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Recommendations for Prevention and Control of Influenza in Children, 2025–2026: Technical Report

Committee on Infectious Diseases

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TECHNICAL REPORT

Recommendations for Prevention and Control of Influenza in Children, 2025–2026: Technical Report

Committee on Infectious Diseases

ABSTRACT. This technical report accompanies the recommendations of the American Academy of Pediatrics for the routine use of influenza vaccine and antiviral medications in the prevention and treatment of influenza in children during the 2025–2026 influenza season. The rationale for the American Academy of Pediatrics recommendation for annual influenza vaccination of all children without medical contraindications starting at 6 months of age is provided. Influenza vaccination is an important strategy for protecting children and the broader community against influenza. This technical report summarizes recent influenza seasons, morbidity and mortality in children, vaccine effectiveness, and vaccination coverage and provides detailed guidance on vaccine storage, administration, and implementation. The report also provides a brief background on inactivated (non-live) and live attenuated influenza vaccines, available vaccines for the 2025–2026 influenza season, vaccination during pregnancy and breastfeeding, diagnostic testing for influenza, and antiviral medications for treatment and chemoprophylaxis. Strategies to promote vaccine uptake are emphasized.

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ABBREVIATIONS: AAP, American Academy of Pediatrics; ACIP, Advisory Committee on Immunization Practices; ANE, acute necrotizing encephalopathy; aOR, adjusted odds ratio; ccIIV, cell culture-based inactivated (non-live) influenza vaccine; ccIIV3, trivalent cell culture-based inactivated (non-live) influenza vaccine; CDC, Centers for Disease Control and Prevention; ED, emergency department; EHR, electronic health record; FDA, US Food and Drug Administration; GBS, Guillain-Barré syndrome; HA, hemagglutinin; HCP, health care personnel; HD-TIV, high-dose trivalent influenza vaccine; IAE, influenza-associated encephalopathy or encephalitis; ICU, intensive care unit; IIV, inactivated (non-live) influenza vaccine; IIV3, trivalent inactivated (non-live) influenza vaccine; IIV3, trivalent inactivated (non-live) influenza vaccine; LAIV, live attenuated influenza vaccine; LAIV3, trivalent live attenuated influenza vaccine; NAI, neuraminidase inhibitor; NVSN, New Vaccine Surveillance Network; RCT, randomized controlled trial; RIDT, rapid influenza diagnostic tests; RIV, recombinant influenza vaccine; RIV3, trivalent recombinant influenza vaccine; RSV, respiratory syncytial virus; SD-QIV, standard-dose quadrivalent influenza vaccine; VE, vaccine effectiveness; WHO, World Health Organization.

INTRODUCTION

This technical report accompanies the recommendations of the American Academy of Pediatrics (AAP) for the routine use of influenza vaccine and antiviral medications in the prevention and treatment of influenza in children during the 2025–2026 season.[1]

SUMMARY OF RECENT INFLUENZA ACTIVITY IN THE UNITED STATES

Recent influenza seasons in the US have varied by severity, duration, and impact on children's health (Table 1). Influenza vaccine effectiveness has likewise varied by year, influenza type and influenza A virus subtype, and age group of the child immunized (Figure 1 and https://www.cdc.gov/flu-vaccines-work/php/effectiveness-studies/index.html).

2024-2025 Influenza Season

According to the Centers for Disease Control and Prevention (CDC), the 2024–2025 influenza season was a high-severity season for persons of all ages, including children, in terms

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of outpatient medical visits, hospitalizations, and death.[2] This was the first high-severity season since 2017-2018. Nationally, between October 1, 2024, and May 17, 2025, the CDC estimated the burden of influenza in individuals of all ages to include 47 to 82 million illnesses, 21 to 37 million influenza-related medical visits, and 610 000 to 1 300 000 influenza-and influenza-related hospitalizations (https://www.cdc.gov/flu-burden/php/data-vis/2024-2025.html). The proportion of outpatient visits for influenza-like illness was highest in children 0 to 4 years of age, peaking at 18% in February 2025. Through June 21, 2025, among people younger than 65 years, hospitalization rates continued to be the highest among children <1 year of age (153.6/100 000) (https://gis.cdc.gov/GRASP/Fluview/FluHospRates.html). Cumulative hospitalization rates for influenza among children were higher than observed in the 2023-2024 season (103.1/100 000 vs 84.3/100 000 in patients 0 to 4 years of age and 36.1/100 000 vs 39.9/100 000 in patients 5 to 17 years of age). In a sample of hospitalized children reported to the Influenza Hospital Surveillance Network (FluSurv-NET), 54.9% had at least 1 underlying medical condition. As in prior years, the most common underlying condition observed in hospitalized children was asthma (25.4%; https://gis.cdc.gov/grasp/fluview/FluHospChars.html). Other common underlying conditions in hospitalized children included neurologic disease (17.6%) and obesity (13.3%).

Through June 21, 2025, 253 influenza-related pediatric deaths were reported by the CDC[2] (Figure 2). Of these, 42.7% occurred in children without a high-risk medical condition. Among children who were eligible for influenza vaccination and with known vaccine status, 90% of reported pediatric deaths have occurred in children who were not fully vaccinated against influenza.

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Through June 21, 2025, more than 89% of the influenza viruses identified were influenza A, with similar proportions of H1N1pdm09 (52.8% of isolates with subtyping performed) and H3N2 (47.1%). In an interim analysis posted by the CDC on May 23, 2025, of the subset of virus characterized, most influenza A(H1N1)pdm09 viruses (99.5%) and influenza B/Victoria viruses (96.2%) were antigenically similar to viruses contained in seasonal influenza vaccines compared with 58.6% of influenza A(H3N2) viruses (https://www.cdc.gov/fluview/surveillance/2025-week-20.html). In an interim analysis of vaccine effectiveness (VE) during the 2024-2025 season, VE against any influenza-associated acute respiratory tract infection for children 6 months through 17 years of age ranged from 32% to 60% in outpatient settings; VE was 63% to 78% against influenza-associated hospitalization.[3] Effectiveness against influenza A varied by subtype and surveillance network. In the New Vaccine Surveillance Network (NVSN), VE in outpatient settings was 72% against influenza A(H1N1)pdm09 and 42% against H3N2. In the US Influenza Vaccine Effectiveness Network, VE in outpatient settings was 53% against influenza A(H1N1)pdm09 but was not statistically significant against H3N2 (16%; 95% CI −34% to 49%). VE against influenza hospitalization measured in the NVSN was 63% against influenza A(H1N1)pdm09 and 55% against H3N2.

Highly pathogenic avian influenza (HPAI) A(H5N1) continues to circulate among wild birds in the US, with sporadic outbreaks in poultry, backyard flocks, and dairy cattle. Sporadic cases occur in mammals, including cats. Human cases remain rare. As July 1, 2025, 70 human cases had been reported in the US, and most were in adults with exposure to dairy cattle (n=41) or poultry farms and culling operations (n=24). In November 2024, the first reported case of H5N1 infection in a child in the US was reported in California; the child experienced mild illness and recovered.[4] A second infected child in California was reported in January of 2025 and was

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unrelated to the first. The child had fever and conjunctivitis and recovered.[5] The source of infection has not been determined for either child. A severe case of H5N1 was identified in an adolescent with underlying medical conditions in British Columbia, Canada.[6] The adolescent required mechanical ventilation and extracorporeal membrane oxygenation support but ultimately recovered. The virus recovered from the patient was closely related to viruses detected in wild birds in the region. Fatal pediatric cases have also been reported in 2025 from Mexico, Cambodia, and India; Vietnam reported a severe H5N1 avian flu infection in an 8-year-old girl diagnosed with encephalitis. [7] The CDC provides H5N1 situation updates at https://www.cdc.gov/bird-flu/situation-summary/index.html.

Information about influenza surveillance is available through the CDC Voice Information System (1-800-232-4636) and is posted weekly on the CDC website (www.cdc.gov/flu/index.htm).

INFLUENZA MORBIDITY AND MORTALITY IN CHILDREN

In a typical influenza season, the disease burden among children is substantial. Each year, an estimated 8% to 10% of US children develop symptomatic influenza virus infection, although even higher proportions are observed in some seasons.[8,9] Children infected with influenza virus are more likely to exhibit symptoms than adults. In 2 community-based prospective cohort studies conducted in Managua, Nicaragua, influenza was asymptomatic in just 6.6% of infected children ≤14 years of age, although the asymptomatic fraction increased with age (1.7%, 3.5%, and 9.1% for ages 0–1, 2–4, and 5–14 years, respectively; P <.001).[10]

Common clinical syndromes associated with seasonal influenza virus infection include a nonspecific febrile illness with or without upper respiratory symptoms, bronchiolitis, croup, or a

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pertussis-like illness. Gastrointestinal symptoms, including vomiting, diarrhea, and abdominal pain, are frequently seen in young children.[11] Ocular manifestations, including conjunctivitis, occur uncommonly.[12]

A variety of complications have been reported with influenza virus infection, including myocarditis, pericarditis, myositis, and rhabdomyolysis.[13] Neurologic complications of influenza include febrile seizures, nonfebrile seizures, ataxia, encephalitis, and encephalopathy. In a cohort of children <5 years of age enrolled in 1 state Medicaid program, neurologic complications were uncommon but higher in children younger than 2 years and those with underlying neurologic conditions.[14] Approximately 8% to 11% of children hospitalized with influenza experience neurologic complications, and these are more frequent in children with underlying neurologic conditions and children who are unimmunized.[15,16]

In January 2025, the CDC received anecdotal reports of critical illness and death in children with acute necrotizing encephalopathy (ANE).[17] ANE is a severe form of influenza-associated encephalopathy or encephalitis (IAE) characterized by rapid neurologic deterioration and bilateral symmetric lesions usually affecting the thalami; lesions can also be seen in periventricular white matter, internal capsules, putamina, temporal lobes, upper brainstem tegmentum, or cerebellum.[18] In response to these reports, the Influenza-Associated Pediatric Mortality Surveillance System was queried to assess the frequency of IAE. Of the 1840 pediatric influenza-associated deaths reported by state health departments to CDC using this system during the 2010–2011 through 2024–2025 influenza seasons, 166 (9%) had IAE, ranging from 0% (2020–21 season) to 14% (2011–12 season). IAE prevalence was highest among children aged 2 to 4 years (34 [10%] of 334 total fatal cases), and more than half (89; 54%) had no underlying medical condition. Through February 8, 2025, of the 2024-2025 influenza season, 9

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pediatric influenza-associated deaths in children with IAE were reported to the CDC, 4 cases of which were ANE. Case ascertainment is ongoing. Because no dedicated national surveillance for IAE or ANE exists, it is unknown whether the numbers of cases this season vary from expected numbers.

Bacterial complications of influenza virus infection include otitis media, pneumonia, sinusitis, and bloodstream infections. Among children <16 years of age hospitalized with laboratory-confirmed influenza at 12 Canadian hospitals, bloodstream infections occurred in 0.9% and were associated with intensive care unit admission, need for mechanical ventilation, and longer lengths of stay.[19] *Staphylococcus aureus* and *Streptococcus pneumoniae* were the most common pathogens. Viral infections, including influenza, have previously been identified as risk factors for invasive bacterial infections, including invasive group A streptococcal infections.[20,21] According to the CDC, from 2016 to 2022, increases in invasive group A streptococcal infections coincided with seasonal peaks in respiratory syncytial virus (RSV) and influenza hospitalization rates during most years except 2021.

As many as 10% of all pediatric hospitalizations during the winter are attributable to influenza.[22,23] Hospitalization rates of children with influenza are highest in those younger than 5 years; rates are typically the highest among infants <6 months of age and decrease with increasing age.[8,24] Over 12 influenza seasons in the US following the 2009 H1N1 pandemic, laboratory-confirmed influenza-associated hospitalization rates in children 0 to 4 years ranged from 16 (2011-2012; 95% CI [14.2–17.9]) to 91.4 (2019-2020; 95% CI [86.9–96.0]) per 100 000 children.[25] Influenza-associated hospitalization rates in children 5 to 17 years ranged from 4 (2011-2012; 95%CI [3.5–4.6]) to 30.3 (2022-2023; 95% CI [28.7–31.8]) per 100 000 children.

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Hospitalization rates were not reported for 2020-2021, a year in which there was not substantial circulation of influenza viruses.

The highest influenza-associated hospitalization rates are caused by influenza A virus infection. Some data suggest that influenza subtype influences disease severity and the risk of hospitalization. Across seasons, the greatest proportion of influenza-associated hospitalizations in children are attributable to influenza A(H3N2).[25] However, in 1 large, prospective, multicenter study conducted between 2015 and 2020 in children who were hospitalized or seen in the emergency department, children with influenza A(H1N1)pdm09 had more severe disease, with increased incidence of hospitalization, compared to those with influenza A(H3N2) and B.[26]

Morbidity in children hospitalized with influenza is substantial, as demonstrated by population-based surveillance for influenza-associated hospitalizations conducted by the Influenza Hospitalization Surveillance Network.[27] In the 2017-2018 through 2019-2020 seasons, 6774 children 0 through 17 years of age were hospitalized with influenza; 17.8% had pneumonia, 21.6% required admission to the intensive care unit (ICU), and 5.3% were mechanically ventilated.

Children hospitalized with influenza are commonly treated with antibiotics for suspected bacterial infections, and many children receive antibiotics inappropriately.[28] In 1 active surveillance study of pediatric influenza hospitalizations in Canada over 11 seasons, 71.6% (6424 /8971) received an antibiotic, including 53% of those without an appropriate indication.

Postdischarge respiratory sequelae occur in children hospitalized with critical respiratory illness attributable to influenza. In 1 study (n=165), 78% of children with preexisting asthma experienced asthma symptoms in the 90 days after discharge, and 13% required readmission to

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the hospital.[29] Among patients without preexisting asthma, 11.1% had asthma newly diagnosed (n=10).

During 12 of 13 recent influenza seasons, influenza-associated deaths in children have ranged from 37 in the 2011–2012 season to 207 in the 2023–2024 season (a single pediatric death was reported during the 2020–2021 season, coincident with very low circulation of seasonal influenza viruses) (https://gis.cdc.gov/GRASP/Fluview/PedFluDeath.html).[30] According to the CDC, pediatric influenza deaths are likely underreported, as not all children whose death was related to influenza virus infection may have had viral testing.[31] Statistical models predict that during the 2023-2024 influenza season, for example, as many as 724 children could have died from the flu compared with the 207 reported (https://www.cdc.gov/flu/whats-new/flu-summary-addendum-2023-2024.html).

