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COVID-19–Associated Hospitalizations and Maternal Vaccination Among Infants Aged <6 Months — COVID-NET, 12 States, October 2022–April 2024

Fiona P. Havers, MD[1]; Michael Whitaker, MPH[1]; Bhoomija Chatwani, MPH[1,2]; Monica E. Patton, MD[1]; Christopher A. Taylor, PhD[1]; Shua J. Chai, MD[3,4]; Breanna Kawasaki, MPH[5]; Kimberly Yousey-Hindes, MPH[6]; Kyle P. Openo, DrPH[7,8,9]; Patricia A. Ryan, MS[10]; Lauren Leegwater, MPH[11]; Ruth Lynfield, MD[12]; Daniel M. Sosin, MD[13]; Bridget J. Anderson, PhD[14]; Brenda Tesini, MD[15]; Melissa Sutton, MD[16]; H. Keipp Talbot, MD[17]; Andrea George, MPH[18]; Jennifer Milucky, MSPH[1]; COVID-NET Surveillance Team

Abstract

Infants aged <6 months are at increased risk for severe COVID-19 disease but are not yet eligible for COVID-19 vaccination; these children depend upon transplacental transfer of maternal antibody, either from vaccination or infection, for protection. COVID-19–Associated Hospitalization Surveillance Network (COVID-NET) data were analyzed to estimate COVID-19–associated hospitalization rates and identify demographic and clinical characteristics and maternal vaccination status of infants aged <6 months hospitalized with laboratory-confirmed COVID-19. During October 2022–April 2024, COVID-NET identified 1,470 COVID-19–associated hospitalizations among infants aged <6 months. COVID-19–associated hospitalization rates among young infants were higher than rates among any other age group, except adults aged ≥75 years, and are comparable to rates among adults aged 65–74 years. The percentage of hospitalized infants whose mothers had been vaccinated during pregnancy was 18% during October 2022–September 2023 and decreased to <5% during October 2023–April 2024. Severe outcomes among infants hospitalized with COVID-19 occurred frequently: excluding newborns hospitalized at birth, approximately one in five young infants hospitalized with COVID-19 required admission to an intensive care unit, nearly one in 20 required mechanical ventilation, and nine infants died during their COVID-19–associated hospitalization. To help protect pregnant persons and infants too young to be vaccinated, prevention for these groups should focus on ensuring that pregnant persons receive recommended COVID-19 vaccines.

Introduction

COVID-19 can cause severe disease in children, and infants aged <6 months have the highest COVID-19 hospitalization rates among all pediatric age groups (*1*,*2*). These infants are not yet age-eligible to receive COVID-19 vaccination, and maternal vaccination during pregnancy protects young infants from COVID-19–associated hospitalization (*3*–*5*). Data from the COVID-19–Associated Hospitalization Surveillance Network (COVID-NET) during October 2022–April 2024 were analyzed to describe hospitalization rates, maternal vaccination status, clinical outcomes, and codetections of other viruses among infants aged <6 months hospitalized with laboratory-confirmed SARS-CoV-2 infection.

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Methods

Data Sources

COVID-NET conducts population-based surveillance for laboratory-confirmed COVID-19–associated hospitalization, defined as documentation of a positive SARS-CoV-2 test result during hospitalization or ≤14 days preceding hospital admission, among residents of a predefined catchment area. Demographic data were collected for all COVID-19–associated hospitalizations in 90 counties across 12 states* and were used to calculate age-stratified hospitalization rates.

This analysis describes weekly and seasonal cumulative hospitalization rates among infants aged <6 months (young infants) hospitalized across two respiratory virus seasons (October 2022–September 2023 [2022–23] and October 2023–April 2024 [2023–24]).† Unadjusted weekly COVID-19–associated hospitalization rates (hospitalizations per 100,000 population)§ with rate ratios (RRs) were calculated by dividing the total number of hospitalized patients by age group–specific population estimates for the counties included in the surveillance catchment area. When comparing cumulative rates among infants across seasons, the period was limited to October–April for both periods for comparability. When comparing rates between age groups, cumulative and weekly data comparing pediatric age groups are presented for 2022–2024; cumulative data comparing all age groups are presented for 2023–24 only.

Using previously described methods (*6*), clinical data (signs and symptoms at admission,¶ underlying medical conditions,** viral codetections, and clinical outcomes) were abstracted for a random sample of hospitalized infants.†† Maternal vaccination,

* COVID-NET sites contributing data to this analysis include selected counties in California, Colorado, Connecticut, Georgia, Maryland, Michigan, Minnesota, New Mexico, New York, Oregon, Tennessee, and Utah, representing approximately 10% of the U.S. population.

† Clinical data are complete through April 2024. October–April has been historically defined as the respiratory virus season, although COVID-19 circulates year-round. For October 2021–September 2022 and October 2022–September 2023, 34.9% and 23.6% of pediatric cases, respectively, were reported during the May–September period.

§ Rates are calculated using the National Center for Health Statistics' unbridged-race postcensal population estimates for the counties or county equivalents included in surveillance. Because population estimates are available in 1-year age increments, population denominators for hospitalization rates among infants aged <6 months were calculated as 50% of the population estimate for infants aged <1 year.

¶ COVID-19–related signs and symptoms included respiratory conditions (congestion/runny nose, cough, nausea/vomiting, rash, seizures, shortness of breath/respiratory distress, upper respiratory infection, and wheezing) and nonrespiratory conditions (apnea, conjunctivitis, diarrhea, cyanosis, decreased vocalization/stridor, dehydration, fever, hypothermia, inability to eat/poor feeding, and lethargy). Signs and symptoms data were abstracted from medical charts and might be incomplete.

** Defined as one or more of the following conditions: blood disorder, cardiovascular disease including congenital heart disease, chronic lung disease of prematurity/bronchopulmonary dysplasia, asthma/reactive airway disease or airway abnormality, chronic metabolic disease, gastrointestinal disease, genetic disorder, immunosuppressive condition, neurologic disorders, prematurity, renal disease, or other underlying condition.

†† During October 2022–April 2024, some sites chose to complete all charts for pediatric patients; the remainder did a random sample. Random numbers (1–100) were generated and assigned to each patient to produce random samples for medical record abstraction stratified by site, age group, and month. Unweighted case counts and weighted percentages that better represent the hospitalized population of the catchment area are presented for sampled data. Percentages were weighted to account for probability of selection for sampled patients.

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defined as receipt of any COVID-19 vaccination at any time during pregnancy, was obtained through state immunization information systems; infant characteristics were compared by maternal vaccination status. The analysis of clinical data excluded newborns who received a positive SARS-CoV-2 test result during their birth hospitalization[§§] because the clinical significance of a positive test result in this setting is difficult to determine.

Statistical Methods

Wilcoxon rank-sum tests and Fisher's exact chi-square tests were used to compare medians and proportions, respectively; p-values <0.05 were considered statistically significant. Percentages were weighted to account for the probability of selection for sampled cases, and further adjusted to account for nonresponse (i.e., an incomplete medical chart review). Variances were estimated using Taylor series linearization method. Data were analyzed using SAS (version 9.4; SAS Institute). This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy.[¶¶]

[§§] A birth hospitalization was defined as the hospitalization during which the infant was born.

