	—††
They are easier to get than other tobacco products such as cigarettes	70,000	5.2 (3.7–7.3)	202,000	4.7 (3.8–5.9)	272,000	4.8 (4.1–5.8)	5.0 (3.9–6.2)	4.7 (3.8–5.8)	4.5 (3.6–5.6)	—††	5.9 (4.5–7.8)	—††
Famous people on TV or in movies use them	—††	—††	—††	—††	84,000	1.5 (1.0–2.2)	—††	—††	—††	—††	—††	—††
They are less harmful than other forms of tobacco, such as cigarettes	216,000	16.1 (13.7–18.9)	743,000	17.4 (15.5–19.4)	959,000	17.1 (15.6–18.7)	19.9** (17.6–22.4)	13.9** (11.5–16.6)	16.5 (14.5–18.7)	12.7 (10.4–15.5)	18.9 (16.4–21.7)	—††
They are available in flavors, such as mint, candy, fruit, or chocolate	360,000	26.8** (23.7–30.3)	1,382,000	32.3** (30.3–34.5)	174,000	31.0 (29.4–32.7)	31.4 (28.8–34.1)	30.6 (28.1–33.2)	29.0 (26.4–31.7)	33.5 (26.6–41.1)	34.6 (32.0–37.2)	32.1 (23.9–41.6)
They can be used in areas where other tobacco products, such as cigarettes are not allowed	—††	—††	337,000	7.9 (6.6–9.4)	393,000	7.0 (5.8–8.5)	7.2 (5.8–9.1)	6.7 (5.1–8.8)	7.3 (6.0–8.8)	—††	7.2 (4.8–10.7)	—††
Some other reason	422,000	31.5 (27.5–35.6)	1,351,000	31.6 (29.5–33.8)	1,773,000	31.6 (29.6–33.6)	31.5 (29.3–33.8)	31.6 (29.0–34.4)	32.1 (29.4–35.1)	29.4 (24.3–35.1)	30.9 (28.0–34.1)	31.8 (24.3–40.3)

Abbreviation: CI = confidence interval.
* Participants who responded "yes" to the question "Have you ever used an electronic cigarette or e-cigarette, even once or twice?"
† Response to the question, "What are the reasons why you have used electronic cigarettes or e-cigarettes? (Check all that apply)" are not mutually exclusive.
§ Persons of Hispanic ethnicity can be of any race or combination of races.
¶ Estimated number of users based on sample weight.
** p-value <0.05 from chi-square test for difference in percentages within specified levels of school (middle or high), sex, or race/ethnicity.
†† Unstable estimate because subgroup size <50 or relative standard error >0.3. Chi-square test was not conducted.

"they are easier to get than other tobacco products, such as cigarettes" (4.8%), "they cost less than other tobacco products such as cigarettes" (3.2%), and "famous people on TV or in movies use them" (1.5%) (Table 1).

Among U.S. middle and high school students who reported using e-cigarettes (e-cigarettes only, e-cigarettes with combustible tobacco only, and e-cigarettes with combustible and noncombustible tobacco) during the past 30 days, the most commonly selected reasons for e-cigarette use were "they are available in flavors, such as mint, candy, fruit, or chocolate" (41.1%, 46.0%, and 29.1%, respectively), "friend or family member used them" (35.1%, 26.6%, and 20.2%, respectively),

and "they are less harmful than other forms of tobacco, such as cigarettes" (23.7%, 24.6%, and 22.8%, respectively) (Table 2).

Discussion

Among U.S. middle and high school students who had ever used e-cigarettes in 2016, the most commonly selected reasons for e-cigarette use were "friend or family member used them," "they are available in flavors, such as mint, candy, fruit, or chocolate," and "they are less harmful than other forms of tobacco, such as cigarettes." Regardless of whether users reported using e-cigarettes exclusively or with other tobacco products during the past 30 days, these reasons remained the most commonly selected reasons for e-cigarette use. The availability of flavors, use by a friend or family member, and belief that e-cigarettes are less harmful than other forms of tobacco might be important factors for initiation or maintenance of e-cigarette use among middle school and high school students. Although percentages reported here are lower, the findings from this study are consistent with those of previous studies reporting that availability of flavors is among the most prominently cited reasons for youths' e-cigarette use (*4*,*5*).