HIGH-RISK GROUPS IN PEDIATRICS

Children younger than 5 years (especially those younger than 2 years) and children of any age with certain underlying medical conditions have a high risk of complications from influenza (see Table 2 in the policy statement[1] at https://doi.org/10.1542/peds.2025-073620). These medical conditions include obesity, a condition that affects more than 14 million children and adolescents in the US.[32] In a recent systematic review and meta-analysis, obesity increased the odds of hospitalization in children with influenza, although the definition of obesity varied among included studies.[33] Additionally, in children hospitalized for influenza, obesity was associated with a worse prognosis, including ICU admission and death.

Influenza vaccination is particularly important in these high-risk groups (see Table 4 in the policy statement at https://doi.org/10.1542/peds.2025-073620) and populations

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disproportionately affected by severe influenza outcomes. Health disparities are apparent in both influenza diagnosis as well as influenza morbidity and mortality.[34] In 1 test-negative case control study conducted in an urban population of children <14 years of age, public or self-pay insurance was associated with increased risk of an influenza diagnosis.[35] In a retrospective cohort study using the National Inpatient Sample from January 1, 2008, to December 31, 2017, Hispanic (adjusted odds ratio [aOR], 1.25; 95% CI, 1.17 to 1.33), non-Hispanic-Black (aOR, 1.21; 95% CI, 1.17 to 1.33) and non-Hispanic other children (aOR, 1.11; 95% CI, 1.04 to 1.19) were more likely to be hospitalized with an influenza diagnosis than non-Hispanic white children, although mortality was similar.[36] In a cross-sectional study that included 10 influenza seasons, higher rates of severe influenza disease were reported in Black, Hispanic, American Indian/Alaska Native, and Asian/Pacific Islander people compared with white people, and differences were pronounced in children ≤4 years of age.[37] In this age group, hospitalization rates were higher in Black children (relative risk [RR], 2.21; 95% CI, 2.10 to 2.33), Hispanic children (RR, 1.87; 95% CI, 1.77 to 1.97), American Indian/Alaska Native children (RR, 3.00; 95% CI, 2.55 to 3.53), and Asian/Pacific Islander children (RR, 1.26; 95% CI, 1.16 to 1.38) compared with white children. Rates of ICU admission were also higher (Black children: RR, 2.74; 95% CI, 2.43 to 3.09; Hispanic children: RR, 1.96; 95% CI, 1.73 to 2.23; American Indian/Alaska Native children: RR, 3.51; 95% CI, 2.45 to 5.05). The rate of in-hospital death was threefold to fourfold higher in Black, Hispanic, and Asian/Pacific Islander children compared with white children. Disparities have also been noted in subpopulations of children with high-risk medical conditions. In pediatric solid organ transplant recipients, for example, the risk of an influenza-associated hospital encounter was higher in non-Hispanic Black patients (adjusted subdistribution hazard ratio [aSHR], 1.63; 95% CI, 1.28 to 2.07; P <.001) and Hispanic patients (aSHR, 1.57; 95% CI,

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1.27 to 1.94; P <.001) compared with non-Hispanic white patients.[38] Importantly, factors associated with disparities observed with other respiratory viruses (eg, SARS-CoV-2 and RSV),[39,40] including lack of access to quality health care, crowded living conditions, and social vulnerability, were not evaluated in these studies. Additional research is needed to understand how social drivers of health impact influenza-associated hospitalization, but 1 study that utilized hospitalization data collected by FluSERV-NET during the 2010-2011 and 2011-2012 seasons found increasing rates of influenza-related hospitalization with increasing census tract poverty.[41] This association was found in all ages and racial/ethnic groups.[41] Additional strategies are needed to understand and address disparities in influenza-associated morbidity, including social needs screening/assessment to identify high-risk populations and increase their access to quality health care.

Although protecting all children against influenza through timely vaccination remains critically important, increased efforts are needed to eliminate barriers to immunization in all people experiencing higher rates of complications from infection with influenza viruses.

EFFECTIVENESS OF INFLUENZA VACCINATION ON MORTALITY, HOSPITALIZATION, LABORATORY-CONFIRMED INFLUENZA ILLNESS IN AMBULATORY CHILDREN, AND ANTIBIOTIC USE

Although influenza vaccination does not prevent all cases of influenza, it does offer substantial health benefits, including protection against severe and life-threatening disease and reduced health resources utilization.[42]

Mortality

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Historically, up to 80% of influenza-associated pediatric deaths have occurred in unvaccinated or incompletely vaccinated children.[43] Influenza vaccination is associated with reduced risk of laboratory-confirmed influenza-related pediatric death.[44] In 1 case-cohort analysis of laboratory-confirmed influenza-associated pediatric deaths in the US from 2010 to 2014, overall VE against influenza-associated death in all children was 65% (95% CI, 54% to 74%) and 51% (95% CI, 31% to 67%) in children with underlying conditions.[44] Similarly, in a case-control study conducted over 2 influenza seasons (2010 to 2012), influenza vaccination was associated with a three-quarters reduction in the risk of life-threatening influenza illness in children.[45] During the 2023–2024 season, influenza vaccination prevented an estimated 266 deaths in children 6 months through 17 years of age (https://www.cdc.gov/flu-burden/php/data-vis-vac/2023-2024-prevented.html).[46]

Hospitalization

A robust body of evidence supports the effectiveness of influenza vaccination in preventing hospitalization in children, even during seasons in which overall VE is lower (Table 2).[47-59] According to a systematic review, VE is the highest in children younger than 5 years.[51] During the 2023–2024 season, the CDC estimates that influenza vaccination prevented 19 946 hospitalizations in children 6 months through 17 years of age (https://www.cdc.gov/flu-burden/php/data-vis-vac/2023-2024-prevented.html).[46]

Laboratory-Confirmed Influenza Illness and Medically Attended Influenza Illness in Ambulatory Settings

In an analysis of US Influenza Vaccine Effectiveness Network data that included 9 seasons (from 2011-2012 through 2019-2020), pooled VE against outpatient influenza illness

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was 46% (95% CI, 43 to 50).[60] VE was lowest against influenza A(H3N2)-associated illness (33% [95% CI, 27 to 39]), and estimates were similar for influenza B (54% [95% CI, 49 to 59]) and influenza A(H1N1)pdm09 (57% [95% CI: 51 to 62]). VE was highest for children 6 through 59 months of age compared with older children. During the 2023–2024 season, the CDC estimates that influenza vaccination prevented 3 098 105 symptomatic flu-related illnesses and 1 611 014 medical visits in children 5 through 17 years of age, a group in whom adjusted VE was 52% (95% CI, 51.8 to 52.2) (https://www.cdc.gov/flu-burden/php/data-vis-vac/2023-2024-prevented.html). In children 6 months through 4 years of age, adjusted VE was higher (65% [95% CI, 64.7 to 65.3]), resulting in an estimated 1 422 807 symptomatic flu-related illnesses and 953 281 medical visits prevented.

Antibiotic Use in Ambulatory Children

Antibiotics are prescribed for an estimated 11% to 43% of patients of all ages in whom influenza is diagnosed,[61-63] and not all prescribing is appropriate. Patients are prescribed antibiotics with and without recognized bacterial complications of influenza, including pneumonia, otitis media, and sinusitis.[64] In 1 population-based retrospective cohort study spanning 2012 to 2017, the antibiotic prescription rate in ambulatory children declined by 3/1000 person-months for each 1% increase in influenza vaccination coverage.[65]

Household and Community Transmission

Influenza vaccination of children may reduce influenza virus transmission in the home and in the community. In a prospective case-ascertained household transmission cohort study that enrolled patients over 3 consecutive influenza seasons (2017 to 2020), influenza VE for

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preventing secondary infections among household contacts was 21% (95% CI, 1.4% to 36.7%) and varied by influenza type.[66]

Increasing vaccination rates in schools may protect unvaccinated students. In 1 prospective cohort study that evaluated school-located vaccination programs on laboratory-confirmed influenza and absenteeism, vaccination of nearly 50% of a school's enrollees conferred 54% indirect protection to unvaccinated children.[67]

SEASONAL INFLUENZA VACCINES

The seasonal influenza vaccines licensed for children and adolescents for the 2025-2026 season are described in Table 4 of the policy statement. All 2025-2026 seasonal influenza vaccines for use in the US are trivalent and contain hemagglutinin derived from the same influenza strains as recommended by the World Health Organization (WHO) and the US Food and Drug Administration (FDA) for the Northern Hemisphere (see Table 1 in the policy statement at https://doi.org/10.1542/peds.2025-073620).[68,69] The influenza A(H3N2) component is different this season compared with last season, whereas the influenza A(H1N) and influenza B Victoria lineage components are unchanged. Different but antigenically related influenza A strains are included in this season's egg-based and cell-based or recombinant vaccines. However, they are still matched to the strains expected to circulate in the 2025-2026 season.

Inactivated Influenza Vaccine (IIV)

For the **2025-2026** season, among inactivated influenza vaccines available for children, 4 are egg-based (seed strains grown in eggs), and 1 is cell culture-based (seed strains grown in Madin-Darby canine kidney cells) (see Table 4 in the policy statement at https://doi.org/10.1542/peds.2025-073620). All inactivated egg-based vaccines (Afluria, Fluarix,

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FluLaval, and Fluzone) and 1 cell culture-based based vaccine (Flucelvax) are licensed for children 6 months and older, and all are available in single-dose, thimerosal-free, prefilled syringes.[70]

A trivalent recombinant baculovirus-expressed hemagglutinin (HA) influenza vaccine (RIV3 [Flublok]) was originally licensed only for people 18 years and older, but on March 31, 2025, the FDA approved the use of use of this vaccine in individuals as young as 9 years of age.[71] In 1 randomized controlled trial that enrolled 159 children 9 to 17 years of age, the safety and immunogenicity of RIV4 was similar to the comparator IIV.[72]

A trivalent high-dose inactivated (non-live) influenza vaccine (HD-IIV3 [Fluzone High Dose) and a trivalent MF-59 adjuvanted inactivated vaccine (aIIV3 [Fluad]) are licensed for people 65 years and older. Adjuvanted seasonal influenza vaccines are not licensed for children in the US; however, studies of adjuvanted vaccines in children have been performed, and evaluation is ongoing.[73-76]

Children 6 months and older can receive any licensed, age-appropriate inactivated (non-live) influenza vaccine (IIV). Trivalent egg-based and cell culture-based IIVs contain **15 mcg HA from each strain in 0.5-mL. The recommended dose volume (and, therefore, the recommended antigen content) for younger children varies by product. The dose of Fluarix, FluLaval, and Flucelvax is 0.5-mL for all children 6 months and older.**[77] Children 6 through 35 months of age can receive a 0.25-mL or 0.5-mL dose of Fluzone from a multidose vial; 0.5-mL prefilled syringes are also available.[78] These 2 doses demonstrated comparable safety and immunogenicity in a single, randomized multicenter study.[79] Children 3 years and older should receive 0.5 mL. Afluria is supplied in 0.25- and 0.5-mL single-dose syringes. The

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dose of Afluria is 0.5 mL for children 3 years and older and 0.25 mL for children 6 through 35 months of age.[80]

The dose of RIV3 for children 9 years and older is also 0.5 mL. Each dose is 135 mcg HA per 0.5 mL (45 mcg HA from each influenza virus strain) and is available in prefilled syringes.

IIV Storage

The CDC has published best practice guidelines (https://www.cdc.gov/vaccines/hcp/imz-best-practices/ and https://www.cdc.gov/vaccines/hcp/storage-handling/) for vaccine storage and administration. Additionally, the AAP offers guidance on the components of a written disaster plan, including a comprehensive vaccine management protocol to keep the vaccine storage temperature constant during a power failure or other disaster (see the AAP Pediatric Preparedness Resource Kit at https://downloads.aap.org/AAP/PDF/PedPreparednessKit.pdf).

IIVs for intramuscular injection are shipped and stored at 2°C to 8°C (36°F to 46°F); vaccines that are inadvertently frozen should not be used.

IIV Administration

Vaccines are administered intramuscularly into the anterolateral thigh of infants and young children and into the deltoid muscle of older children and adults. Given that various IIV formulations are available, careful attention should be paid to ensure that each product is used according to its approved age indication, dosing, and volume of administration (Table 3).

For vaccines that include a multidose vial option, the maximum number of doses drawn from a multidose vial is specified in the package insert and should not be exceeded; residual product must be discarded regardless of the remaining volume in the vial. A 0.5-mL prefilled syringe of any IIV should not be split into 2 separate 0.25-mL doses. If a prefilled syringe of

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Fluzone is used for a child younger than 36 months, the dose volume will be 0.5 mL per dose. If a child is inadvertently vaccinated with a formulation only approved for older children or adults, the dose is counted as valid. If a lower dose than recommended is inadvertently administered to a child 36 months or older (eg, 0.25 mL), an additional 0.25-mL dose is to be administered to provide a full dose of 0.5 mL as soon as possible.

Coadministration of Inactivated Influenza Vaccine and Other Immunizations

In general, all vaccines indicated on a given day can be administered. Influenza vaccine can also be administered concomitantly or any time before or after currently available COVID-19 vaccines.[81-84] Overall, the benefits of timely vaccination with same-day administration of IIV and other recommended vaccines outweigh the risk of potential reactogenicity in children. Influenza vaccine can also be administered to children concomitantly or at any time before or after administration of nirsevimab.

Neither the CDC nor AAP define the maximum volumes that can be injected into each muscle group in different age groups (https://www.aap.org/en/patient-care/respiratory-syncytial-virus-rsv-prevention/nirsevimab-frequently-asked-questions/). Separating injection sites by 1 inch or more, if possible, is a recommended practice.