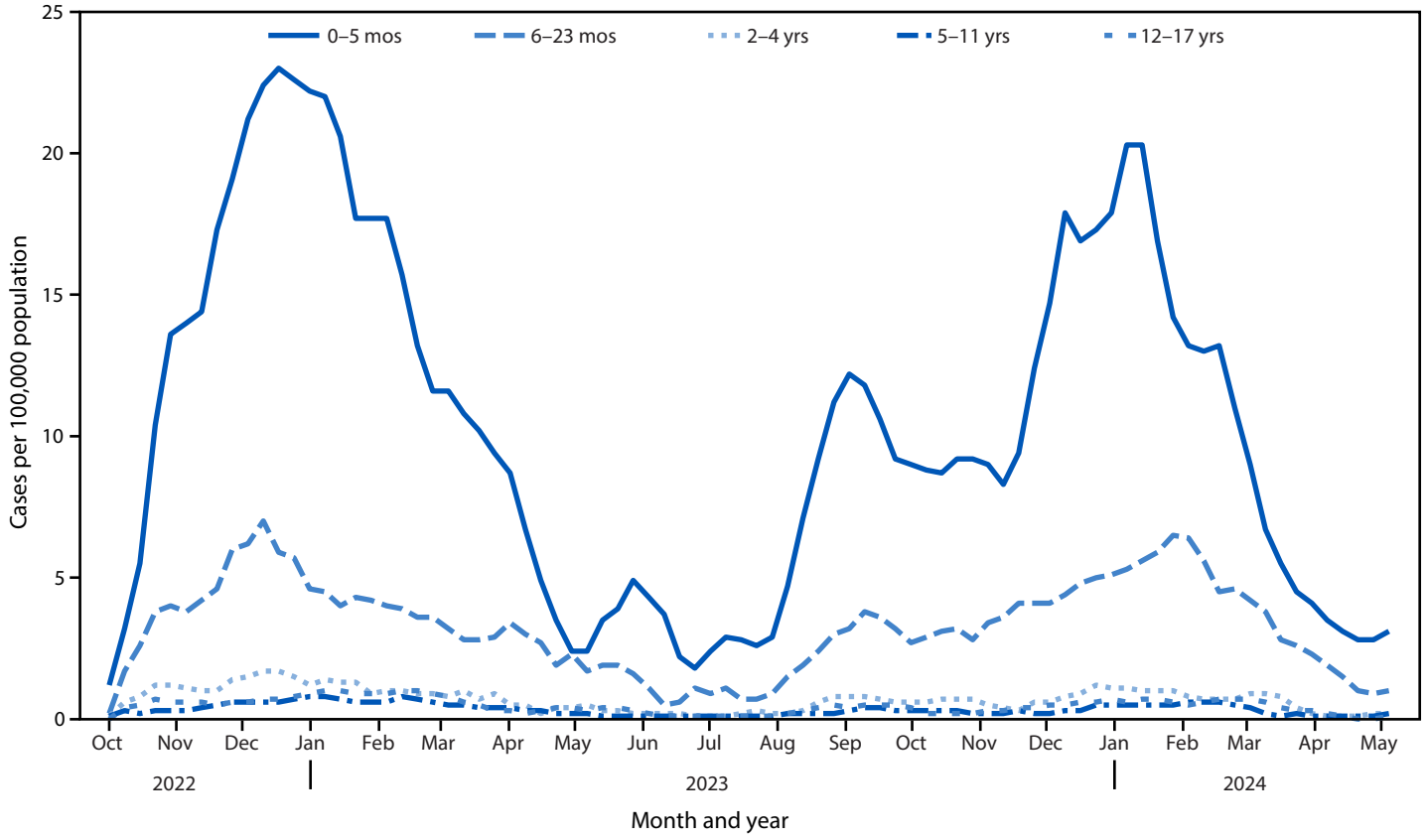
Results

COVID-19–Associated Hospitalization Rates

During October 2022–April 2024, a total of 1,470 COVID-19–associated hospitalizations among infants aged <6 months who received a positive SARS-CoV-2 test result were identified. Weekly COVID-19 hospitalization rates were highest among infants aged <6 months compared with rates in other pediatric age groups, peaking at 23.0 and 20.3 per 100,000 infants during the weeks ending December 17 in 2022–23 and January 13 in 2023–24, respectively (Figure 1). Cumulative hospitalization rates among young infants were lower during October 2023–April 2024 (319.8) than during October 2022–April 2023 (413.6) (RR = 0.77; 95% CI = 0.69–0.86). In 2023–24, compared with rates among

[¶¶] 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

FIGURE 1. Weekly COVID-19–associated hospitalization rates (3-week moving average) among children and adolescents aged <18 years,* by age group — COVID-19–Associated Hospitalization Surveillance Network, 12 states,† October 1, 2022–April 30, 2024



* Number of patients with a laboratory-confirmed COVID-19–associated hospitalization per 100,000 population.
† Selected counties in California, Colorado, Connecticut, Georgia, Maryland, Michigan, Minnesota, New Mexico, New York, Oregon, Tennessee, and Utah.

young infants (319.8), hospitalization rates were higher only among adults aged ≥75 years (940.1) (RR = 0.34; 95% CI = 0.31–0.37) and were comparable to hospitalization rates among adults aged 65–74 years (284.2) (RR = 1.1; 95% CI = 1.0–1.2) (Supplementary Figure, https://stacks.cdc.gov/view/cdc/162443).

Full chart reviews were conducted for a random sample of 1,266 (86%) of 1,470 hospitalized infants; among these, 118 (9.4%) were newborns who received a positive SARS-CoV-2 test result during their birth hospitalization and were excluded from the analysis of clinical data. Among these 118 infants who received a positive test result during the birth hospitalization, 23 (18.3%) had COVID-19–related signs and symptoms recorded, compared with 1,071 (92.6%) of 1,148 infants hospitalized with COVID-19 during a nonbirth hospitalization (Supplementary Table 1, https://stacks.cdc.gov/view/cdc/162444).

Maternal COVID-19 Vaccination Status

Among 1,148 infants for whom the clinical course was assessed (Table), maternal vaccination status was available for 1,065 (92.6%). Among these infants, the mothers of 921 (87.5%) had no documentation of receipt of COVID-19 vaccination during pregnancy. The percentage of hospitalized infants whose mothers were vaccinated significantly decreased from 17.6% (132 of 745) during 2022–23 to 4.3% (12 of 320) during 2023–24 (p<0.001) (Figure 2). Infants whose mothers were vaccinated during pregnancy were older at hospitalization (median age = 109 days; IQR = 56–145 days) than were infants whose mothers had no record of vaccination during pregnancy (median age = 58 days; IQR = 28–114 days) (Supplementary Table 2, https://stacks.cdc.gov/view/cdc/162445). Among infants whose mothers' COVID-19 vaccination status was known, all who died in-hospital were born to mothers with no record of vaccination during pregnancy.

Characteristics of Infant COVID-19–Associated Hospitalizations

The median age at hospital admission for the 1,148 infants for whom clinical information was reviewed was 64 days (IQR = 28–121 days) (Table). A total of 260 (22.1%) infants were admitted to an intensive care unit (ICU), and nine (0.8%) died in hospital; 245 (21.4%) received high-flow nasal cannula or bilevel positive airway pressure/continuous positive airway pressure (BiPAP/CPAP) oxygen support, and 56 (4.8%) received mechanical ventilation. Approximately one quarter (290; 24.0%) of infants had one or more underlying medical condition; the most common conditions identified were prematurity*** (196; 17.1%), cardiovascular disease (74; 6.6%), chronic lung disease††† (58; 4.7%), and neurologic disorders (35; 3.3%). Among 999 (87.1%) hospitalized infants who were tested for additional viruses, at least one other virus was detected among 286 (29.7%), including 19.3% (175 of 979) who received a positive respiratory syncytial virus test result, 12.2% (64 of 521) who received a positive rhinovirus/

*** Prematurity was defined as gestational age at birth of <37 weeks.
††† For infants aged <6 months, chronic lung disease includes bronchopulmonary dysplasia and chronic lung disease of prematurity. Asthma or reactive airway disease are not included.