The U.S. Surgeon General has concluded that e-cigarette use among youths and young adults is a public health concern (*2*). The prevalence of e-cigarette use among youths increased substantially during 2011–2015 (*6*,*7*). In 2016, e-cigarettes were the most common tobacco product used among adolescents, although the overall prevalence of use declined from previous years (*1*,*8*). The Surgeon General has also concluded that e-cigarettes can contain harmful and potentially harmful constituents, including nicotine (*2*,*8*); exposure to nicotine during adolescence can cause addiction and can harm the developing adolescent brain (*2*,*8*). Recent research indicated that e-cigarette use declined among adolescent students in 2016, likely in part because of population-based efforts to prevent youths' e-cigarette initiation and use (*1*,*9*). Continued efforts are important to further reduce all forms of tobacco product use, including e-cigarettes, among U.S. youths. As noted by the Surgeon General, population-level strategies

TABLE 2. Reasons for e-cigarette use among middle and high school students who reported using e-cigarettes and other tobacco products during the past 30 days (current users) — National Youth Tobacco Survey, United States, 2016

	Use of e-cigarettes and other tobacco products during the past 30 days* (sample n = 1,281)					
	Use e-cigarettes only§ (sample n = 543)		Use e-cigarettes and combustible tobacco only ¶ (sample n = 419)		Use e-cigarettes with combustible and noncombustible tobacco (sample n = 273)	
Reason for e-cigarette use†	No. of users**	% (95% CI)	No. of users	% (95% CI)	No. of users	% (95% CI)
Friend or family member used them	276,000	35.1 (31.2–39.2)	157,000	26.6 (21.9–31.8)	85,000	20.2 (14.4–27.7)
To try to quit using tobacco products, such as cigarettes	—††	—††	109,000	18.5 (14.8–22.9)	110,000	26.3 (19.6–34.2)
They cost less than other tobacco products, such as cigarettes	—††	—††	—††	—††	—††	—††
They are easier to get than other tobacco products, such as cigarettes	—††	—††	—††	—††	—††	—††
Famous people on TV or in movies use them	—††	—††	—††	—††	—††	—††
They are less harmful than other forms of tobacco, such as cigarettes	187,000	23.7 (19.3–28.8)	145,000	24.6 (20.1–29.7)	95,000	22.8 (15.8–31.7)
They are available in flavors, such as mint, candy, fruit, or chocolate	324,000	41.1 (36.0–46.4)	271,000	46.0 (40.8–51.2)	122,000	29.1 (20.7–39.2)
They can be used in areas where other tobacco products, such as cigarettes, are not allowed	—††	—††	95,000	16.1 (12.8–20.2)	87,000	20.9 (15.4–27.6)
I used them for some other reason	270,000	34.3 (30.0–38.9)	199,000	33.8 (28.4–39.7)	124,000	29.7 (22.5–38.1)

Abbreviation: CI = confidence interval.

* Mutually exclusive categories. Subgroup for e-cigarettes and noncombustible tobacco (smokeless tobacco, snus, or dissolvable tobacco on ≥1 day in the past 30 days) is not shown because of small subgroup size.

† Response to question, "What are the reasons why you have used electronic cigarettes or e-cigarettes? (Check all that apply)" are not mutually exclusive.

§ Reported use of only e-cigarettes on ≥1 day in the past 30 days.

¶ Reported use of e-cigarettes and only combustible tobacco including cigarettes, cigars, pipes, bidis, or hookah on ≥1 day in the past 30 days.

** Estimated number of users based on sample weight.

†† Unstable estimate because of subgroup size <50 or relative standard error >0.3.

Summary

What is already known about this topic?

Electronic cigarettes (e-cigarettes) were the most commonly used tobacco product among U.S. middle school and high school students in 2016. The Surgeon General concluded that e-cigarettes can contain harmful and potentially harmful constituents, including nicotine. Nicotine exposure during adolescence can cause addiction and can harm the developing adolescent brain.

What is added by this report?

Among student respondents to the National Youth Tobacco Survey reporting ever using e-cigarettes in 2016, the most commonly selected reasons for use were used by "friend or family member" (39%), availability of "flavors such as mint, candy, fruit, or chocolate" (31%), and the belief that "they are less harmful than other forms of tobacco such as cigarettes" (17%). The least commonly selected reasons were "they are easier to get than other tobacco products, such as cigarettes" (5%), "they cost less than other tobacco products such as cigarettes" (3%), and "famous people on TV or in movies use them" (2%).

What are the implications for public health practice?

Efforts to prevent middle school and high school students from initiating the use of any tobacco product, including e-cigarettes, are important to reduce tobacco product use among U.S. youths. Regulation of the manufacturing, distribution, and marketing of tobacco products by the Food and Drug Administration, along with sustained implementation of comprehensive tobacco control and prevention strategies, could reduce e-cigarette use and initiation by middle school and high school students.

include incorporating e-cigarettes into smoke-free indoor air policies, restricting youths' access to e-cigarettes in retail settings, licensing retailers, and establishing specific package requirements (*2*).