Safety of IIV and RIV

IIVs are well tolerated in children and can be used in healthy children as well as those with underlying chronic medical conditions. The most common injection site adverse reactions following administration of IIV in children are pain (17%–67%), redness (13%–37%), and swelling (10%–25%). The most commonly reported systemic adverse events are drowsiness (13%–38%), irritability (14%–54%), abnormal crying (33%–41%), loss of appetite (11%–32%), fatigue (10%–20%), muscle aches (10%–39%), headache (10%–23%), arthralgia (10%–13%),

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and gastrointestinal tract symptoms (10%–20%). Fever can occur, especially in children 6 through 35 months of age, but is uncommon. RIV is also well-tolerated. In 1 clinical trial enrolling children 9 through 17 years of age, the most common solicited injection-site adverse reaction was pain (34.4%). The most common solicited systemic adverse reaction was myalgia (19.3%), followed by headache (18.5%) and malaise (16.1).[71] Package inserts for US-licensed vaccines are available on the FDA website.[77]

The AAP continues to support the current WHO recommendations for use of thimerosal as a preservative in multiuse vials in the global vaccine supply.[85] Thimerosal-containing vaccines are not associated with an increased risk of autism spectrum disorder in children.[86,87] Thimerosal from vaccines has not been linked to any neurologic condition. Despite the lack of evidence of harm, some states have legislation restricting the use of vaccines that contain even trace amounts of thimerosal and in June 2025, the Advisory Committee on Immunization Practices recommended that children and adults only receive influenza vaccine in single-dose formulations that are free of thimerosal as a preservative.[88] The benefits of protecting children against the known risks of influenza are clear. Therefore, to the extent permitted by state law, children should receive any available formulation of IIV rather than delaying vaccination while waiting for reduced-thimerosal content or thimerosal-free vaccines. IIV formulations that are free of even trace amounts of thimerosal are widely available, as described in the policy statement (https://doi.org/10.1542/peds.2025-073620). Additional information to assist clinicians in responding to parental concerns about thimerosal is available at from the Children's Hospital of Philadelphia Vaccine Education Center (https://www.chop.edu/sites/default/files/vaccine-education-center-thimerosal.pdf).

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Vaccination in the Setting of Immunosuppression

Non-live vaccines, including IIVs, are safe in persons with altered immune competence, but immunogenicity may be diminished. Decreases in immunogenicity vary by underlying condition. Guidelines for the immunization of immunocompromised children and adults have been published by the Infectious Diseases Society of America and the CDC.[89,90] Guidelines for the immunization of solid organ transplant recipients have been published by the American Society of Transplantation.[91] The CDC has published additional recommendations for influenza immunization of adult solid organ transplant recipients.[70] In June 2024, the CDC Advisory Committee on Immunization Practices (ACIP) recommended high-dose inactivated (HD-IIV3) and adjuvanted inactivated (aIIV3) influenza vaccines as acceptable options for influenza vaccination of solid organ transplant recipients aged 18 through 64 years who are on immunosuppressive medication regimens, without a preference over other age-appropriate IIV3s or RIV3. Studies in pediatric solid organ transplant recipients are ongoing.

Live Attenuated (Intranasal) Influenza Vaccine

Overview

The history of live attenuated influenza vaccine (LAIV) use in the US, along with a detailed discussion of VE over serial seasons, is available in the 2021 technical report.[92] For the **2025-2026** season, trivalent live attenuated influenza vaccine (LAIV3) has replaced quadrivalent live attenuated influenza vaccine (LAIV4).

Storage and Administration

The cold-adapted, temperature-sensitive LAIV3 formulation is shipped and stored at 2°C to 8°C (36°F to 46°F). LAIV3 is administered intranasally in a prefilled, single-use sprayer containing 0.2-mL of vaccine. A removable dose-divider clip is attached to the sprayer to

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facilitate administration of 0.1-mL separately into each nostril. If the child sneezes immediately after administration, the dose should not be repeated. Administration of LAIV intranasally is not an aerosol-generating procedure; however, vaccine administrators are advised to wear gloves when administering LAIV given the potential for contact with respiratory secretions.

Coadministration of LAIV and Other Vaccines

LAIV may be administered simultaneously with other inactivated or live vaccines. If not administered simultaneously, it is recommended that administration of injectable live vaccines is separated by a 4-week interval from LAIV vaccination. Oral typhoid vaccine can be administered simultaneously with or at any interval before or after LAIV.[93]

In addition to LAIV administration in traditional settings, in September 2024, the FDA approved an application from Astra Zeneca to allow eligible adult patients to self-administer LAIV; caregivers will be allowed to administer the vaccine to eligible children 2 years and older.[94] To access LAIV for home administration, the guardian completes an online application for each eligible household member. A health care professional at a centralized pharmacy reviews the application for eligibility; if approved, LAIV is mailed to the patient's home with detailed directions for storage and administration with a phone number to call for any questions. Caregivers attest electronically that vaccine has been administered, and the dispensing pharmacy will submit the administration to state immunization registries.

In a small pilot feasibility study that enrolled 27 parents/caregivers and 41 children (age range 2.6 to 17.9 years of age; mean 10.5 years), LAIV was successfully administered in the home setting by all participants.[95] Participating parents/givers voiced a preference for administration of home administration of LAIV. Additional practical considerations for home LAIV are presented in Box 1.

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Box 1

Considerations for Use of LAIV in the Home Setting

Logistical Considerations

Caregiver/patient must initiate the process to receive LAIV at home

- Prescription by patient's physician not required; after eligibility is determined, a prescription is generated through an online pharmacy service.
- Modest shipping and processing fee charged at time of order.
- Shipped to patient home using validated and approved cold-chain procedures and packaging.
- Detailed instructions for use provided in updated package insert[94] and videos available via product website portal.
- Updated package insert instructs vaccine recipient or caregiver to seek immediate medical attention if the vaccine recipient experiences any symptoms of an acute allergic reaction.
- Pharmacist documents in IIS based on caregiver attestation that vaccine administered.
- Used sprayer is mailed to medical waste company in a pre-labeled, pre-paid envelope for disposal.

Administration of Partial Dose

Caregiver contacts pharmacist at online pharmacy service to determine next steps (if an additional dose is to be sent or recommendation to seek vaccination through a retail or clinic setting).

Financial Considerations

- Not covered as part of Vaccines for Children in the 2025-2026 influenza season.
- Privately insured patients will pay a modest shipping and processing fee.

Because administration cannot be verified, LAIV home administration is not recommended in situations in which influenza vaccine is mandated. This includes children required to have a flu vaccine for child care attendance or health care personnel (HCP) who have flu vaccination as a condition of employment.

Safety of LAIV

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The most common solicited adverse reactions after LAIV administration in clinical trials included runny nose or nasal congestion (recipients 2 years through 49 years), fever >100°F (children ages 2 years through 6 years), and sore throat (adults ages 18 years through 49 years).[96]

LAIV and Immunocompromised Hosts

IIV (or RIV, if age-eligible) is the vaccine of choice for severely immunocompromised patients and anyone in close contact with a subset of severely immunocompromised people (ie, those requiring a protected environment). This preference is based on the theoretical risk of infection attributable to an LAIV strain in an immunocompromised contact of an LAIV-immunized person. HCP immunized with LAIV may continue to work in most units of a hospital, including the neonatal intensive care unit and general oncology ward, using standard infection control techniques. As a precautionary measure, people recently vaccinated with LAIV should restrict contact with severely immunocompromised patients (eg, those requiring a protective environment) for 7 days after vaccination, although there have been no reports of LAIV transmission from an LAIV-vaccinated person to an immunocompromised person.[97] In the theoretical scenario in which an immunocompromised host develops a symptomatic LAIV infection, the LAIV strains are susceptible to antiviral medications.

LAIV and Asthma/Wheezing

The AAP and ACIP currently consider asthma in persons ≥5 years of age to be a precaution for LAIV. The LAIV package insert states, "Children younger than 5 years of age with recurrent wheezing and persons of any age with asthma may be at increased risk of wheezing following administration of FluMist." Although LAIV administration is currently contraindicated in children 2 through 4 years of age with asthma or a history of recurrent wheezing,[1,70] 1 systematic literature review of 14 studies over 20 years[98] demonstrated that LAIV

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was well tolerated in children and adults 2 through 49 years of age with mild to moderate asthma or recurrent wheeze, with no safety concerns or increased risk identified for any of the respiratory outcomes measured when comparing LAIV-AA with injectable influenza vaccines or nonvaccine controls. In a more recent systematic literature review, Bandell et al found no difference in the number or severity of asthma exacerbations among 5- to 17-year-olds with asthma and no increase in medically significant wheezing among 2- to 17-year-olds with asthma or recurrent wheeze following LAIV versus IIV administration.[99] One cited study observed a higher incidence of rhinitis after LAIV administration in patients aged 6 to 17 years with asthma. They also found no difference in medical resource utilization and a similar or lower incidence of emergency department (ED) visits or hospitalizations after LAIV versus IIV administration. Based on these data, several countries, including Canada, have issued more permissive guidelines regarding LAIV use in children with asthma and/or recurrent wheeze.[100] The use of LAIV in children with asthma and wheezing deserves additional review. As of July 5, 2025, the ACIP recommendations are unchanged while data continue to accumulate and are reviewed by expert groups.

TIMING OF INFLUENZA VACCINATION AND DURATION OF PROTECTION

Although peak influenza activity in the US typically occurs from January through March, influenza viruses can begin to circulate in early fall (October), as occurred in the 2022–2023 season. Circulation can continue to late spring (May or later), with 1 or more disease peaks, as was the case in the 2021–2022 season. The typical pattern of circulation was substantially altered during the COVID-19 pandemic, although prepandemic patterns have been observed in recent seasons. Still, predicting the onset and duration or the severity of the influenza season with accuracy is impossible. Timely influenza vaccination is important to ensure that individuals are

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optimally protected before influenza viruses are circulating in the community. Thus, the AAP and CDC recommend children, especially those who need 2 doses, should be immunized as soon as vaccine becomes available and complete influenza vaccination by the end of October. Because the duration of the influenza season is unpredictable, vaccination should continue as long as influenza viruses are circulating and unexpired vaccine is available (no influenza vaccines in the US are labeled with an expiration date past June 30 of the prior influenza season[101]).

Immunity after influenza vaccination can wane over time.[102] Studies in adults suggest that very early vaccination (July or August) might be associated with suboptimal immunity before the end of the influenza season, and the CDC now discourages influenza vaccination in the summer months for most adults.[70] There is less evidence of waning immunity in children.[103-105] In some studies in children, VE decreased within a single influenza season, and this decrease correlated with increasing time after vaccination. However, this decay in VE was not consistent across different age groups and varied by season and virus types and influenza A virus subtypes.[103,106-113] Waning VE was more evident among older adults and younger children[107-109] and with influenza A(H3N2) viruses more than influenza A(H1N1) or B viruses.[103,108,112] Most recently, waning immunity after influenza vaccination was studied over 9 influenza seasons in Ontario, Canada.[114] In a cohort of individuals ≥6 months vaccinated during the 2011–2012 to the 2018–2019 seasons, the odds of laboratory-confirmed influenza increased 1.09 times every 28 days since vaccination, but waning immunity varied by season, influenza subtype and age group. Unlike older persons, individuals <18 years had lower odds of influenza at subsequent intervals and waning protection was not observed. A systematic review and meta-analysis that included 3 studies of influenza-vaccinated children found that antibody levels waned over time but remained elevated compared with prevaccination levels for 6 months after vaccination.[115]

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Adjuvanted vaccines, which are not currently available for children, elicited higher antibody responses than standard vaccines. In a cohort of influenza vaccine-naive patients 6 to <24 months of age in Nicaragua who received a single dose of vaccine, VE against laboratory-confirmed influenza illness declined 9% per month in the first 4 months following immunization and then plateaued.[116] Waning of immunity after 2 doses of vaccine, as is recommended in the US, was not studied. Collectively, these studies support the current recommendation to immunize children as soon as possible after vaccine becomes available. An early onset of the influenza season, as occurred for the 2022–2023 season, is a concern when considering delaying vaccination, and delays increase the likelihood of missing influenza vaccination altogether.[70]

Although influenza activity in the US is typically low during the summer, influenza cases and outbreaks can occur, particularly among international travelers, who may be exposed to influenza year-round, depending on destination. Influenza can occur throughout the year in the tropics. The CDC has recommended that individuals who did not receive the current seasonal influenza vaccine during the Northern Hemisphere fall/winter season and who are traveling to parts of the world where influenza activity is ongoing should consider seasonal influenza vaccination ≥2 weeks before departure, if available.[117] This includes persons traveling to the tropics, to destinations in the Southern Hemisphere during the Southern Hemisphere influenza season (April to September), or on cruise ships or with organized tourist groups during an influenza season.[70]

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INFLUENZA VACCINE CONSIDERATIONS FOR SUBPOPULATIONS, INCLUDING CONTRAINDICATIONS AND PRECAUTIONS

Contraindications and precautions to available influenza vaccines are detailed in Table 5 in the policy statement[1] (https://doi.org/10.1542/peds.2025-073620). A precaution for vaccination is a condition that might increase the risk or seriousness of a vaccine-related adverse reaction, might compromise the ability of the host to develop immunity after vaccination, or might cause diagnostic confusion.[118] Vaccination may be recommended in the presence of a precaution if the benefit of protection from the vaccine outweighs the potential risks.

Previous Allergic Reaction: Contraindication

Although a severe allergic reaction (eg, anaphylaxis) to a previous dose of any influenza vaccine is generally a contraindication to future receipt of influenza vaccines, the AAP recommends that children who have had an allergic reaction after a previous dose of any influenza vaccine be evaluated by an allergist to determine whether future receipt of the vaccine is appropriate. Children who are allergic to gelatin (very rare) should receive IIV3 instead of LAIV3. RIV3 is an option for patients with gelatin allergy who are ≥9 years of age.

Moderate or Severe Illness, Including COVID-19: Delay Is Recommended

Mild illnesses, with or without fever, are neither precautions nor contraindications to the use of influenza vaccines, including among children with mild upper respiratory infection symptoms or allergic rhinitis. In children judged by the clinician to have a moderate to severe illness, vaccination should be deferred until resolution of the illness. Children with an amount of nasal congestion that would notably impede vaccine delivery into the nasopharyngeal mucosa may receive IIV or should have LAIV deferred until symptom resolution.