TABLE. Demographic characteristics, clinical outcomes, and maternal vaccination status among infants aged <6 months hospitalized with laboratory-confirmed SARS-CoV-2 infection* — COVID-19–Associated Hospitalization Surveillance Network, 12 states,† October 2022–April 2024

Characteristic	No.	Weighted %§ (95% CI)
Age		
Median age, days (IQR)	1,148	64 (28–121)
<1 mos	292	26.4 (23.5–29.5)
1–2 mos	404	34.5 (31.5–37.7)
3–5 mos	452	39.0 (35.9–42.3)
Sex		
Female	454	40.6 (37.3–43.9)
Male	694	59.4 (56.1–62.7)
Race and ethnicity¶		
Asian or Native Hawaiian or Pacific Islander	65	5.7 (4.2–7.4)
Black or African American	186	16.6 (14.1–19.3)
White	408	34.6 (31.6–37.8)
Hispanic or Latino	378	33.2 (30.1–36.4)
Other races	42	3.6 (2.5–5.0)
Unknown	69	6.3 (4.8–8.0)
Underlying conditions		
None	858	76.0 (73.2–78.6)
One or more underlying medical condition**	290	24.0 (21.4–26.8)
Prematurity (gestational age <37 wks)	196	17.1 (14.7–19.7)
Cardiovascular disease (including congenital heart disease)	74	6.6 (5.1–8.4)
Chronic lung disease††	58	4.7 (3.6–6.2)
Neurologic disorders	35	3.3 (2.2–4.9)
Feeding tube dependence	30	2.4 (1.6–3.5)
COVID-19–related signs and symptoms at admission§§	**1,071**	**92.6 (90.7–94.2)**
Hospitalization intervention/Outcome		
Length of hospital stay, days, median (IQR)	1,148	2 (1–3)
ICU admission	260	22.1 (19.5–24.8)
In-hospital death	9	0.8 (0.4–1.5)
Highest level of oxygen support received during hospitalization		
Supplemental oxygen	251	23.0 (20.1–26.1)
High flow nasal canula or BiPAP/CPAP	245	21.4 (18.8–24.2)
Invasive mechanical ventilation	56	4.8 (3.6–6.3)
Viral codetection¶¶		
Any viral codetection	286	29.7 (26.4–33.1)
RSV	175	19.3 (16.3–22.5)
Influenza	21	1.9 (1.2–3.0)
Rhinovirus/Enterovirus	64	12.2 (9.3–15.5)
Other viral detections	60	10.8 (8.3–13.9)

See table footnotes on the next page.

TABLE. (*Continued*) Demographic characteristics, clinical outcomes, and maternal vaccination status among infants aged <6 months hospitalized with laboratory-confirmed SARS-CoV-2 infection* — COVID-19–Associated Hospitalization Surveillance Network, 12 states,† October 2022–April 2024

Characteristic	No.	Weighted %§ (95% CI)
Maternal vaccination status* **		
No record of maternal vaccination during pregnancy	921	87.5 (85.3–89.5)
Mother vaccinated during pregnancy	144	12.5 (10.5–14.7)
First trimester	62	44.9 (36.1–54.0)
Second trimester	49	33.6 (25.6–42.4)
Third trimester	33	21.5 (15.1–29.1)

Abbreviations: BiPAP/CPAP = bilevel positive airway pressure/continuous positive airway pressure; ICU = intensive care unit; RSV = respiratory syncytial virus.

* Excluding birth hospitalizations. A birth hospitalization was defined as the hospitalization during which the infant was born.

† Selected counties in California, Colorado, Connecticut, Georgia, Maryland, Michigan, Minnesota, New Mexico, New York, Oregon, Tennessee, and Utah.

§ Data are from a weighted sample of hospitalized children with completed medical record abstractions. Sample sizes presented are unweighted with weighted percentages.

¶ Persons of Hispanic or Latino (Hispanic) origin might be of any race but are categorized as Hispanic; all racial groups are non-Hispanic. Persons of all other races include non-Hispanic American Indian or Alaska Native and multiracial persons. If ethnicity was unknown, non-Hispanic ethnicity was assumed.

** Defined as one or more of the following conditions: blood disorder, cardiovascular disease including congenital heart disease, chronic lung disease of prematurity/bronchopulmonary dysplasia, asthma/reactive airway disease or airway abnormality, chronic metabolic disease, gastrointestinal disease, genetic disorder, immunosuppressive condition, neurologic disorders, prematurity, renal disease, or other underlying condition.

†† For infants aged <6 months, chronic lung disease includes bronchopulmonary dysplasia and chronic lung disease of prematurity but does not include asthma or reactive airway disease.

§§ COVID-19–related signs and symptoms included respiratory conditions (congestion/runny nose, cough, nausea/vomiting, rash, seizures, shortness of breath/respiratory distress, upper respiratory infection, and wheezing) and non-respiratory conditions (apnea, conjunctivitis, cyanosis, decreased vocalization/stridor, dehydration, diarrhea, fever, hypothermia, inability to eat/poor feeding, and lethargy). Signs and symptoms data were abstracted from medical charts and might be incomplete.

¶¶ Results reported among infants who received testing (as opposed to all hospitalized infants). Because of differing testing practices, denominators differed among the viral respiratory pathogens: 999 infants for any additional virus; 979 infants for RSV, 992 for influenza (influenza A, influenza B, and influenza not subtyped), 521 for rhinovirus/enterovirus, and 523 for other viruses (adenovirus, human metapneumovirus, parainfluenza 1, parainfluenza 2, parainfluenza 3, parainfluenza 4, and other non–SARS-CoV-2 coronaviruses).

*** Maternal vaccination is defined as receipt of COVID-19 vaccine during the pregnancy of the infant hospitalized. A total of 83 (7.4%) infants had unknown maternal vaccination status and were excluded from maternal vaccination status. Proportions presented are calculated with those with known vaccination status (1,065) as the denominator.

enterovirus test result, and 1.9% (21 of 992) who received a positive influenza test result. Among 233 (89.8%) of 260 young infants admitted to an ICU who were tested for additional pathogens, an additional virus was detected among 97 (41.2%), including 56 (25.1%) with respiratory syncytial virus detected.

Summary

What is already known about this topic?

Infants aged <6 months have high COVID-19–associated hospitalization rates and are not age-eligible for COVID-19 vaccination.

What is added by this report?

COVID-19–associated hospitalization rates among infants aged <6 months remain higher than those among any other age group except adults aged ≥75 years and were comparable to hospitalization rates in adults aged 65–74 years. Among approximately 1,000 hospitalized infants with COVID-19, 22% were admitted to an intensive care unit, and nine died while hospitalized. The percentage of hospitalized infants whose mothers had been vaccinated during pregnancy was 18% during October 2022–September 2023 and decreased to <5% during October 2023–April 2024.

What are the implications for public health practice?