The findings in this report are subject to at least five limitations. First, because only students from public and private schools in the United States are recruited in the NYTS, the findings might not be generalizable to youths who are homeschooled, in detention centers, or have dropped out of school. Second, selected reasons for ever use of e-cigarettes might not necessarily be consistent with actual reasons for use in the 30 days before the survey. Third, self-reported data are subject to underreporting and recall bias (*10*). Fourth, only predetermined potential reasons were assessed, rather than participant-generated reasons for use. For example, 31.6% of ever users indicated "I used them for some other reason." Thus, the importance of these reasons relative to other potential explanations cannot be assessed. Finally, the use of a response list, even with "select all that apply" available, might lead to underselection of other relevant reasons.

Comprehensive strategies to prevent and reduce the use of all tobacco products, including e-cigarettes, among U.S. youths are warranted (*2*). Regulation of the manufacturing, distribution, and marketing of tobacco products by FDA,* along with sustained implementation of comprehensive tobacco control and prevention strategies, could reduce youths' e-cigarette initiation and use (*2*,*7*). In addition, continued monitoring of e-cigarette use, including reasons for use and product characteristics, is important to guide strategies to prevent and reduce use of e-cigarettes among youths.

*https://www.federalregister.gov/articles/2016/05/10/2016-10685/deeming-tobacco-products-to-be-subject-to-the-federal-food-drug-and-cosmetic-act-as-amended-by-the.

Conflict of Interest

No conflicts of interest were reported.

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Notes from the Field

Underreporting of Maternal Hepatitis C Virus Infection Status and the Need for Infant Testing — Oregon, 2015

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The rate of deliveries to women with hepatitis C virus (HCV) infection has increased sharply in the United States (*1*). A review of 2009–2014 birth certificate data from 47 states that report HCV status of the mother on infant birth certificates found an 89% increase in prevalence of maternal HCV infection, from 1.8 per 1,000 live births in 2009 to 3.4 in 2014 (*2*). During the same period in Oregon, the prevalence of births to women with HCV infection increased 33%, from 2.91 per 1,000 live births in 2009 to 3.87 in 2014. Although North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition guidelines recommending testing of infants born to HCV-infected mothers at age 18 months were published in 2012 (*3*), a recent study conducted by the Philadelphia Department of Health found that only 16% of infants born to HCV-infected mothers in Philadelphia during 2011–2013 had been appropriately tested (*4*). To evaluate the completeness of reporting of maternal HCV infection in the state, the Oregon Health Authority compared birth certificate data with data reported to the state's Acute and Communicable Disease Prevention (ACDP) program. The results of that comparison suggested that use of birth certificate data to identify infants born to women with HCV infection underestimates the prevalence of maternal HCV infection and that the majority of exposed infants did not receive age-appropriate HCV testing.

The following two data sources were used in the Oregon analysis: 1) female HCV cases reported to ACDP during 2001–2015 and 2) Oregon birth certificate records from all live births in 2015, which included maternal HCV status. Using a probabilistic record linkage program for registry database linkage, ACDP surveillance records for HCV-positive women aged 15–50 years in 2015 were matched with mothers' names and dates of birth from all live births in Oregon. The study was considered public health practice under Oregon statute and did not require review by the Oregon Health Authority's public health institutional review board.

Among women with a positive HCV laboratory result reported to ACDP during 2001–2015, a total of 13,058 were aged 15–50 years in 2015. Among 44,712 women who had a live birth in 2015, maternal HCV infection was recorded on the birth certificates of 181 (0.4%) infants. Among these women, 150 (82.9%) were matched by name and date of birth to women with a positive HCV laboratory result reported to ACDP; 31 (17.1%) of the 181 women identified in birth certificates had not been reported to ACDP during the period 2001–2015 (Table). An additional 113 women with a positive HCV laboratory result reported to ACDP matched women who had a live birth during 2015 but did not have a diagnosis of maternal HCV infection recorded on the birth certificate. Thus, the linkage resulted in identification of 294 women with HCV infection who gave birth in 2015, a 62% increase over the estimate of 181 women using birth certificates alone.

Assuming an estimated 5.8% rate of perinatal HCV transmission (*5*), 17 of the 294 exposed infants would be expected to have acquired HCV infection. As of July 31, 2017 (at which time all children born in 2015 would have reached age 18 months, the recommended age for testing children born to HCV-infected mothers), the ACDP database had recorded five positive HCV reports from infants born in 2015. Negative HCV tests are not reportable in Oregon, so it is unknown how many of the exposed infants were appropriately tested. However, the discrepancy between the number of reported positive results and the expected number based on estimates of perinatal transmission suggests that as many as 12 infants with HCV might not have been tested by age 18 months.