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Guillain-Barré Syndrome: Precaution

History of Guillain-Barré syndrome (GBS) following influenza vaccine is considered a precaution for the administration of influenza vaccines. GBS is rare, especially in children, and there is a lack of evidence on the risk of GBS following influenza vaccination in children. Nonetheless, regardless of age, a history of GBS less than 6 weeks after a previous dose of influenza vaccine is a precaution for administration of influenza vaccine. GBS may occur after influenza virus infection. The benefits of influenza vaccination might outweigh the risks for certain people who have a history of GBS (particularly if not temporally occurring after prior influenza vaccination) and who also are at high risk for severe complications from influenza.

Influenza Vaccines and Egg Allergy: Not a Contraindication or Precaution

There is strong evidence that individuals with egg allergy can safely receive influenza vaccine without any additional precautions beyond those recommended for any vaccine.[119,120] The presence of egg allergy in an individual is not a contraindication to receive IIV or LAIV. Vaccine recipients with egg allergy are at no greater risk for a systemic allergic reaction than those without egg allergy. Therefore, precautions such as choice of a particular vaccine, special observation periods, or restriction of administration to particular medical settings are not warranted and constitute an unnecessary barrier to vaccination. It is not necessary to inquire about egg allergy prior to the administration of any influenza vaccine, including on screening forms. Routine prevaccination questions regarding anaphylaxis after receipt of any vaccine are appropriate. Standard vaccination practice for all vaccines in children should include the ability to respond to rare acute hypersensitivity reactions.

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Pregnancy: IIV Recommended, Not a Contraindication or Precaution

Influenza vaccination is recommended by the ACIP, the American College of Obstetricians and Gynecologists (ACOG), and the American Academy of Family Physicians (AAFP) for all pregnant individuals, during any trimester of gestation, to protect against influenza and its complications.[70,121] Influenza vaccination prevents laboratory-confirmed influenza disease and its complications in pregnant individuals and protects their infants in the first months of life (up to 6 months) through transplacental passage of antibodies.[121-131] Two recently published studies reinforce the benefits of influenza vaccination during pregnancy to infants. Over 9 influenza seasons in Ontario, Canada, vaccination during any trimester was associated with reduced risk of laboratory-confirmed influenza (VE 64% [95% CI, 50% to 74%]) and influenza hospitalization (VE 67% [95% CI, 50% to 78%]) during the first 6 months of life.[132] In a prospective, test-negative case control study that analyzed data from the NVSN (2016–2017 to 2019–2020), VE in infants younger than 6 months was 39% against influenza-associated hospitalization (95% CI, 12% to 58%) and 19% against influenza-associated ED visits (95% CI, -24% to 48%).[133] Effectiveness was highest among infants <3 months (53% [95% CI, 30% to 68%]) and infants whose birthing parent was vaccinated during the third trimester (52% [95% CI, 30% to 68%]).

Any licensed, recommended, and age-appropriate IIV or RIV may be administered to pregnant individuals during any trimester of gestation and postpartum. The AAP and ACIP consider LAIV to be contraindicated during pregnancy. This differs from the prescribing information for FluMist 2024-2025 Formula, which indicates that FluMist is not absorbed systemically following intranasal administration and use during pregnancy is not expected to result in fetal exposure to the drug.[94] Influenza vaccine may be administered during the same

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visit as other recommended vaccines, including RSV, COVID-19, and Tdap vaccines. Data on the safety of influenza vaccination at any time during pregnancy continues to support the safety of influenza immunization during pregnancy.[121,123-134] Most studies demonstrate that vaccination during pregnancy, including during the first trimester, is not associated with a risk of spontaneous abortion[135-138] or with the overall risk of major congenital malformations,[139-142] autism spectrum disorder, or other neurodevelopmental disorders.[143,144] Assessments of any association with influenza vaccination and preterm birth and small-for-gestational-age infants have yielded inconsistent results, with most studies reporting a protective effect or no association with these outcomes.[145-148]

Despite clear evidence of benefit to pregnant individuals and their infants, influenza vaccination in this population is suboptimal. During the 2024–2025 influenza season, 38% of pregnant individuals were vaccinated through March 29, 2025.[149] Vaccination coverage was highest among non-Hispanic Asian pregnant persons (53.1%) and lowest among non-Hispanic Black pregnant persons (26.4%).

Racial disparities in uptake of influenza vaccine during pregnancy have been identified previously, with Black women consistently having the lowest rates.[133,150] Black women report a lower rate of being offered or recommended to receive influenza vaccine, despite evidence that a provider recommendation is associated with vaccine acceptance.[150] Lower influenza vaccination coverage also has been reported in Medicaid-insured pregnant women compared with privately insured women and in women residing in rural areas compared with those residing in urban areas.[151,152] A comprehensive intervention that coupled a strong provider recommendation for influenza immunization with patient education and point-of-care availability of vaccine improved immunization rates in pregnant persons attending 1 urban prenatal clinic in Canada.[153]

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Breastfeeding: Recommended, Not a Contraindication or Precaution

Influenza vaccination with IIV, RIV, or LAIV during breastfeeding is safe for lactating individuals and their infants, and vaccination is recommended for individuals not already vaccinated during the current season. Breastfeeding is strongly recommended to protect infants against influenza viruses by activating innate antiviral mechanisms, specifically type-1 interferons. Human milk from pregnant individuals vaccinated during the third trimester also contains higher levels of influenza-specific immunoglobulin A.[154] Greater exclusivity of breastfeeding in the first 6 months of life decreases the episodes of respiratory illness with fever in infants of vaccinated lactating parents. For infants whose birthing parent has confirmed influenza illness at delivery, breastfeeding is encouraged, and guidance on breastfeeding practices is available on the CDC website (https://www.cdc.gov/breastfeeding-special-circumstances/hcp/illnesses-conditions/flu.html and https://www.cdc.gov/flu/hcp/infection-control/peri-post-settings.html). Birthing parents may pump and feed expressed breast milk if they or their infants are too ill to breastfeed.

INFLUENZA VACCINATION COVERAGE

Influenza vaccination coverage of children decreased coincident with the COVID-19 pandemic, mirroring the declines in other routine pediatric vaccines during the pandemic, and has not returned to prepandemic levels.[155-158] During the 2024-2025 season, influenza vaccination coverage decreased for the fifth year in a row, remaining well below the Healthy People 2030 target of 70% (Figure 3).[159,160] Through April 26, 2025, only 49.2% of children 6 months through 17 years had been vaccinated, 14.5 percentage points lower than in at the end of the 2019-2020.[160] Historically, the lowest influenza immunization rates have been observed in non-Hispanic Black children. This season, non-Hispanic white children had the lowest influenza

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vaccine coverage (46.2%) compared with several groups with higher coverage, including non-Hispanic Black children (47.8%), Hispanic children (53.1%), and children identified as other/non-Hispanic (55.3%). Coverage levels were also lower among children residing in rural areas (36.5%) compared with suburban (49%) or urban (56.2%) areas. Coverage rates also varied by poverty level, with the lowest coverage among children classified as "above poverty, income < $75,000" (42.4%). Higher rates were reported in children classified as "poverty status unknown" (44.6%), "below poverty" (49.4%) and "above poverty, income ≥$75,000" (53.3%).

Disparities by insurance type have previously been reported. In a cross-sectional study using the Massachusetts All Payer Claims Database (2014–2018), privately insured children with asthma were significantly more likely to receive an influenza vaccination than Medicaid-insured children with asthma,[161] although vaccination coverage in both groups was low (51.3% vs 45.1%). Because National Immunization Survey-Flu data may overestimate vaccination rates in some populations, actual immunization rates may be lower.[162]

Factors contributing to declining influenza vaccination coverage in the early years of the pandemic included logistical barriers, including lack of transportation and altered school and work schedules, which may reduce access to routine medical care.[163] Some of these barriers persist. A recent analysis of data from the National Immunization Survey-Child found that estimated coverage with most of the routinely recommended childhood vaccines by age 24 months, including influenza vaccine, was lower among children born in 2020 and 2021 compared with coverage among those born in 2018 and 2019.[164] Vaccination coverage was lower among Black, Hispanic, and AI/AN children, those insured by Medicaid or other nonprivate insurance, uninsured children, children living in more rural areas, and children in families with

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incomes below the federal poverty level. These data suggest the need to reduce financial obstacles and improve access to vaccination services.

Parental vaccine hesitancy may also contribute to suboptimal influenza immunization rates.[165] Data collected by the CDC through National Immunization Survey-Flu in 2019 found that 1 in 5 US children had a parent who was vaccine hesitant, and hesitancy was negatively associated with childhood influenza vaccination.[165] Between 2019 and 2022, parental vaccine hesitancy toward routine childhood vaccines remained stable at ~19%.[166] A higher percentage of parents voice hesitancy about influenza vaccine compared to routine childhood vaccines, although that percentage has remained relatively stable (33.8% in 2020 vs 30.9% on 2022-2023).[165] Parental surveys collected through the National Immunization Survey-Child COVID-19 Module October 2022 through April 2023 found the highest rates of parental vaccine hesitancy among parents of Black children (39.8%) and children of other or multiple races (35.3%) compared with parents of white (30.2%), Asian (20.3%), and Hispanic (27.9%) children.

Rates of influenza vaccine hesitancy by race and ethnicity have been previously reported and suggest the need for tailored interventions. For example, in 1 small mixed-methods study of parents and legal guardians presenting with their children to a pediatric emergency department (ED) during the 2021–2022 influenza season, Black caregivers expressed more hesitancy to vaccinate their children for influenza than did white caregivers (42% vs 21%; $P = .01$).[167] Hispanic caregivers also expressed more hesitancy than white caregivers (37%), but this difference was not statistically significant. Barriers to influenza vaccination voiced by Black and Hispanic caregivers included perceived vaccine side effects, lack of necessity, inadequate data, and distrust of the science, health care system, and government. Vaccine hesitancy in Black

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communities is rooted in part in historical trauma, including unethical medical trials, and has persisted because of ongoing experiences of discrimination, racism, mistreatment, and other health disparities.[168,169] Black caregivers highlighted the importance of health care personnel communicating about vaccines in a transparent, nonjudgmental way. Facilitators of vaccination emphasized by Black and Hispanic caregivers included desire to protect others, employer facilitation of vaccination, and personal stories from others. The use of trusted messengers in their communities, such as faith-based leaders, to promote vaccination is also paramount.[168]

Vaccination interventions must balance the considerable diversity that exists within racial and ethnic groups. For example, within a study enrolling 309 economically marginalized Hispanic mothers of children younger than 5 years of age in the US, there were notable differences in intent to vaccinate, mistrust of influenza vaccine and access to vaccine, suggesting the need for person-centered strategies.[170]

Influenza immunization rates in groups of children with health conditions that increase the risk for severe influenza[171-174] trend higher than rates in children without these health conditions, but opportunities for improvement persist. Tailored interventions may also be needed for these populations. For example, adolescent patients with rheumatic disease receiving immunosuppression (n=81) and their parents (n=145) were surveyed about their knowledge of influenza and barriers to influenza vaccination.[171] Commonly cited reasons for not receiving the influenza vaccine included worry about disease flare (25.6%), concern the vaccine will cause influenza (25.6%), and lack of vaccine effectiveness (20.5%).

Achieving high influenza vaccination coverage of infants, children, and adolescents remains a priority to protect them against influenza disease and its complications. Multifaceted

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strategies are needed to increase influenza vaccination coverage, especially in vulnerable, high-risk populations.

INFLUENZA VACCINE DELIVERY AND IMPLEMENTATION STRATEGIES

Timely annual distribution of influenza vaccine to health care facilities serving children and adolescents, especially primary medical homes, may help avoid missed opportunities. Placing initial vaccine orders early and creating systems for tracking and reordering when necessary throughout the season may optimize supply. Such efforts may be particularly important when there are disruptions in vaccine delivery because of supply chain issues, inclement weather, or other unforeseen circumstances, along with prioritizing delivery to primary care settings, especially when supply is limited or delayed. The AAP has developed guidance for addressing influenza vaccine supply, payment, coding, and liability issues (https://www.aap.org/influenza).

The AAP and CDC recommend influenza vaccination at any visit to the medical home during influenza season. Influenza vaccination in the medical home is ideal, especially for the youngest children. Administering influenza vaccine in diverse locations, such as subspecialty practices, perioperative clinics, urgent care clinics, EDs, schools, and pharmacies, may help augment these efforts.[175-177] This may be particularly useful for children at high risk for influenza-related complications and children who do not have or cannot readily access their medical home, including those residing in rural areas where coverage levels are markedly lower than in suburban or urban areas. EDs are an underutilized resource. In 1 tertiary care ED and 3 affiliated sites, a standardized influenza vaccination program consisting of nursing education, standing orders, and a best practice advisory in the electronic health record (EHR) significantly increased the number of influenza vaccines administered.[178] Children vaccinated during the

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intervention period were more likely to be of Black race (8.4% vs 7.2%) or multiple/other race (26.0% vs 19.8%), Hispanic ethnicity (46.0% vs 34.7%), and with public insurance (64.3% vs 56.0%), suggesting a standardized ED influenza vaccination program could be an effective way to increase immunization rates among minority and government-insured children. In a recent national survey completed by 142 pediatric emergency medicine physicians representing 61 EDs, only 26 of 61(44%) administer any influenza vaccine and 17 of 61(28%) administered <50 vaccines annually.[179] Investigators projected that up to 18 750 additional patients could receive influenza vaccine annually if nonvaccinating EDs offered influenza vaccine to children and achieved a 10% acceptance rate.

Expanding pharmacy-based influenza vaccine administration is another strategy with the potential to increase vaccine access, as an estimated 93% of the population lives within 5 miles of a pharmacy.[180,181] The number of children immunized by pharmacists has been increasing but still remains relatively low. In 1 retrospective cohort study that utilized a claims data warehouse of commercially insured persons to analyze influenza vaccines administered to children between July 1, 2016, and June 30, 2017, only 5.2% of vaccines were administered by pharmacists.[181] State-specific restrictions on the minimum age for pharmacist-administered vaccinations vary and may limit the number of children who can be immunized in this setting.[180]

Hospitalized patients should be vaccinated before discharge, unless medically contraindicated. Historically, a substantial proportion of children hospitalized for influenza have been hospitalized previously during the same season; failure to offer vaccine to hospitalized children is a missed opportunity.[182] An automated, hospital-based influenza vaccination screening program integrated into the hospital medical record may increase vaccination of eligible patients.[183]

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A system for reporting influenza vaccine administrations is crucial to ensure adequate communication and maintain accurate patient records across settings. Integration of immunization information systems (IISs) with EHR systems can enhance data accuracy and up-to-date vaccination status.[184]

For patients with a fragmented medical home or in communities where patients often receive vaccines in diverse settings, querying the IIS prior to administration of vaccination may prevent unnecessary vaccine administration. Use of patient portals for parents to self-report vaccination is one strategy for health systems looking to calculate influenza vaccination coverage of their patient population and to decrease unnecessary communications to patients who received vaccinations outside the medical home.