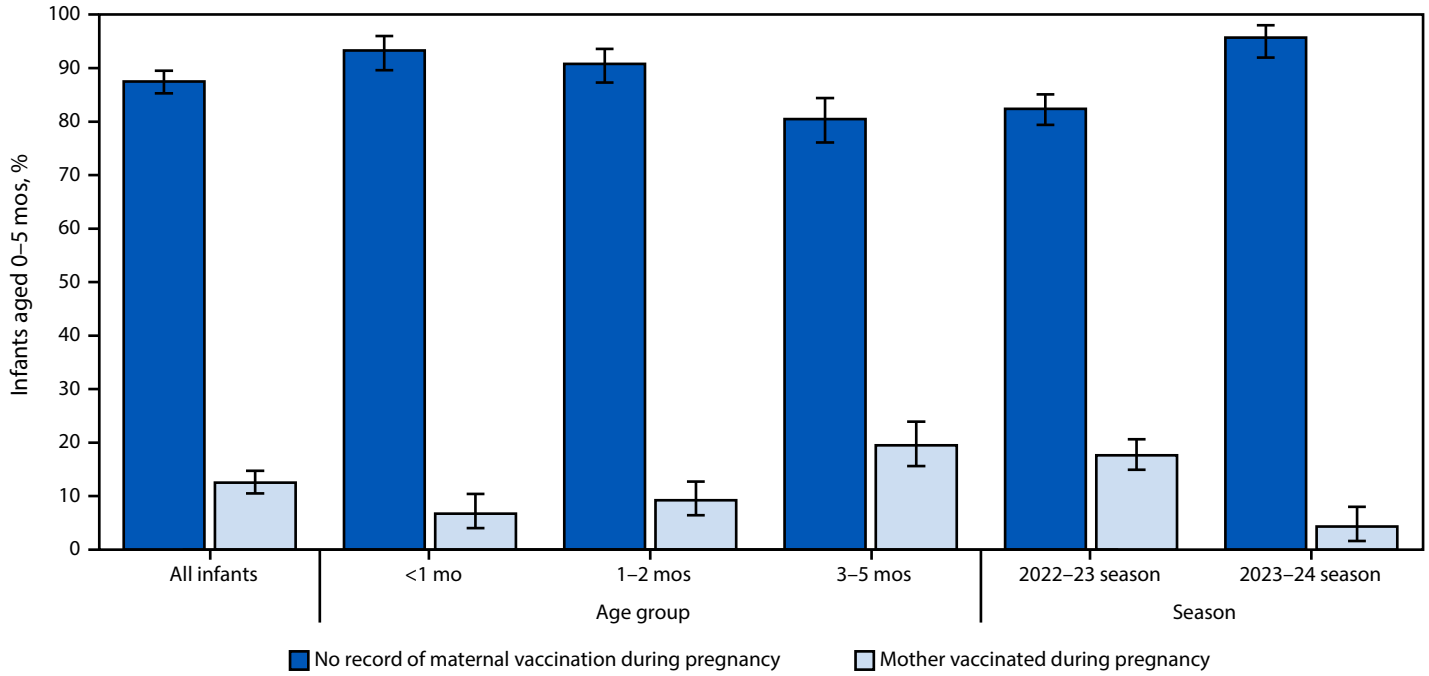
COVID-19 can cause severe disease in infants aged <6 months; prevention should focus on ensuring that pregnant persons receive recommended COVID-19 vaccines to protect themselves and their young infants.

Discussion

Infants aged <6 months represent one of the population groups most severely affected by COVID-19. During October 2023–April 2024, COVID-19 hospitalization rates among young infants were higher than rates among any other age group except adults aged ≥75 years and were comparable to hospitalization rates in adults aged 65–74 years. The percentage of infants hospitalized with COVID-19 whose mothers had been vaccinated during pregnancy decreased from 17.6% during October 2022–September 2023 to <5% during October 2023–April 2024. Outcomes among hospitalized infants were often serious; excluding birth hospitalizations, approximately one in five young infants hospitalized with COVID-19 required ICU admission, nearly one in 20 required mechanical ventilation, and nine infants died during their COVID-19–associated hospitalization.

Infants aged <6 months are too young to be vaccinated against COVID-19 and generally lack immunity acquired from previous SARS-CoV-2 exposure. To protect young infants from severe COVID-19–associated outcomes, prevention should focus on vaccination of pregnant persons, which protects infants through transplacental transfer of antibodies, and nonpharmaceutical interventions, such as hand hygiene and avoiding exposure to persons with respiratory illness signs and symptoms (*5*,*7*). Maternal vaccination during pregnancy has been shown to be safe and effective in protecting young infants from COVID-19 hospitalization (*3*–*5*); COVID-19 vaccination is recommended by CDC for all persons aged ≥6 months, including those who are pregnant (*8*,*9*). Findings from this

FIGURE 2. Maternal vaccination status among infants aged <6 months hospitalized with laboratory-confirmed SARS-CoV-2 infection,*,† by age group and season§ — COVID-19–Associated Hospitalization Surveillance Network, 12 states,¶ October 2022–April 2024



* Excluding birth hospitalizations. A birth hospitalization was defined as the hospitalization during which the infant was born.
† With 95% CIs indicated by error bars.
§ The 2022–23 season is defined as occurring during October 1, 2022–September 30, 2023, and the 2023–24 season is defined as occurring during October 1, 2023–April 30, 2024.
¶ Selected counties in California, Colorado, Connecticut, Georgia, Maryland, Michigan, Minnesota, New Mexico, New York, Oregon, Tennessee, and Utah.

analysis are consistent with other evidence demonstrating low COVID-19 vaccine coverage among pregnant persons (*5*), including a 2023 survey of pregnant persons that found that nearly one quarter (24.7%) received a COVID-19 vaccination during pregnancy (*10*). High rates of COVID-19–associated hospitalization among young infants reflect the ongoing vulnerability of this population to severe COVID-19–associated outcomes and indicate an urgent need to improve COVID-19 vaccination coverage among pregnant persons to protect vulnerable infants.

Limitations

The findings in this report are subject to at least four limitations. First, maternal vaccination information in immunization information systems might not be complete, and misclassification might have occurred. Second, population estimates for infants aged <6 months were not available; rates were calculated using 50% of the population of infants aged <1 year and might not be accurate. Third, COVID-NET relies on clinician-driven testing, and not all hospitalized infants might have been tested for SARS-CoV-2, which might result in underascertainment of COVID-19–associated hospitalizations. Finally, the COVID-NET catchment areas include approximately 10% of the U.S. population, and findings might not be nationally generalizable.

Implications for Public Health Practice

Infants aged <6 months, who are not yet eligible to receive COVID-19 vaccine, continue to be hospitalized for COVID-19 at higher rates than all age groups except adults aged ≥75 years and at rates comparable to hospitalization rates for adults aged 65–74 years, and severe outcomes were common. During the 2023–24 respiratory virus season, mothers of <5% of infants hospitalized for COVID-19 were vaccinated during pregnancy. To protect pregnant persons and infants too young to be vaccinated, and in the setting of low maternal COVID-19 vaccination coverage, prevention should focus on ensuring that pregnant persons receive recommended COVID-19 vaccines, as well as follow recommendations such as hand hygiene for COVID-19 prevention and newborn care.

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COVID-NET Surveillance Team

Darpun Sachdev, California Department of Public Health; Nisha Alden, Colorado Department of Public Health & Environment; Emily Zmek, Connecticut Emerging Infections Program, Yale School of Public Health; Lucy Witt, Division of Infectious Diseases, Emory University of Medicine, Georgia Emerging Infections Program; Maya L. Monroe, Maryland Department of Health; Elizabeth McCormick, Michigan Department of Health and Human Services; Paige D'Heilly, Minnesota Department of Health; Susan L. Ropp, New Mexico Department of Health; Kerianne Engesser, New York State Department of Health; Erin Licherdell, University of Rochester School of Medicine and Dentistry; Sam Hawkins, Public Health Division, Oregon Health Authority; William Schaffner, Vanderbilt University Medical Center; Holly Staten, Salt Lake County Health Department.