This investigation suggests that the use of birth certificate data to identify infants born to women with HCV infection underestimates the prevalence of maternal HCV infection and that the majority of exposed infants do not receive age-appropriate HCV testing. New public health strategies are needed to actively identify infants at risk for HCV infection and ensure that they are tested appropriately.

TABLE. Comparison of women identified with hepatitis C virus (HCV) infection on infant's birth certificates in 2015 with female HCV cases reported to the ACDP program — Oregon, 2001–2015

Laboratory diagnosis of HCV infection reported to ACDP	Maternal HCV infection recorded on infant's birth certificate		
	Yes	No	Total
Yes	150	113	**263**
No	31	—	**31**
Total	**181**	**113**	**294**

Abbreviation: ACDP = Acute and Communicable Disease Prevention.

Conflict of Interest

No conflicts of interest were reported.

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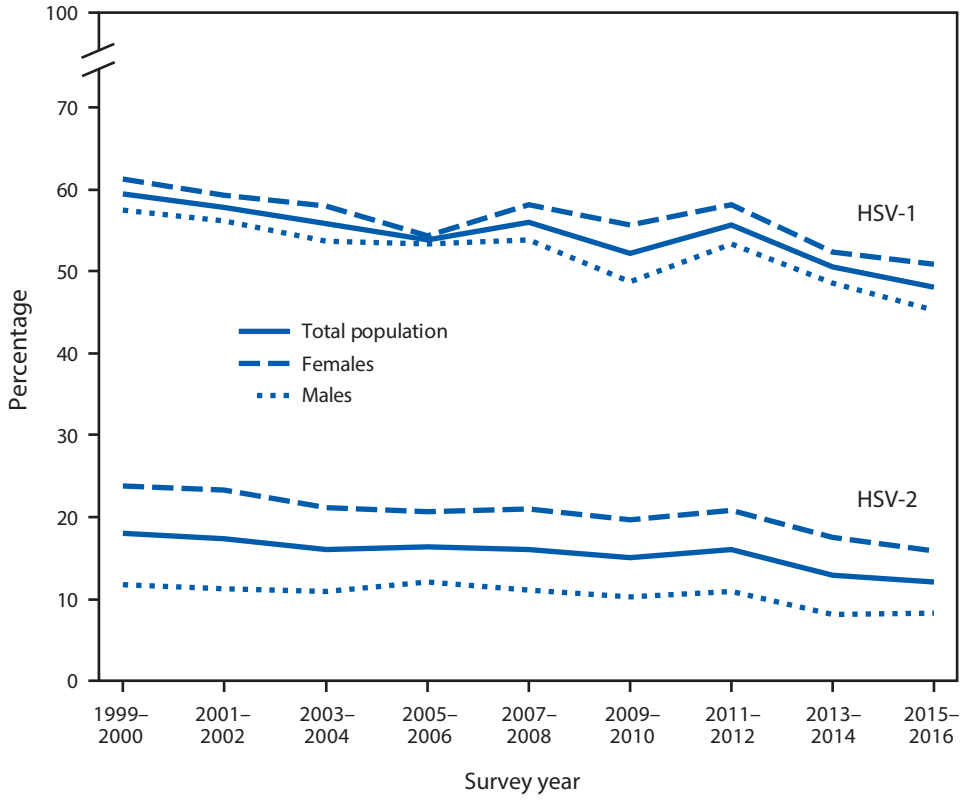
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Age-Adjusted* Trends in the Prevalence of Herpes Simplex Virus Type 1 (HSV-1) and Herpes Simplex Virus Type 2 (HSV-2) Among Adolescents and Adults Aged 14–49 Years — United States, 1999–2000 Through 2015–2016



* Age–adjusted by the direct method to the 2000 U.S. Census population, using age groups 14–19, 20–29, 30–39, and 40–49 years.

During 2015–2016, the age-adjusted prevalence of HSV-1 was 48.1% among adolescents and adults aged 14–49 years (50.9% for females and 45.2% for males). Prevalence was higher for females than males in most 2-year periods from 1999–2000 to 2015–2016. Also during 2015–2016, the age-adjusted prevalence of HSV-2 for those aged 14–49 years was 12.1% (15.9% among females compared to 8.2% among males) and was higher for females than males for all 2-year periods. Prevalence significantly declined from 1999–2000 through 2015–2016 for HSV-1 and HSV-2 among both males and females.

Source: NCHS Data Brief No. 304. https://www.cdc.gov/nchs/products/databriefs/db304.htm.

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