Practices should prepare in advance for their influenza vaccine campaign and leverage a range of evidence-based strategies[185,186] throughout the season to increase vaccination rates in their patient population (see Table 3 in the policy statement[1] at https://doi.org/10.1542/peds.2025-073620). The AAP has created tools to help practices in this work (https://www.aap.org/influenza). Some practices expand their hours of operation (ie, evenings, weekends) or schedule vaccine-only clinics to increase patient access to influenza vaccine early in the season and during peak periods. Sending reminder/recall messages using a modality (ie, telephone, text, letter, email, messaging via the patient portal) that is feasible for their practice and aligns with the preferences of their patient population may improve immunization rates.[187-189] A Cochrane Review from 2018 concluded that reminder/recall improves childhood influenza vaccination with moderate certainty of evidence (RR, 1.51; 95% CI, 1.14 to 1.99).[190] Effective messages notify families of influenza vaccine availability and provide other key information such as the child's vaccination status and where, when, and why

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the child should receive the vaccine. This information is beneficial early in the campaign as well as throughout the season. For example, 1 clinical trial[191] found that sending text message reminders to parents of children who remain unvaccinated in the late fall increased influenza vaccine uptake. Another trial[192] demonstrated the effectiveness of using text message reminders for children requiring 2 doses in a season, particularly when the messages embedded information regarding the need for a timely second dose. Not all studies have shown an impact, including a recent study of text versus patient portal messaging,[193] neither of which improved overall immunization rates. Other strategies may be needed, such as those addressing vaccine hesitancy.

Effective influenza vaccine communication with patients and families is crucial. Messaging should be consistent across all members of the care team, including front office staff, medical assistants, nurses, physicians and advanced practice providers (including those specializing in primary care and subspecialty care). Practices should educate their staff, physicians, and other clinicians about influenza and influenza vaccine-related topics, including the importance of annual vaccination, vaccine effectiveness and safety, the 2-dose requirement for certain children, vaccine contraindications, and common parental concerns. Making vaccine-related information readily available (ie, via a practice website, social media platform, or educational handout)[194,195] and tailoring this information for their patients and families (ie, materials in preferred language) have been effective. Resources are available from the AAP at https://www.aap.org/en/patient-care/influenza/social-media-toolkit-influenza/.

Digital storytelling, featuring compelling accounts of lived experience, is a promising behavioral intervention that could be leveraged to improve influenza immunization rates.[196]

Care team members should use evidence-based communication strategies in their conversations with patients and families. These include offering a strong, presumptive influenza

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vaccine recommendation, bundling their recommendation for influenza vaccine with recommendations for other needed vaccines, and pursuing their initial recommendation when families initially decline the vaccine.[197-200] Moreover, communication should be tailored to address the specific vaccine-related concerns of patients and families. Resources regarding effective vaccine communication techniques are available on the AAP website at https://aap.org/vaccinecommunication.

Practices, staff, physicians, and other clinicians should consider expanding their conversations and messaging campaigns about influenza to include other preventable respiratory illnesses (ie, RSV, COVID-19). Messaging examples from the AAP are available at https://www.healthychildren.org/English/tips-tools/ask-the-pediatrician/Pages/can-children-get-COVID-19.aspx. Exact language is particularly important in their discussions and messaging to patients and families. While acknowledging that influenza can sometime cause gastrointestinal symptoms, especially in young children, referring to all viral gastrointestinal illnesses as "stomach flu," creates unnecessary confusion. In Spanish, the term "gripe" is commonly used to refer to viral influenza but is a nonprecise term referring to respiratory illnesses. Using this term may cause confusion about the actual illness prevented by influenza vaccine and result in decreased confidence about vaccine effectiveness. "Influenza" rather than "la gripe" is preferred when discussing influenza and influenza vaccine with Spanish-speaking patients and families.

Strategies to reduce missed opportunities during patient visits include standardization of practice workflow to screen all patients for influenza vaccine eligibility and administer the vaccine to any patient who is due for the vaccine. This workflow could be utilized at all visit types, including preventive care, acute care, and mental/behavioral health visits. Influenza vaccination can be administered when patients present for other needed vaccines as well.

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Practices may identify influenza vaccine champion(s) within their practice to spearhead these efforts. Informatic tools can also facilitate influenza vaccination. For example, studies have shown that standing vaccine orders and vaccine prompts in the EHR increase influenza vaccine uptake in both inpatient and outpatient settings.[201,202] Audits and performance feedback for providers have also been shown to be effective as part of multimodal interventions.[186] Additionally, these tools can be used to identify patients who have a precaution or contraindication to a particular formulation or who need repeat vaccinations and support future dose scheduling. Practices should attempt to schedule a timely return visit for any patient identified as needing a future dose (eg, vaccine dose deferred because of concomitant moderate or severe illness or second dose indicated because of age). Additionally, health systems looking to identify patients at high risk for severe influenza illness can leverage information from the EHR to identify patients at risk and provide targeted communications. Sample value sets for use in creating electronic clinical decision support tools are presented in Table 3. Implementation can be challenging, but some institutions have used these sources. Local adaptation may be needed.

For practices that choose to offer influenza vaccine to family members and other close contacts of children and adolescent patients, the AAP technical report, "Immunizing Parents and Other Close Family Contacts in the Pediatric Office Setting,"[203] provides medical liability risk management guidance on documenting in a separate record screening, informed consent, and National Vaccine Injury Compensations Program (VICP)-required immunization administration data. Guidance is provided on ascertaining whether immunizing adults is covered by customary pediatric medical liability insurance policies for any adverse events not covered by the VICP; logistical and financial barriers are also addressed. Practices that participate in value-based care contracts with insurance companies should understand the plan-specific implications of

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immunizing parents. In some cases, immunizing a parent or adult caregiver could result in that individual being attributed to the pediatrician's roster and result in negative financial consequences. Additional resources are available at https://aap.org/immunization.

Partnership with community entities, including early childhood learning centers, schools, school-based health centers, public health agencies, pharmacies, and other organizations, can optimize influenza vaccine distribution, communication, and administration. These partnerships may be particularly important for reaching patients with limited access to care, including those residing in rural areas. For example, practices could help with outreach initiatives such as influenza vaccine fairs or mobile vaccine vans. Partnering with faith-based organizations may be an effective intervention to increase immunization rates in communities in which mistrust and vaccine hesitancy are high.[204] Collectively, practices and partners can educate families and community members on the importance of influenza vaccination and address common concerns. The AAP has created communication resources to convey key messages and to help the public understand influenza vaccination recommendations on the AAP website at https://www.aap.org/en/news-room/campaigns-and-toolkits/flu-campaign-toolkit.

The AAP supports influenza vaccination as a condition of employment for HCP in all settings, including outpatient locations. Optimal prevention of influenza in these settings requires that at least 90% of HCP are vaccinated. Estimated influenza vaccination coverage of HCP was 75.4% during the 2023–2024 season, similar to coverage of 75.9% in 2022-2023, but decreased from 80.6% during the 2021–2022 season.[205] Coverage levels continued to be the highest among HCP who reported an employer requirement for influenza vaccination (97.5%). Coverage levels were also higher among HCP working in hospitals (89.1%) compared with those working in ambulatory settings (74.6%) or long-term care and home health care settings (65.2%). Influenza

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vaccination programs for HCP benefit the health of employees, their patients, and members of the community, especially because HCP frequently come into contact with high-risk patients in their clinical settings. The programs reduce HCP absenteeism and may reduce disruptions in care delivery associated with personnel shortages.[206] Influenza vaccination as a condition of employment for HCPs is considered ethical, just, and necessary to improve patient safety. For the prevention and control of influenza, HCP must prioritize the health and safety of their patients, honor the requirement of causing no harm, and act as role models for both their patients and colleagues by receiving influenza vaccination annually.

INFLUENZA TREATMENT AND CHEMOPROPHYLAXIS

Antiviral Therapy

The AAP, CDC,[207] Infectious Diseases Society of America,[208] and Pediatric Infectious Diseases Society recommend antiviral treatment for children with serious, complicated, or progressive disease presumptively or definitively caused by influenza, irrespective of influenza vaccination status (the circulating strains may not be well matched with vaccine strains) or whether illness began >48 hours before presentation. Earlier treatment provides better clinical responses, but treatment after 48 hours of symptoms in adults and children with moderate to severe disease or with progressive disease has been shown to provide some benefit and should be offered.[209-211] Additionally, the AAP recommends treatment of children at risk for severe complications of influenza, regardless of duration of symptoms. Otherwise healthy children who have suspected or confirmed influenza with an uncomplicated presentation should be considered for antiviral medication, particularly if they are in contact with other children who either are younger than 6 months (as they are not able to receive influenza vaccine) or have high-risk conditions (including age <5 years) that predispose them to complications of influenza, when

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influenza viruses are known to be circulating in the community. Antiviral treatment should be started as soon as possible after illness onset and should not be delayed while waiting for a definitive influenza test result, because early therapy provides the best outcomes. Algorithms for interpreting positive and negative influenza tests are available (https://www.cdc.gov/flu/hcp/testing-methods/algorithm-results-circulating.html).

The balance between benefits and harms should be considered when making decisions about the use of antiviral agents for either treatment or chemoprophylaxis of influenza. The cost of antiviral therapy may be a barrier to treatment for some families. When there are shortages of antiviral agents, antivirals are prioritized for patients at greatest risk of influenza-related complications and those who are hospitalized.[212]

Antiviral agents available for both influenza treatment and chemoprophylaxis in children of all ages can be found in Table 6 in the policy statement[11] (https://doi.org/10.1542/peds.2025-073620) (including doses for preterm infants that have not been evaluated by the FDA) and on the CDC website.[207] These include the neuraminidase inhibitors (NAIs [oseltamivir, zanamivir, peramivir]) and a selective inhibitor of influenza cap-dependent endonuclease (baloxavir), all of which have activity against influenza A and B viruses.[208]

The AAP considers oseltamivir (Tamiflu), administered orally or by feeding tube, to be the antiviral drug of choice for the management of illness caused by influenza virus infections. This is the only drug recommended by the AAP for treatment of hospitalized children.[1] Oseltamivir is preferred because of the cumulative experience of this drug in children, relative cost, and ease of administration. The FDA has approved oseltamivir for treatment of

[1] AAP recommendations for the use of oseltamivir differ from FDA-approved labeling.

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children as young as 2 weeks of age. Given preliminary pharmacokinetic data and limited safety data, the CDC and AAP support the use of oseltamivir to treat influenza in both term and preterm infants from birth, because benefits of therapy for neonatal influenza are likely to outweigh possible risks of treatment. If the breastfeeding parent requires antivirals, treatment with oral oseltamivir is preferred.

Other Antivirals for the Treatment of Influenza

Although more difficult to administer, inhaled zanamivir (Relenza) is an acceptable alternative for patients 7 years and older who do not have chronic respiratory disease. In 1 nationwide, population-based cohort study that included ambulatory children and adults who were treated with antiviral medications within 48 hours of a clinical diagnosis of influenza, inhaled zanamivir was not inferior to oral oseltamivir in preventing influenza-related hospitalization or death, but an exploratory subgroup analysis favored oseltamivir in children 5 through 17 years of age. This may reflect the ability of children to correctly use a zanamivir inhaler.

A single dose of intravenous peramivir (Rapivab) is approved for the treatment of acute uncomplicated influenza in ambulatory children 6 months and older who have been symptomatic for no more than 2 days. The efficacy of peramivir in patients with serious influenza requiring hospitalization has not been established.[208] In a retrospective cohort study of children 0 to 5 years of age hospitalized with influenza in China, oral oseltamivir and IV peramivir were associated with similar clinical outcomes when used for the treatment of influenza B.[213] In children with influenza A, oseltamivir treatment was associated with improved recovery and shorter hospital stays (5 vs 6 days; $P = .02$). In another retrospective cohort study of 97 children 29 days to 18 years of age hospitalized with influenza and treated with peramivir, duration of fever and

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influenza nucleic acid amplification test positivity were shorter in children infected with influenza A H3N2 compared with children with influenza B; other outcomes were similar.[214]

Baloxavir marboxil (Xofluza) is approved for treatment of acute uncomplicated influenza in healthy individuals as young as 5 years of age and all individuals 12 years and older, including those at high risk of developing influenza-related complications.[215] It is also approved by the FDA for postexposure prophylaxis of influenza for persons ≥5 years of age within 48 hours of contact with an individual with influenza. At present, the CDC does not recommend use of baloxavir for outpatients with complicated or progressive illness, severely immunosuppressed people, hospitalized patients or during pregnancy or breastfeeding because of the lack of information on use of baloxavir in these groups (https://www.cdc.gov/flu/treatment/baloxavir-marboxil.html). There are no available data regarding the presence of baloxavir in human milk, the effects on the breastfed infant, or the effects on milk production.

Baloxavir is administered as a single dose and could be considered as an alternative to oseltamivir for eligible patients when compliance is a concern or there is poor tolerance of an antiviral regimen requiring multiple medication doses.

Outcomes in patients treated with baloxavir are generally similar to those for NAIs.[216,217] In a randomized controlled trial (RCT) that enrolled adolescents and adults, baloxavir had better efficacy than oseltamivir in the treatment of influenza B.[218] Some observational studies suggest more rapid resolution of fever in children treated with baloxavir compared with oseltamivir.[219,220] In an observational study conducted at 10 outpatient clinics across 9 prefectures in Japan during the 2012–2013 and 2019–2020 influenza seasons, baloxavir compared with oseltamivir significantly reduced the median duration of fever in children with influenza B (20.3 hours [95% CI, 9.4 to 31.3] vs 35.0 hours [95% CI, 21.3 to 59.0]).[221] Median duration of fever was similar in

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children with influenza A(H1N1)pdm09 or A(H3N2). A post hoc analysis of an RCT demonstrated similar durations of fever in children 5 to 11 years of age treated with baloxavir or oseltamivir.[222] In a post hoc analysis of 2 open label studies[223] of baloxavir in children 1 to <12 years of age in Japan, symptom recurrence after day 4 was noted in 54.5% of treated children <6 years of age, while fever recurrence was noted in 50%.[224] In some patients, fever and symptom recurrence occurred during or after increases in virus titer, although titer increases were transient and all patients with symptom recurrence recovered without the need for additional antiviral treatment. In 2 studies, baloxavir treatment reduced the duration of viral shedding compared with oseltamivir treatment in patients infected with influenza.[222,225]

The oral suspension formulation of baloxavir was not available in the US for the 2024–2025 influenza season, limiting use in children who were old enough to receive the drug but weigh less than 20 kg.[226] Availability of this formulation for the 2025–2026 influenza season is unknown at this time.