Corresponding author: Fiona P. Havers, fhavers@cdc.gov.

[1]Coronavirus and Other Respiratory Viruses Division, National Center for Immunization and Respiratory Diseases, CDC; [2]Eagle Health Analytics, Atlanta, Georgia; [3]California Emerging Infections Program, Oakland, California; [4]Career Epidemiology Field Officer Program, CDC; [5]Colorado Department of Public Health & Environment; [6]Connecticut Emerging Infections Program, Yale School of Public Health, New Haven, Connecticut; [7]Emory University School of Medicine, Atlanta, Georgia; [8]Georgia Emerging Infections Program, Georgia Department of Public Health; [9]Atlanta Veterans Affairs Medical Center, Decatur, Georgia; [10]Maryland Department of Health; [11]Michigan Department of Health and Human Services; [12]Minnesota Department of Health; [13]New Mexico Department of Health; [14]New York State Department of Health; [15]University of Rochester School of Medicine and Dentistry, Rochester, New York; [16]Public Health Division, Oregon Health Authority; [17]Vanderbilt University Medical Center, Nashville, Tennessee; [18]Salt Lake County Health Department, Salt Lake City, Utah.

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Maternal Respiratory Syncytial Virus Vaccination and Receipt of Respiratory Syncytial Virus Antibody (Nirsevimab) by Infants Aged <8 Months — United States, April 2024

Hilda Razzaghi, PhD[1]; Emma Garacci, MS[2]; Katherine E. Kahn, MPH[3]; Megan C. Lindley, MPH[1]; Jefferson M. Jones, MD[4]; Shannon Stokley, DrPH[1]; Kayla Calhoun, MS[1]; Carla L. Black, PhD[1]

Abstract

Respiratory syncytial virus (RSV) is the most common cause of hospitalization among U.S. infants. CDC recommends RSV vaccination for pregnant persons or administration of RSV antibody (nirsevimab) to infants aged <8 months to prevent RSV lower respiratory tract disease among infants. To determine maternal and infant RSV immunization coverage for the 2023–24 RSV season, CDC conducted an Internet panel survey during March 26–April 11, 2024. Among 678 women at 32–36 weeks' gestation during September 2023–January 2024, 32.6% reported receipt of an RSV vaccine any time during pregnancy. Among 866 women with an infant born during August 2023–March 2024, 44.6% reported receipt of nirsevimab by the infant. Overall, 55.8% of infants were protected by maternal RSV vaccine, nirsevimab, or both. Provider recommendation for maternal vaccination or infant nirsevimab was associated with higher immunization coverage, whereas lack of a provider recommendation was the main reason for not getting RSV immunization. The main reason for definitely or probably not getting nirsevimab for infants was concern about the long-term safety for the infant. Activities supporting providers to make RSV prevention recommendations and have informative conversations with patients might increase the proportion of infants protected against severe RSV disease. CDC and the American College of Obstetricians and Gynecologists have resources to assist providers in effectively communicating the importance of immunization.

Introduction

Respiratory syncytial virus (RSV) is the most common cause of hospitalization among U.S. infants, with the highest RSV-associated hospitalization incidence among infants aged <3 months (*1*). To protect all infants against RSV-associated lower respiratory tract disease, the Advisory Committee on Immunization Practices (ACIP) recommends a single lifetime dose of RSV vaccine for pregnant persons at 32–36 weeks' gestation using seasonal administration during September–January (*2*) or administration of nirsevimab, an RSV antibody, for infants aged <8 months born during or entering their first RSV season during October–March in most of the continental United States (*3*). For most infants, both products are not needed except in rare circumstances (*2*). The 2023–24 RSV season was the first season during which maternal RSV vaccination and nirsevimab for infants were recommended for prevention of severe infant RSV disease. This report provides estimates of RSV maternal vaccination coverage, receipt of nirsevimab by infants, and proportion of infants protected by either product in the United States during the 2023–24 RSV season (*4*).

Methods

Data Source and Study Participants

CDC conducted an Internet panel* survey during March 26–April 11, 2024, to determine end-of-season influenza vaccination coverage among pregnant women, as previously described (*5*). Questions about maternal RSV vaccination and nirsevimab administration for infants were included. Women aged 18–49 years who reported being pregnant at any time since August 1, 2023, were eligible for the survey. Among 2,473 eligible women, 2,266 (91.6%)† completed the survey. The final analytic sample included 2,263 currently and recently pregnant women. Data were weighted to reflect pregnancy status and outcome at the time of survey completion, age, race and ethnicity, and geographic distribution of the total U.S. population of pregnant women.

Data Analysis

Analysis of RSV vaccination coverage among pregnant and recently pregnant women was limited to 678 women who were 32–36 gestational weeks' pregnant any time during September 1, 2023–January 31, 2024. Women who reported receipt of RSV vaccine during pregnancy were considered vaccinated regardless of timing of vaccination. Analysis of nirsevimab coverage among infants as well as proportion of infants protected by either maternal or infant immunization

* Pregnant women were recruited from a large, preexisting, opt-in Internet panel of the general population, operated by Dynata. https://www.dynata.com/wp-content/uploads/2024/01/Dynata_Panel_Book.pdf

† A survey response rate requires specification of the denominator at each stage of sampling. During recruitment of an online opt-in survey sample, such as the Internet panels described in this report, these numbers are not available; therefore, a response rate cannot be calculated. Instead, the survey completion rate is provided.

was evaluated among 866[§] women who had a live birth during August 1, 2023–March 31, 2024, whose infants would have been eligible to receive nirsevimab during October 1, 2023–March 31, 2024. Infants were considered protected against severe RSV disease if mothers reported either receipt of maternal RSV vaccination or receipt of nirsevimab by the infant. The analysis of immunization preference for maternal RSV vaccine or infant nirsevimab included 2,023 currently pregnant and recently pregnant women who had a live birth.

SAS (version 9.4, SAS institute) and SAS-callable SUDAAN software (version 11.0.4; RTI International) were used to conduct all analyses. Weighted proportions and corresponding 95% CIs for maternal and infant RSV immunization coverage were estimated overall and by selected demographic characteristics. Differences among groups were determined using *t*-tests, with p-values <0.05 considered statistically significant. This activity was reviewed by CDC, deemed research not involving human subjects, and was conducted consistent with applicable federal law and CDC policy.[¶]

Results

Maternal RSV Vaccination Coverage

Among 678 eligible women, maternal RSV vaccination coverage was 32.6% overall and was significantly higher among those with private or military insurance (38.9%) than among those with public insurance (28.0%); those living at or above poverty (35.0%) compared with those living below poverty (26.4%); those with higher than a college degree (50.1%) than among those with a college degree or less (28.7%–32.7%); and among those who received a provider recommendation for either maternal or infant RSV immunization (56.7%) than among those who received no recommendation (1.9%) (Table 1). The majority of vaccinated women (54.1%) reported receiving the vaccine at an obstetrician or gynecologist's office.

Infant Nirsevimab Coverage

Among 866 women with a live birth, infant coverage with nirsevimab was 44.6% overall and was significantly higher among infants whose mothers were employed (48.5%) than among those whose mothers were unemployed (38.7%) and among those who received a provider recommendation for either maternal or infant RSV immunization (58.7%) than among those who did not receive a recommendation (28.3%). Overall, 55.8% of infants were protected by either maternal RSV vaccination, nirsevimab, or both; 14.2% of infants were protected by both.

Reasons for Nonvaccination

The most frequently reported main reasons for nonreceipt of maternal RSV vaccination were 1) not receiving a recommendation for vaccination from a doctor, nurse, or other medical professional (16.9%); 2) not knowing that RSV vaccination was needed during pregnancy (15.0%); and 3) having concerns about possible safety risks to the infant (12.0%) (Figure).

[§] Among the 866 women, 20 reported multiple births, but these were considered a single infant in the analysis.

[¶] 45 C.F.R. part 46; 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

TABLE 1. Respiratory syncytial virus vaccination and respiratory syncytial virus antibody (nirsevimab) coverage among pregnant women and their infants, by selected characteristics — Internet panel survey, United States, April 2024

Characteristic	Maternal RSV vaccination*		Receipt of nirsevimab by infant†		Maternal RSV vaccination or receipt of nirsevimab by infant§	
	Total no. (weighted %)[¶]	Weighted % vaccinated (95% CI)**	Total no. (weighted %)[¶]	Weighted % vaccinated (95% CI)**	Total no. (weighted %)[¶]	Weighted % vaccinated (95% CI)**
Overall	**678**	**32.6 (28.8–36.6)**	**866**	**44.6 (40.9–48.3)**	**866**	**55.8 (52.1–59.6)**
Maternal age group, yrs						
35–49 (Ref)	**181 (17.6)**	37.4 (29.8–45.5)	**257 (20.6)**	48.4 (41.8–55.2)	**257 (20.6)**	61.3 (54.5–67.7)
25–34	**378 (60.8)**	28.9 (24.1–34.1)	**466 (58.9)**	42.5 (37.6–47.6)	**466 (58.9)**	54.0 (48.9–59.0)
18–24	**119 (21.5)**	39.1 (29.7–49.2)	**143 (20.5)**	46.5 (37.5–55.7)	**143 (20.5)**	55.8 (46.6–64.8)
Race and ethnicity††						
Black or African American	**110 (14.5)**	36.4 (26.6–47.0)	**129 (14.0)**	51.1 (41.4–60.7)	**129 (14.0)**	56.5 (46.8–65.9)
White (Ref)	**396 (49.5)**	33.8 (28.8–39.0)	**524 (51.2)**	44.2 (39.7–48.8)	**524 (51.2)**	57.8 (53.2–62.3)
Hispanic or Latino	**121 (26.5)**	29.3 (21.2–38.6)	**147 (25.7)**	43.9 (35.1–53.0)	**147 (25.7)**	53.7 (44.7–62.6)
Other	**51 (9.4)**	29.9 (16.5–46.3)	**66 (9.1)**	38.5 (25.9–52.3)	**66 (9.1)**	50.0 (35.7–64.2)
Maternal education						
Higher than college degree (Ref)	**86 (10.6)**	50.1 (38.1–62.0)	**112 (11.3)**	37.2 (27.8–47.5)	**112 (11.3)**	63.4 (53.0–72.8)
College degree	**234 (33.6)**	32.7 (26.2–39.7)§§	**302 (33.8)**	46.2 (39.9–52.5)	**302 (33.8)**	55.9 (49.5–62.1)
Some college, no degree	**169 (23.2)**	30.0 (22.9–38.0)§§	**220 (24.6)**	45.3 (38.0–52.7)	**220 (24.6)**	55.2 (47.7–62.6)
High school diploma or less	**189 (32.6)**	28.7 (21.8–36.4)§§	**232 (30.4)**	45.0 (37.7–52.4)	**232 (30.4)**	53.5 (46.0–60.9)
Maternal employment status						
Employed (Ref)	**410 (59.1)**	35.7 (30.7–40.9)	**531 (59.8)**	48.5 (43.8–53.2)	**531 (59.8)**	60.1 (55.3–64.7)
Unemployed	**268 (40.9)**	28.2 (22.2–34.7)	**335 (40.2)**	38.7 (32.9–44.8)§§	**335 (40.2)**	49.6 (43.5–55.7)§§

See table footnotes on the next page.

TABLE 1. (*Continued*) Respiratory syncytial virus vaccination and respiratory syncytial virus antibody (nirsevimab) coverage among pregnant women and their infants, by selected characteristics — Internet panel survey, United States, April 2024

Characteristic	Maternal RSV vaccination*		Receipt of nirsevimab by infant†		Maternal RSV vaccination or receipt of nirsevimab by infant§	
	Total no. (weighted %)¶	Weighted % vaccinated (95% CI)**	Total no. (weighted %)¶	Weighted % vaccinated (95% CI)**	Total no. (weighted %)¶	Weighted % vaccinated (95% CI)**
Poverty status¶¶						
At or above poverty (Ref)	**496 (72.1)**	35.0 (30.4–39.8)	**647 (73.3)**	44.5 (40.2–48.8)	**647 (73.3)**	57.3 (53.0–61.6)
Below poverty	**182 (27.9)**	26.4 (19.8–33.9)§§	**219 (26.7)**	44.7 (37.4–52.2)	**219 (26.7)**	51.7 (44.2–59.3)
Area of residence* **						
Nonrural (Ref)	**536 (79.7)**	33.1 (28.8–37.7)	**693 (81.2)**	44.7 (40.6–48.9)	**693 (81.2)**	56.2 (52.0–60.4)
Rural	**142 (20.3)**	30.5 (22.4–39.7)	**173 (18.8)**	43.9 (35.8–52.3)	**173 (18.8)**	54.3 (45.7–62.7)
Region†††						
Northeast (Ref)	**86 (15.1)**	38.6 (27.4–50.8)	**116 (15.9)**	44.0 (34.2–54.2)	**116 (15.9)**	54.3 (44.1–64.3)
Midwest	**163 (19.5)**	36.8 (29.0–45.2)	**212 (20.2)**	48.7 (41.2–56.1)	**212 (20.2)**	61.2 (53.6–68.3)
South	**299 (40.3)**	29.9 (24.3–35.9)	**379 (40.5)**	47.4 (41.8–53.0)	**379 (40.5)**	56.5 (50.9–62.0)
West	**130 (25.0)**	30.1 (21.9–39.3)	**159 (23.5)**	36.6 (28.5–45.2)	**159 (23.5)**	51.2 (42.3–60.1)
Prenatal insurance coverage§§§						
Private or military insurance only (Ref)	**313 (41.7)**	38.9 (32.9–45.1)	**417 (45.1)**	43.1 (37.9–48.4)	**417 (45.1)**	58.9 (53.6–64.1)
Any public insurance	**339 (53.8)**	28.0 (22.9–33.6)§§	**418 (50.9)**	46.9 (41.6–52.3)	**418 (50.9)**	53.7 (48.3–59.1)
No insurance	**26 (4.4)**	—¶¶¶	**31 (4.0)**	—¶¶¶	**31 (4.0)**	—¶¶¶
Provider recommendation of RSV vaccination or nirsevimab administration****						
Recommendation (Ref)	**388 (56.0)**	56.7 (51.1–62.2)	**469 (53.5)**	58.7 (53.6–63.7)	**469 (53.5)**	79.2 (74.6–83.3)
No recommendation	**290 (44.0)**	1.9 (0.6–4.4)§§	**397 (46.5)**	28.3 (23.5–33.5)§§	**397 (46.5)**	29.0 (24.2–34.2)§§
Timing of maternal RSV vaccination††††						
Before 32 weeks' gestation	**69 (29.7)**	NA	**NA**	NA	**NA**	NA
32–36 weeks' gestation	**134 (58.4)**	NA	**NA**	NA	**NA**	NA
After 36 weeks' gestation	**28 (11.9)**	NA	**NA**	NA	**NA**	NA
Place of maternal RSV vaccination						
Obstetrician, gynecologist, or midwife's office	**124 (54.1)**	NA	**NA**	NA	**NA**	NA
Family physician or other physician's office	**23 (9.7)**	NA	**NA**	NA	**NA**	NA
Health department clinic	**14 (4.9)**	NA	**NA**	NA	**NA**	NA
Hospital	**28 (13.1)**	NA	**NA**	NA	**NA**	NA
Store (supermarket, drug store, or pharmacy)	**41 (18.0)**	NA	**NA**	NA	**NA**	NA
At work	—§§§§ **(0.2)**	NA	**NA**	NA	**NA**	NA

Abbreviations: NA = not applicable; Ref = referent group; RSV = respiratory syncytial virus.