Rationale for Influenza Treatment in Children

The rationale for influenza treatment recommendations are threefold: 1) reduce the duration of symptoms; 2) reduce complication of influenza, including hospitalization and death; and 3) potentially reduce transmission. RCTs to evaluate the efficacy of influenza antiviral medications among outpatients with uncomplicated influenza have found that timely treatment (optimally ≤2 days from symptom onset) can reduce the duration of influenza symptoms and fever in pediatric and adult populations.[227-231] Observational studies in pediatric and adult populations suggest that antivirals are safe and could reduce the risk of certain influenza

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complications, including hospitalization and death.[232-236]

A Cochrane review of 6 RCTs involving treatment of 2356 children with clinically diagnosed influenza, of whom 1255 had laboratory-confirmed influenza, showed that in children with laboratory-confirmed influenza, oral oseltamivir and inhaled zanamivir reduced median duration of illness by 36 hours (26%; P <.001) and 1.3 days (24%, P <.001), respectively.[231] Among the studies reviewed, 1 trial of oseltamivir in children with asthma who had laboratory-confirmed influenza showed a nonsignificant reduction in illness duration (10.4 hours; 8%; P = .542). Another Cochrane review of RCTs in adults and children, which included 20 oseltamivir (9623 participants) and 26 zanamivir trials (14 628 participants)[228] found no effect of oseltamivir in reducing the duration of illness in asthmatic children, but in otherwise healthy children, there was a reduction by a mean difference of 29 hours (95% CI, 12 hours to 47 hours; P = .001). No significant effect was observed with zanamivir. This review did not find a significant effect of NAIs on reducing hospitalizations, pneumonia, bronchitis, otitis media, or sinusitis in children.[228] More recently, a meta-analysis of 5 new RCTs that included 1598 children with laboratory-confirmed influenza showed that treatment with oseltamivir significantly reduced the duration of illness in this population by 17.6 hours (95% CI, –34.7 hours to –0.62 hours).[229] When children with asthma were excluded, this difference was larger (–29.9 hours; 95% CI, –53.9 hours to –5.8 hours). The risk of otitis media was 34% lower in this group as well. Similarly, a meta-analysis conducted by Tejada et al showed a statistically significant reduction in the risk of acute otitis media occurrence among treated children over placebo recipients (odds ratio [OR]: 0.48; 95% CI, 0.30 to 0.77).[236] Overall, efficacy outcomes are best demonstrated in patients with laboratory-

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confirmed influenza.

There are no prospective, fully enrolled, completed RCTs of antivirals versus placebo for treatment of influenza in hospitalized children or pediatric patients with comorbidities, and prospectively collected data to determine the role of antiviral agents in treating severe influenza are limited. One RCT of oseltamivir treatment of influenza in hospitalized children in El Salvador and Panama suggested clinical benefit, but no statistically significant findings were reported, because only 21% of the target sample size was enrolled, and therefore, the study was substantially underpowered.[237] Nevertheless, on the basis of information obtained from retrospective observational studies and meta-analyses conducted to date in both adults and children, most experts support the use of antiviral medications as soon as possible to treat pediatric patients with severe influenza, including hospitalized patients.[229-234,237]

In a retrospective study of 784 pediatric intensive care unit admissions from 2009 to 2012, the estimated risk of death was reduced in 653 NAI-treated individuals (OR, 0.36; 95% CI, 0.16 to 0.83).[209] In a retrospective analysis of data from the US Influenza Hospitalization Surveillance Network, administration of antiviral agents ≤2 days after illness onset was associated with shorter lengths of stay in children admitted to the intensive care unit (adjusted hazard ratio: 1.46; $P = .007$) and in children with underlying medical conditions not admitted to the ICU (adjusted hazard ratio: 1.37; $P = .02$). In the relatively small number of patients studied, antiviral treatment ≥3 days after illness onset had no significant effect in either cohort.[238] Similarly, early antiviral treatment of children with tracheostomy hospitalized with influenza reduced length of stay by 1 day (6.4 vs 7.5 days; $P = .01$).[239] In a multicenter, retrospective cohort study involving 55 799 children hospitalized with influenza between 2007 and 2020, oseltamivir use on hospital day 0 or 1 was associated with shorter hospital stays and lower odds

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of readmission within 7 days, transfer to the ICU and the composite outcome use of extracorporeal membrane oxygenation and in-hospital mortality.[240]

Several studies also suggest that treatment of index patients with influenza reduces transmission to household contacts to some extent, but the magnitude of the effect is inconsistent across published reports.[241]

Potential limitations of the trials conducted to date in children include the study size (the number of events might not be sufficient to assess specific outcomes in small studies), variations in the case definition of influenza illness (clinically diagnosed versus laboratory confirmed), time of treatment administration in relation to the onset of illness, and inclusion of children of varying ages and underlying health conditions. Observational studies using administrative data may be biased by misclassification of both influenza infection status and oseltamivir exposure.[242] Nevertheless, the totality of available evidence supports the treatment of children with influenza.

No additional benefit exists for double-dose NAI therapy on reduction of mortality or viral clearance, compared with standard-dose therapy, on the basis of a recent systematic review and meta-analysis of 10 published studies[243] (4 RCTs and 6 observational studies) involving 20 947 adult and pediatric patients. In a randomized, parallel-group, double-blind, placebo-controlled, superiority trial, combining baloxavir with NAIs did not result in superior clinical outcomes compared with NAIs alone in patients 12 years and older hospitalized with laboratory-confirmed influenza.[244]

Oseltamivir Adverse Effects

In adverse event data collected systematically in prospective trials, vomiting was the only adverse effect reported more often with oseltamivir compared with placebo when studied in

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children 1 through 12 years of age (ie, 15% of treated children versus 9% receiving placebo). Diarrhea was reported in clinical trials of oseltamivir in 7% of treated children <1 year of age. Following reports from Japan of possible oseltamivir-attributable neuropsychiatric adverse effects, a review of controlled clinical trial data and ongoing surveillance has failed to establish a link between this drug and neurologic or psychiatric events.[245,246] Neurologic and neuropsychiatric complications including abnormal behavior occur in children with influenza in the absence of exposure to oseltamivir.[247] In a retrospective cohort study of children 5 through 17 years of age in Tennessee, the incidence rate of neuropsychiatric events was 51 per 100 000 person-weeks of influenza, and rates were higher among adolescents and those with risk factors for influenza complications.[248] The study did not support an association between oseltamivir and neuropsychiatric events, but was unable to characterize the dose, duration, or timing of oseltamivir administration in relation to the onset of neuropsychiatric events.

Adherence to Antiviral Treatment Guidance

Despite the body of evidence supporting antiviral treatment of children hospitalized with confirmed or suspected influenza and longstanding guidance recommending antiviral use in children at high risk for complications, antiviral prescribing is suboptimal.[249-253]

A multicenter, prospective surveillance cohort study conducted from 1 December 2016 to 31 March 2020 at 7 pediatric medical centers as a part of the NVSN confirmed that children hospitalized with laboratory-confirmed influenza frequently do not receive antiviral treatment.[254] Of 1213 children with laboratory-confirmed influenza, 652 children (53.8%) received an antiviral. A hematologic disorder (aOR = 1.76; 95% CI, 1.03 to 3.02), an oncologic or immunocompromising disorder (aOR = 2.41; 95% CI, 1.13 to 5.11), receipt of antivirals for current illness prior to hospitalization (aOR 2.34; 95% CI, 1.49 to 3.67), and ICU admission at

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presentation (aOR 1.53; 95% CI, 1.02 to 2.29) were associated with receipt of an antiviral medication. Rates of antiviral therapy differed fivefold across sites.

Data from the NSVN and FluSurv-NET indicate that antiviral treatment of children and adolescents hospitalized with influenza declined during the pandemic and has not returned to prepandemic levels.[255] The overall percentage of hospitalized patients aged <18 years with laboratory-confirmed influenza who were treated with antiviral medications during the 2017-2018 season was 70% in NVSN and 86% in FluSurv-NET. During the 2023-2024 season, only 52% (NVSN) and 59% (FluSurv-NET) of children and adolescents hospitalized with influenza received antiviral treatment. A higher proportion of children aged <6 months received antiviral treatment (68% [NVSN]; 73% [FluSurv-NET]) compared with older children. Antiviral treatment was also more prevalent among children admitted to an ICU (84% [NVSN]; 82% [FluSurv-NET]) or who received noninvasive or invasive ventilation (89%–94% [NVSN]; 82% [FluSurv-NET]).

In the ambulatory setting, only 31% of children and adolescents recommended to receive antiviral treatment were prescribed antivirals. The percentage of prescriptions was highest among children aged <6 months (49%), a group known to be a high-risk for complications of influenza.

Additional studies are needed to explore barriers to treatment of children with influenza and test multifactorial interventions to increase the number of children with influenza who are treated in accordance with recommendations.

INFLUENZA CHEMOPROPHYLAXIS

Antiviral medications are important adjuncts to influenza vaccination for control and prevention of influenza disease in children who are at least 3 months of age. Randomized

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placebo-controlled studies showed that oral oseltamivir and inhaled zanamivir were efficacious when administered as chemoprophylaxis to household contacts after a family member had laboratory-confirmed influenza.[208] The efficacy of baloxavir was demonstrated in a randomized, placebo-controlled trial in Japan conducted during the 2018–2019 influenza season. Among household members ≥5 years of age treated with a single dose of baloxavir within 48 hours of exposure to a symptomatic household contact with influenza, 2% developed influenza compared with 13% in the placebo group (aRR, 0.14).[256] For additional context, 73% started baloxavir within 24 hours of the index case's symptom onset, an exercise that would be difficult to replicate in practice in the US. There are no data on intravenous peramivir for chemoprophylaxis.

Decisions on whether to administer antiviral chemoprophylaxis should include consideration of the exposed person's risk of influenza complications, vaccination status, type and duration of contact, time since exposure, recommendations from local or public health authorities, and clinical judgment. Optimally, postexposure chemoprophylaxis should only be used when antiviral agents can be started within 48 hours of exposure; the lower once-daily dosing for chemoprophylaxis with oral oseltamivir or inhaled zanamivir should not be used for treatment of children symptomatic with influenza.[208] Early, full treatment dosing (rather than once-daily chemoprophylaxis dosing) should be used in high-risk symptomatic patients without waiting for laboratory confirmation.

Toxicities may be associated with antiviral agents, and indiscriminate use might limit availability. Pediatricians should inform recipients of antiviral chemoprophylaxis that risk of influenza is lowered, but not eliminated, while taking the medication, and susceptibility to influenza returns when medication is discontinued. Chemoprophylaxis is not a substitute for vaccination and among some high-risk people, both vaccination with IIV and antiviral

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chemoprophylaxis may be considered.[208] The effectiveness of LAIV but not IIV or RIV will be decreased for children receiving oseltamivir or other influenza antivirals.[208] Updates will be available at www.aapredbook.org and www.cdc.gov/flu/professionals/antivirals/index.htm.

ANTIVIRAL RESISTANCE

Resistance to any antiviral drug can emerge, necessitating continuous population-based assessment. In 2023, global surveillance of influenza virus isolates available in the Global Initiative on Sharing All Influenza Data identified an increase in the number of influenza A(H1N1)pdm09 viruses with mutations conferring decreased susceptibility to neuraminidase inhibitors.[257] Fortunately, for nearly all influenza A isolates in the 2024–2025 season to date, antiviral resistance was rarely detected.[258] One influenza A(H1N1)pdm09 isolate (<0.1% of all viruses tested) exhibited reduced inhibition by oseltamivir; 5 influenza A(H1N1)pdm09 isolates exhibited highly reduced inhibition by oseltamivir and peramivir (0.2% of all viruses tested).

Influenza viruses with reduced baloxavir susceptibility have been identified coincident with treatment in children. In an analysis of 4 pediatric trials, the incidence of subjects with treatment-emergent resistance substitutions after baloxavir use was highest in subjects <5 years of age with a clear peak of resistance in subjects 2 to 4 years of age (https://www.fda.gov/media/162113/download). Resistance was substantially higher in subjects infected with influenza A(H3N2). Knowledge of the circulating influenza strain may influence the decision to use baloxavir. Surveillance in the US during the 2024-2025 season did not detect significant resistance to baloxavir. One influenza A(H1N1)pdm09 virus (<0.1%) and 1 influenza A H3N2 virus (0.1%) exhibited decreased susceptibility to baloxavir.

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Influenza B Victoria viruses represented a small proportion of infections in the US during the 2024-2025 influenza season. No influenza B Victoria viruses exhibited reduced susceptibility to antiviral agents (https://www.cdc.gov/fluview/surveillance/2025-week-16.html).

High levels of resistance to amantadine and rimantadine persist among the seasonal influenza A viruses currently circulating; neither drug is effective against influenza B viruses. Adamantane medications are not currently recommended for use against seasonal influenza.[208]

To date, most novel influenza A virus, including avian influenza A(H5N1) have been susceptible to antivirals recommended for treatment of seasonal influenza, including oseltamivir, peramivir, zanamivir, and baloxavir.[259] Oseltamivir resistance has been reported in a case of influenza A H5N1 infection associated with a fatal outcome.[260]

If a newly emergent antiviral-resistant virus is a concern, recommendations for alternative treatment will be available from the AAP and CDC. Resistance characteristics can change for an individual patient over the duration of a treatment course, especially in those who are severely immunocompromised. Information on current recommendations and therapeutic options can be found on the AAP website (www.aap.org or www.aapredbook.org), through state-specific AAP chapter websites, or on the CDC website (https://www.cdc.gov/flu/hcp/antivirals/summary-clinicians.html).