* Respondents 32–36 gestational weeks pregnant any time during September 1, 2023–January 31, 2024, were included in the analyses. Women who reported receipt of an RSV vaccination any time during their pregnancy were considered immunized.

† Infants born to survey participants during August 2023–March 2024 were included in the analysis. Infants with reported nirsevimab receipt were considered immunized. Although nirsevimab is indicated for infants aged <8 months during October 1–March 31, and thus born during February 2023–March 2024, the survey sample was based on influenza vaccination recommendations and only includes women whose pregnancy began August 1, 2023, or later.

§ Infants born to survey participants during August 2023–March 2024 were included in the analysis. Infants with reported nirsevimab receipt, or those born to women 32–36 weeks pregnant at any time during September 2023–January 2024 who reported receiving an RSV vaccination any time during their pregnancy, were considered immunized.

¶ The total unweighted number and weighted proportion of respondents in the sample.

** Modified Clopper-Pearson 95% CI according to the approach of Korn and Graubard. https://www150.statcan.gc.ca/n1/en/pub/12-001-x/1998002/article/4356-eng.pdf?st = nQVSWv1i

†† Race and ethnicity were self-reported. Respondents identifying as Hispanic or Latino might be of any race. The "Other" race category included Asian, American Indian or Alaska Native, Native Hawaiian or Pacific Islander, and women who selected multiple races.

§§ Statistically significant difference compared with Ref.

¶¶ Poverty status was defined based on the reported number of persons living in the household and annual household income, according to U.S. Census Bureau poverty thresholds. https://www.census.gov/data/tables/time-series/demo/income-poverty/historical-poverty-thresholds.html

*** Rurality was defined using zip codes areas in which >50% of the population lives in a nonmetropolitan county, a rural U.S. Census Bureau tract, or both, according to the Health Resources and Services Administration's definition of rural population. https://www.hrsa.gov/rural-health/about-us/definition/index.html

††† https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf

§§§ Respondents pregnant on their survey date were asked what medical insurance or medical care coverage they had; respondents who had already delivered were asked what coverage they had during their most recent pregnancy. Women considered to have public insurance selected at least one of the following options: Medicaid, Medicare, state-sponsored medical plan, or other government plan. Respondents considered to have private or military insurance selected private medical insurance, military medical care, or both and did not select any type of public insurance.

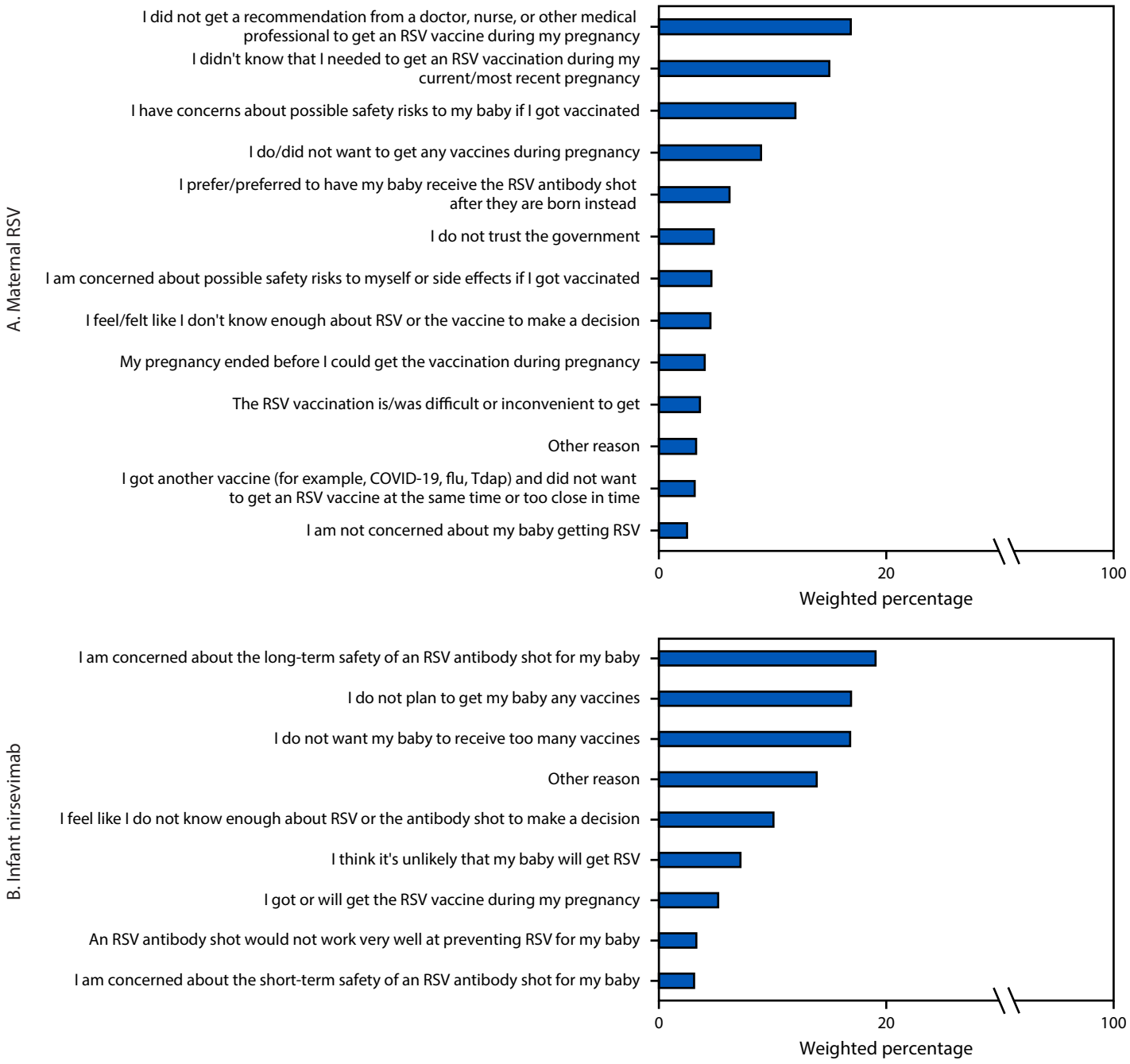
¶¶¶ Estimates do not meet the National Center for Health Statistics' standards of reliability. https://www.cdc.gov/nchs/data/series/sr_02/sr02_175.pdf

**** Respondents were asked, "During your current/most recent pregnancy, did any doctor, nurse, or other medical professional recommend that you get an RSV vaccination or that your baby receive an RSV antibody shot?"