DIAGNOSTIC TESTS FOR INFLUENZA

Diagnostic testing for influenza may be beneficial when results will be used to inform clinical management or infection prevention measures and to distinguish from other respiratory viruses with similar symptoms. Performance characteristics of tests vary and are impacted by duration of illness in the person being tested and proper specimen collection and handling. Test

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results must be interpreted in the context of community influenza activity (Table 4); false-positive test results may occur during periods of low influenza activity.

Molecular assays include rapid molecular tests, reverse-transcriptase polymerase chain reaction (RT-PCR) test, and other nucleic acid amplification tests. Multiplex assays that allow for the simultaneous detection of influenza viruses plus SARS-CoV-2 and RSV are available. These assays can be particularly useful when these viruses are cocirculating, because signs and symptoms of these viruses may be similar, clinical differentiation is difficult, and different treatment strategies are recommended. A list of FDA-cleared and FDA-authorized tests is available at https://www.fda.gov/medical-devices/in-vitro-diagnostics/influenza-diagnostic-tests.

Antigen detection tests include rapid influenza diagnostic tests (RIDTs) and immunofluorescence assays. Some available RIDTs detect SARS-CoV-2 as well as influenza A and B. An updated list of RIDTs is available at https://www.cdc.gov/flu/professionals/diagnosis/table-ridt.html.

Rapid molecular assays are highly sensitive and are preferred over RIDTs in ambulatory children in whom testing is performed. During periods of high community influenza activity, clinicians should consider confirming negative RIDTs with a molecular test. When influenza is circulating in the community, hospitalized patients with signs and symptoms of influenza should be tested with a molecular assay with high sensitivity and specificity.

Most influenza tests ordered in clinical settings do not distinguish avian influenza A(H5) viruses from seasonal influenza A viruses.[261] In January 2025, amid the ongoing avian influenza A(H5) virus animal outbreak in the US and an increasing number of sporadic human cases, the CDC recommended expedited subtyping of influenza A specimens recovered from hospitalized

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patients, particularly those in intensive care units. When isolates test positive for influenza A but negative for seasonal influenza A virus subtypes (ie, A[H1] and A[H3]), further testing at public health laboratories is indicated as soon as possible and within 24 hours of obtaining results to evaluate for influenza A(H5).

Over-the-counter at-home tests are available under FDA emergency use authorization to diagnose both influenza A and B and SARS-CoV-2 in symptomatic individuals as young as 2 years. There are multiplex antigen tests that detect SARS-CoV-2 and influenza A/B viruses in upper respiratory tract specimens, and 1 multiplex molecular assay that detects SARS-CoV-2 and influenza A/B (https://www.fda.gov/medical-devices/in-vitro-diagnostics/influenza-diagnostic-tests). At a minimum, parents, especially those of children at high risk for complications of influenza, will benefit from counseling about timely communication with the medical home about the results of home tests and education that a negative test result cannot completely exclude influenza.

FUTURE DIRECTIONS

Safety and Effectiveness of Available Influenza Vaccines

Continued evaluation of the safety, immunogenicity, and effectiveness of influenza vaccines, especially for at-risk and diverse populations, is important. The safety of LAIV in children with asthma/recurrent wheeze deserves additional review. If guidelines for administration are revised, safety should be monitored using existing systems, including the Vaccine Adverse Event Reporting System (VAERS), the Clinical Immunization Safety Assessment Project, and the Vaccine Safety Datalink.

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The duration of protection, potential role of previous influenza vaccination on overall VE, and VE by vaccine formulation, virus strain, timing of vaccination, and subject age and health status in preventing outpatient medical visits, hospitalizations, and deaths continue to be evaluated. Additional controlled data are needed to inform the timing, schedule, and type of influenza vaccine for optimal vaccine immunogenicity among immunocompromised children, but use of high-dose IIV in selected populations is a promising strategy. In a phase 2, multicenter, double blind, randomized, controlled trial comparing immunogenicity and safety of high-dose trivalent influenza vaccine (HD-TIV) and standard-dose quadrivalent influenza vaccine (SD-QIV) in children and adolescents 3 through 17 years of age who had received an allogeneic hematopoietic cell transplant 3 to 35 months earlier, 2 doses of HD-TIV were more immunogenic than 2 doses of SD-QIV.[262] Two doses of either vaccine were more immunogenic than a single dose. The greatest benefit of HD-TIV relative to SD-QIV was in individuals receiving their first influenza immunization 6 months or more after receiving a hematopoietic cell transplant.[263] The safety profile of vaccines was similar, although mild to moderate injection site reactions were slightly higher after the second dose of HD-TIV.[262,263] In a subcohort of 65 patients re-enrolled and vaccinated in a second season, a single dose of HD-TIV or SD-QIV was more immunogenic in year 2 than 2 doses of the same formulation in year 1.[264] Injection site and systemic reactions were similar.

Influenza Vaccines in Development

Development efforts continue for universal influenza vaccines that induce broader protection and eliminate the need for annual vaccination. The success of mRNA and other novel technologies used in the development of COVID-19 vaccines may accelerate the prospects of broad influenza vaccines. Ongoing federal support of National Institutes of Health-sponsored

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research related to vaccine development is crucial. Understanding the establishment of immunity against influenza in early life and developing a safe, immunogenic vaccine for infants younger than 6 months are essential. Studies on the effectiveness and safety of influenza vaccines containing adjuvants that enhance immune responses to influenza vaccines or that use novel routes of administration are needed in children. Efforts to improve the vaccine development process to allow for a shorter interval between identification of vaccine strains and vaccine production continue.

Promoting Vaccine Confidence and Increasing Vaccination Coverage

Systematic health services research is needed to examine influenza vaccination coverage, factors associated with undervaccination, and interventions to increase uptake in diverse populations. Prospective assessment of the impact of at-home administration of LAIV on immunization rates is warranted, as well as logistical challenges such as accurate and timely reporting of doses.

National data from 2019 found that 25.8% of parents were hesitant about influenza vaccine.[265] Children of parents who were hesitant about childhood vaccines had 25.6% lower influenza vaccination coverage in the influenza 2018–2019 season compared with children of parents not reporting hesitancy.[266] Vaccine hesitancy remains a major public health threat. Future studies, including those funded by the NIH, should aim to improve our understanding of influenza vaccine hesitancy and identify effective strategies to respond to parental concerns, address misinformation/disinformation, foster greater vaccine confidence, and increase influenza vaccine acceptance.[267] Although social media may be a source of misinformation about influenza vaccine, it has also been used as tool to increase acceptance of vaccines.[268] The AAP has created a resource to help pediatricians respond to vaccine misinformation on social media

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(https://www.aap.org/vaccinecommunication). Additional research is needed to understand the impact of social media messaging on influenza immunization rates.

Additional evaluation is needed to understand the impact of social media messaging on influenza immunization rates.

Engagement of key stakeholder groups in addressing vaccine hesitancy is crucial, including patients and families, health care professionals, practices as well as health systems, public health officials, and community leaders. Enhanced collaboration may facilitate more equitable influenza vaccine supply and delivery and more effective community outreach, particularly to vulnerable populations. Novel approaches for reducing barriers to accessing preventive care services may also help to reduce disparities in influenza vaccination coverage. Ongoing efforts should include broader implementation and evaluation of mandatory HCP vaccination programs in both inpatient and outpatient settings.

Antiviral Treatment

New antiviral drugs are in various development phases, given the need to improve options for the treatment and chemoprophylaxis of influenza. Additionally, with limited data on the use of antivirals in hospitalized children and in children with underlying medical conditions, prospective clinical trials to inform optimal timing and efficacy of antiviral treatment in these populations are warranted, particularly as new antivirals or new indications for existing antivirals become available. Barriers to timely treatment of children at high risk for complications, especially hospitalized patients, must be explored.

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ADDITIONAL RESOURCES

Pediatricians can remain informed of advances and other updates during the influenza season by following the CDC Influenza page (www.cdc.gov/flu) and the AAP *Red Book Online* Respiratory Illness Season News and Resources Page (https://publications.aap.org/redbook/resources/15189).

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Embedded links to cdc.gov and fda.gov sites were active and reviewed by AAP subject matter experts as of July 5, 2025.

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Figure 1. Adjusted Vaccine Effectiveness (VE)[a] in Children in the United States, by Season, as Reported by the Centers for Disease Control and Prevention (CDC), US Influenza Vaccine Effectiveness Network[b]

Influenza Type/ Age Group	2019–2020 B/Victoria and A(H1N1)pdm09 VE% (95% CI)	2021–2022 A(H3N2) VE% (95% CI)	2022–2023 A(H3N2) VE% (95% CI)	2023–2024 A(H3N2)[c] VE% (95% CI)
Influenza A and B				
Overall all ages	39 (32, 44)	36 (21, 48)†	49 (36, 60)†	67 (48, 80)
6 mo–8 y	34 (19, 46)	Not reported	Not reported	
9–17 y	40 (22, 53)	Not reported	Not reported	
Influenza A(H1N1)pdm09				
Overall all ages	30 (21, 39)	Not reported	56 (28, 72)	61 (26, 81)
6 mo–8 y	23 (-3, 42)	Not reported		
9–17 y	29 (-7, 52)	Not reported		
Influenza A(H3N2)				
Overall all ages	Not reported	36 (20, 49)	45 (29, 58)	Not reported
6 mo–8 y	Not reported	51 (19, 70)		
9–17 y	Not reported	34 (-7, 59)		
Influenza B Victoria				
Overall all ages	45 (37, 52)	Not reported	Not reported	Not reported
6 mo–8 y	39 (20, 54)	Not reported	Not reported	89 (70, 97)
9–17 y	43 (23, 58)	Not reported	Not reported	Not reported

[a] VE is estimated as 100% x (1 − odds ratio [ratio of odds of being vaccinated among outpatients with CDC's real-time RT-PCR influenza-positive test results to the odds of being vaccinated among outpatients with influenza-negative test results]); odds ratios were estimated using logistic regression. Adjusted for study site, age group, sex, race/ethnicity, self-rated general health, number of days from illness onset to enrollment, and month of illness using logistic regression. **VE 0-30 % >30-50% >50%**

[b] VE could not be assessed for 2020–2021 season because of low virus circulation. However, the A(H1N1)pdm09, A(H3N2), and B/Victoria strains that were genetically characterized were similar to the strains included in the vaccine.

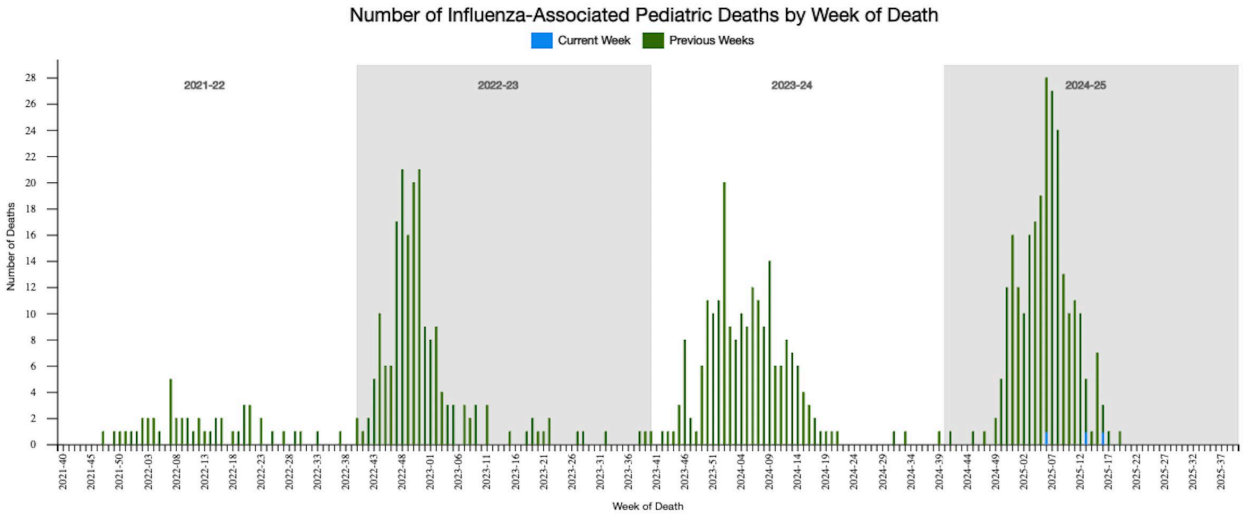
[c] Interim VE estimates.[269]

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Figure 2. Influenza-Associated Pediatric Deaths by Season

From: https://gis.cdc.gov/GRASP/Fluview/PedFluDeath.html. Accessed July 16, 2025.

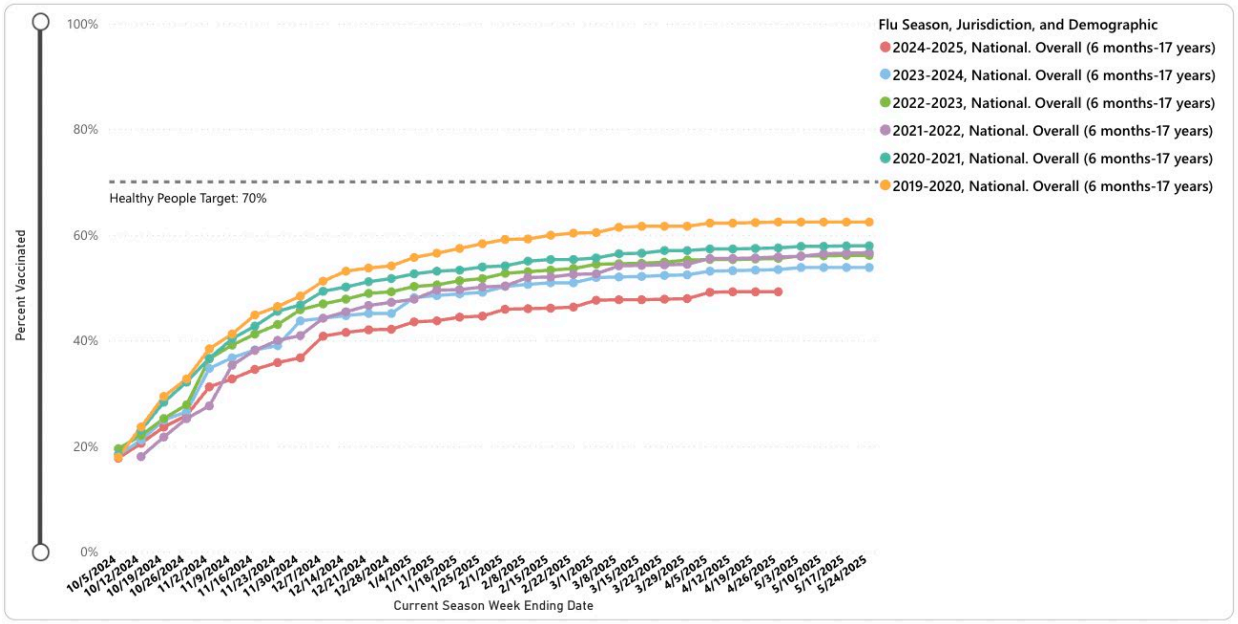


Seasons	Total Deaths	Deaths reported During the Week Ending 21 Jun 2025
2021-22	49	0
2022-23	187	0
2023-24	207	0
2024-25	253	3

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Figure 3. Influenza Vaccination Coverage in Children 6 Months to 17 Years of Age in the United States, 2019–2020 to 2024–2025



Influenza vaccination coverage in children 6 months to 17 years of age in the US, 2019-2020 to 2024-2025 From Centers for Disease Control and Prevention. Influenza Vaccination Coverage, Children 6 months through 17 years, United States. Data source: NIS-Flu.
Available at: https://www.cdc.gov/fluvaxview/dashboard/children-vaccination-coverage.html. Accessed July 6, 2025.

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Table 1. Summary of Recent Influenza Seasons

	2020-2021	2021-2022	2022-2023[a]	2023-2024[b]
Severity	Low	Low	Moderate with high severity in children	Moderately severe
Duration	—	—	—	—
Predominant Viruses	Influenza A(H3N2) Influenza B (Victoria)	Influenza A(H3N2)	Influenza A(H3N2)	A(H1N1)pdm09
Vaccination Coverage in Children	58.2%	57.8%	55.1%	53.8
Hospitalization Rate	0.8/100 000 overall rate	32.1/100 000 (0–4 y) 14.1/100 000 (5–17 y)	112/100 000 (0–4 y) 42.1/100 000 (5–17 y)	86.1 /100 000 (0–4 y) 34.3 /100 000 (5–17 y)
Characteristics of Hospitalized Children	• Not available because of low case numbers	54.1% had ≥1 underlying condition[c] • Asthma 28.% • Neurologic disorder 16.9% • Obesity 13.3%	51.9% had ≥1 underlying condition[c] • Asthma 27.6% • Neurologic disorder 15.7% • Obesity 14.4%	54.6% had ≥1 underlying condition[c] • Asthma 24.5% • Neurologic disorder 18.7% • Obesity 16.1%
Pediatric Deaths[d]	1	49 • 39.1% without underlying condition • Bacterial co-infection in 53.8%	187 • 53.4% without underlying condition • Bacterial coinfection in 51.4%	207 • 51% without underlying condition • Bacterial co-infection in 48% • 17.2% of vaccine-eligible children fully vaccinated[e]
Notable Findings	• Low severity season likely because of COVID-19 mitigation measures reducing spread of all respiratory illnesses • 1 reported case of novel influenza A(H1N2) in the US	• Influenza activity began to increase in November, declined in January 2022, increased again in March 2022 and remained elevated until mid-June 2022 • Higher number of hospitalizations in the second wave • 13 human infections with novel influenza	• Influenza activity began in October (earlier than prior seasons)[f] • Low proportion of children vaccinated at onset of season • High pediatric hospitalization rates, especially in the southeast • Co-circulation of SARS-CoV2 and RSV	• Influenza activity began to increase in early November and peaked in late December 2023, similar to pre-pandemic pattern of circulation • A(H3N2) and B/Victoria virus activity increased at end of season 21 novel influenza A virus infections identified, including 14 avian influenza A(H5) virus (all cases in

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		A virus identified, including 1 case of avian influenza A(H5) virus (first in a human in the US)		adults) and 7 variant viruses (3 in children <18 y)

—, not reported.

a Centers for Disease Control and Prevention. Preliminary estimated influenza illnesses, medical visits, hospitalizations, and deaths in the United States—2022–2023 Influenza Season. Accessed June 1, 2025. Available at: https://www.cdc.gov/flu-burden/php/data-vis/2022-2023.html

b Centers for Disease Control and Prevention. Influenza Activity in the United States during the 2023–2024 Season and Composition of the 2024–2025 Influenza Vaccine. Accessed March 30, 2025. https://www.cdc.gov/flu/whats-new/flu-summary-2023-2024.html

c Data abstracted from: https://www.cdc.gov/flu-burden/php/data-vis/2022-2023.html; Accessed June 1, 2025.

d Data abstracted from: https://gis.cdc.gov/GRASP/Fluview/PedFluDeath.html. Accessed June 1, 2025.

e Based on interim analysis of 197 deaths and 157 children and adolescents eligible for influenza vaccination (age ≥6 months at date of illness onset) and for whom vaccination status was known.

f White EB, O'Halloran A, Sundaresan D, et al. High influenza incidence and disease severity among children and adolescents aged <18 years—United States, 2022–23 season. *MMWR Morb Mortal Wkly Rep*. 2023;72(41):1108–1114

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Table 2. Adjusted Influenza Vaccine Effectiveness (VE) Against Influenza Hospitalization[a]

Author/Setting	Seasons Included	Population Studied	N	Adjusted VE Partially Vaccinated[b] (95% CI)	Adjusted VE Fully Vaccinated (95% CI)
Feldstein/US New Vaccine Surveillance Network	2015–2016	6 mo to 17 y	1653	18% (–44, 54)	56% (34, 71) -
Israel/Segaloff	2015–2016 2016–2017 2017–2018	6 mo to 8 y	3147	25.6% (−3.0, 47.0)	53.9% (38.6, 68.3)
Australia/Blyth	2018	≤16 y	458	NR	86.1% (76.3, 91.9)
United Kingdom/Pebody	2018–2019	2 to 17 y	986	NR	53.0% (33.3, 66.8) • A(H1N1): 63.5% (34.4, 79.7) • A(H3N2): 31.1% (53.9, 69.2)
Systematic Review/Kalligeros	2005–2019	6 mo to 17 y	NR	33.91(21.12, 46.69)	61.79 (54.45, 69.13)
Japan/Shinjoh	2018–2019	6 mo to 15 y	205	NR	56% (16, 77)[c]
Atlanta, Georgia/Yildirim	2012–2013 2013–2014 2014–2015 2016–2016 2016–2017	6 mo to 17 y	980	46.8% (23.8, 62.8)	55.3% (31.7, 70.7)
Hong Kong/Cowling	2023	9 mo to 17 y	1671	NR	69.6% (49.3%, 81.7%)

NR, not reported.

[a] Laboratory-confirmed influenza hospitalization.

[b] Included only patients 6 months to 8 years.

[c] Included patients with full and partial vaccination.

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Table 3. Value Sets for Underlying Conditions of High-Risk Groups for Influenza Complications

The sets provided are previously published value sets available at the Value Set Authority Center (a service of the National Library of Medicine) and can be accessed at https://vsac.nlm.nih.org. These sets are provided by the relevant steward listed and are not endorsed by the AAP but may serve as a starting point for organizations creating electronic clinical decision support systems.

Category	Description	Established Value Sets	Object Identifier (OID)	Code System	Steward
Underlying Condition or Treatment with Common Examples[a]					
Chronic Pulmonary Disease	Asthma	Asthma Diagnosis ICD-10	2.16.840.1.113762.1.4.1047.308	ICD10CM	American Academy of Allergy Asthma and Immunology
		Asthma Diagnosis Grouping	2.16.840.1.113762.1.4.1047.309	ICD10CM ICD9CM SNOMEDCT	American Academy of Allergy Asthma and Immunology
	Cystic fibrosis	Cystic Fibrosis	2.16.840.1.113883.3.464.1003.102.12.1002	ICD10CM ICD9CM SNOMEDCT	National Committee for Quality Assurance
		Cystic Fibrosis Lung Disease	2.16.840.1.113762.1.4.1219.15	ICD10CM SNOMEDCT	CMS Documentation Requirement Lookup Service

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	Compromised respiratory function (eg, requiring mechanical ventilation, tracheostomy or baseline oxygen requirement)	Mechanical Ventilation	2.16.840.1.113762.1.4.1248.107	ICD10PCS SNOMEDCT	American Institutes for Research
Cardiovascular Disease	Hemodynamically significant conditions (excluding hypertension alone)	No Existing Value Set			
Kidney Disease	Dialysis Chronic kidney disease, including end-stage kidney disease	Dialysis Services	2.16.840.1.113883.3.464.1003.109.11.1026	CPT	National Committee for Quality Assurance
Hepatic Disease	Chronic liver disease Cirrhosis	Chronic Liver Disease Cirrhosis	2.16.840.1.113883.3.464.1003.199.12.1035 2.16.840.1.113762.1.4.1248.149	ICD10CM ICD9CM SNOMEDCT ICD10CM SNOMEDCT	National Committee for Quality Assurance American Institutes for Research
Hematologic Disease	Sickle cell disease	Sickle Cell Anemia and HB S Disease	2.16.840.1.113762.1.4.1235.222	ICD10CM SNOMEDCT	B.well Connected Health
	Other hemoglobinopathies	No Existing Value Set			

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Metabolic Disorders	Diabetes mellitus	Diabetes	2.16.840.1.113883.3.464.1003.103.12.1001	ICD10CM SNOMEDCT	National Committee for Quality Assurance
Neurologic and Neurodevelopmental Conditions	Cerebral palsy	Congenital or Infantile Cerebral Palsy Group	2.16.840.1.113883.3.666.5.1580	ICD10CM ICD9CM SNOMEDCT	Lantana
	Epilepsy	Epilepsy	2.16.840.1.113762.1.4.1034.51	ICD10CM ICD9CM SNOMEDCT	American Academy of Neurology
		Seizure Disorder	2.16.840.1.113883.3.464.1003.105.12.1206	ICD10CM ICD9CM SNOMEDCT	National Committee for Quality Assurance
	Stroke	Stroke	2.16.840.1.113762.1.4.1248.176	ICD10CM	American Institutes for Research
	Intellectual developmental disorder	No Existing Value Set			
	Moderate to severe developmental delay	No Existing Value Set			
	Muscular dystrophy	No Existing Value Set			
	Spinal cord injury	Spinal Cord Injury	2.16.840.1.113883.3.7587.3.1009	ICD10CM ICD9CM SNOMEDCT	American Academy of Physical Medicine and Rehabilitation

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Extreme Obesity	BMI ≥40 for adults[b]	No Existing Value Set			
Immunosuppression	Receipt of immunocompromising medications	No Existing Value Set			
	Congenital or acquired immune deficiency, including HIV	Immunodeficiency Syndromes HIV	2.16.840.1.113762.1.4.1200.189 2.16.840.1.113883.3.464.1003.120.12.1003	ICD10CM ICD10CM ICD9CM SNOMEDCT	Cliniwiz National Committee for Quality Assurance
	Asplenia	Anatomic or Functional Asplenia_HD_CN_Grouping	2.16.840.1.113762.1.4.1235.219	ICD10CM ICD9CM SNOMEDCT	B.well Connected Health
Receiving Treatment with Aspirin or Salicylate-Containing Therapies[c]		No Existing Value Set			
Pregnancy and Up to 2 Weeks Postpartum		No Existing Value Set			

[a] List of examples is not exhaustive.

[b] Not well-defined in children but could consider BMI ≥95% for age.

[c] Applies to children and adolescents <19 years who may be at increased risk of Reye syndrome.

Source: Adapted from Centers for Disease Control and Prevention. Prevention and control of seasonal influenza with vaccines: recommendations of the Advisory Committee on Immunization Practices—United States, 2024–25 influenza season. *MMWR Recomm Rep*. 2025; in press

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Table 4. Comparison of Types of Influenza Diagnostic Tests

Testing Category[a]	Method	Influenza Viruses Detected	Distinguishes Influenza A Virus Subtypes	Typical Time to Results	Performance
Rapid molecular assay	Nucleic acid amplification	Influenza A or B viral RNA	No	15–30 minutes	High sensitivity; high specificity
Rapid influenza diagnostic test	Antigen detection	Influenza A or B virus antigens	No	10–15 minutes	Moderate sensitivity (higher with analyzer reader device; high specificity
Direct and indirect immunofluorescence assays	Antigen detection	Influenza A or B virus antigens	No	2–4 hours	Moderate sensitivity; high specificity
Molecular assays (including RT-PCR)	Nucleic acid amplification	Influenza A or B viral RNA	Yes, if subtype primers are used	1–8 hours	Very high sensitivity; very high specificity
Multiplex molecular assays	Nucleic acid amplification	Influenza A or B viral RNA, other viral or bacterial targets (RNA or DNA)	Yes, if subtype primers are used	1–2 hours	High sensitivity; high specificity
Rapid cell culture (shell vial and cell mixtures)	Virus isolation	Influenza A or B virus	Yes	1–3 days	High sensitivity; high specificity
Viral culture (tissue cell culture)	Virus isolation	Influenza A or B virus	Yes	3–10 days	High sensitivity; high specificity

[a] Negative results may not rule out influenza. Respiratory tract specimens should be collected as close to illness onset as possible for testing. Clinicians should consult the manufacturer's package insert for the specific test for the approved respiratory specimen(s). Specificities are generally high (>90%) for all tests

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compared with reverse transcriptase-polymerase chain reaction (RT-PCR). Sensitivities of rapid influenza diagnostic tests vary by test and are lower compared with RT-PCR and viral culture. The typical sensitivity of a rapid test performed in a physician's office is 50% to 70%, and clinicians may wish to confirm negative test results with molecular assays, especially during peak community influenza activity. Some FDA-cleared rapid influenza diagnostic tests are CLIA-waived; most FDA-cleared rapid influenza molecular assays are CLIA-waived, depending on the complexity.

Sources: Uyeki[208] and https://www.cdc.gov/flu/php/laboratories/table-testing-methods.html.

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