†††† Among the 678 eligible pregnant women, 446 did not report receiving an RSV vaccine; one reported receipt of an RSV vaccine but not when the vaccine was received.

§§§§ Suppressed to avoid risk of disclosure.

FIGURE. Main reason for not receiving respiratory syncytial virus vaccine among unvaccinated pregnant or recently pregnant women (N = 433) (A)* and probably or definitely not receiving respiratory syncytial virus antibody (nirsevimab) for unprotected infants (N = 240) (B)†,§ — Internet panel survey, United States, April 2024



Abbreviations: RSV = respiratory syncytial virus; Tdap = tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccine.

* Currently or recently pregnant women with a live birth who were 32–36 gestational weeks pregnant any time during September 1, 2023–January 31, 2024, and were not vaccinated against RSV during their pregnancy, were asked to select from a list of reasons for not receiving a maternal RSV vaccine (among the 446 unvaccinated women, 11 recently pregnant women who did not report a live birth were not asked the question, and two did not respond to the question, leaving a sample size of 433). Respondents who selected more than one reason were asked to select the main reason. Reasons reported by <2% of respondents are not shown.

† Currently pregnant women who were not vaccinated against RSV, and recently pregnant women with a live birth, who reported their infants had not received nirsevimab and would "definitely" or "probably" not receive nirsevimab were asked to select from a list of reasons why their infant would "definitely" or "probably" not receive nirservimab. Respondents who selected more than one reason were asked to select the main reason. Reasons reported by <2% of respondents are not shown.

§ Estimates for the responses "An RSV antibody shot would not work very well at preventing RSV for my baby" and "I am concerned about the short-term safety of an RSV antibody shot for my baby" do not meet the National Center for Health Statistics' standards of reliability and should be interpreted with caution. https://www.cdc.gov/nchs/data/series/sr_02/sr02_175.pdf

Among unvaccinated pregnant and recently pregnant women with a live birth whose infant did not receive nirsevimab, the main reasons for definitely or probably not getting nirsevimab for their infants included 1) concerns about the long-term safety of nirsevimab for the infant (19.1%); 2) not planning to get the infant any vaccines (16.9%); and 3) not wanting the infant to receive too many vaccines (16.8%) (Figure).

Maternal Product Preference

In determining product preference, 38.1% of respondents preferred to receive an RSV vaccine during pregnancy, 27.8% preferred nirsevimab for their infant, 21.3% had no preference, and 12.8% would not get the maternal RSV vaccine or nirsevimab for their infant (Table 2). Among those who preferred the maternal RSV vaccine, 47.8% believed that maternal vaccination would be safer, 30.2% were worried about their infant getting too many shots, and 30% believed that maternal vaccination would be more effective. Among those who preferred nirsevimab for their infant, 43.6% believed that it would be more effective, and 32.4% believed that it would be safer.

TABLE 2. Maternal preference for immunization by maternal respiratory syncytial virus vaccination or infant respiratory syncytial virus antibody (nirsevimab) among pregnant and recently pregnant women with a live birth,* and reasons for reported preference† (N = 2,023) — Internet panel survey, United States, April 2024

Preference/Reason	No.	Weighted % (95% CI)§
Maternal RSV vaccination during pregnancy	782	38.1 (35.7–40.5)
I believe it will be safer	373	47.8 (43.8–51.9)
I believe it will be more effective	234	30.0 (26.4–33.8)
I am worried the antibody shot will not be available for my baby	105	12.4 (9.9–15.2)
I am worried the antibody shot will cost too much or not be covered by insurance	37	4.9 (3.3–6.9)
I am worried about my baby getting too many shots	225	30.2 (26.6–34.0)
I do not have enough information about the RSV antibody shot	127	16.1 (13.3–19.2)
Other reason	51	5.8 (4.2–7.8)
RSV antibody shot for infant§	576	27.8 (25.7–30.1)
I believe it will be safer	188	32.4 (28.0–36.9)
I believe it will be more effective	258	43.6 (39.0–48.3)
I am worried the vaccination will not be available during my pregnancy	46	7.5 (5.3–10.2)
I am worried the vaccination will cost too much or not be covered by insurance	41	7.3 (5.0–10.2)
I am worried about getting too many shots during my pregnancy	126	23.0 (19.1–27.3)
I do not have enough information about the RSV vaccination during pregnancy	108	18.8 (15.4–22.6)
Other reason	44	7.7 (5.5–10.5)
No preference	419	21.3 (19.3–23.4)
I would not get an RSV vaccination for myself or the RSV antibody shot for my baby	246	12.8 (11.1–14.5)

Abbreviation: RSV = respiratory syncytial virus.
* Currently and recently pregnant women with a live birth were asked the questions on preference.
† Respondents could select more than one reason.
§ Modified Clopper-Pearson 95% CI according to the approach of Korn and Graubard. https://www150.statcan.gc.ca/n1/en/pub/12-001-x/1998002/article/4356-eng.pdf?st=nQVSWv1i.

Discussion

This survey found that during the first season in which new immunization products were recommended to prevent RSV disease among infants, maternal RSV vaccination coverage among eligible pregnant women was 32.6%, and nirsevimab coverage among infants was 44.6%; 55.8% of infants were protected by either or both products. Receipt of a provider recommendation was strongly associated with both maternal and infant immunization.

Multiple challenges in rolling out the new immunization products might have resulted in lower than anticipated coverage. These challenges included timing of recommendations and product availability, differing recommendations in terms of timing of vaccine and nirsevimab administration, complex clinical considerations and nuanced communications, limited time to improve awareness of the new recommendations for both health care providers and pregnant women, cost and reimbursement issues, access issues, and concerns about safety and efficacy of the products (*6*). In addition, nirsevimab availability was limited during the 2023–24 RSV season, creating challenges in accessing maternal RSV vaccine that included cost and reimbursement and lack of supply at many obstetrics and gynecology offices (*6*,*7*). RSV immunization is most likely to prevent and decrease the risk for severe RSV disease when administered shortly before or at the beginning of the RSV season, but the limited availability of RSV products, particularly before the start and during the early months of the RSV season likely limited the effect of immunization during the 2023–24 season (*8*). Complexities in the RSV prevention recommendations, including the timing of vaccination of pregnant women and the recommendation for infant nirsevimab based on maternal RSV vaccination status, as well as the need for coordination of maternal and infant preventive care might also have contributed to an estimated 14.2% of infants reported to have received both nirsevimab and maternal RSV antibody protection, which is not indicated for most infants.

As observed for other immunizations, both receipt of maternal RSV vaccine and nirsevimab for infants was higher among those who received a provider recommendation for either product (*5*). Approximately one half of pregnant women did not report receiving a provider recommendation for maternal RSV vaccination or nirsevimab for their infants, indicating missed opportunities to protect infants from severe RSV disease. These findings further underscore the importance of a strong provider recommendation for immunization.

Summary

What is already known about this topic?

Respiratory syncytial virus (RSV) is the most common cause of hospitalization among U.S. infants. Receipt of either a maternal RSV vaccine or administration of RSV antibody (nirsevimab) to infants was first recommended during the 2023–24 RSV season.

What is added by this report?

In a CDC survey, 33% of eligible pregnant women reported receiving an RSV vaccination. Among women with a live birth, 45% reported that their infant received nirsevimab. Overall, 56% of infants were protected against severe RSV disease by either product or both. Provider recommendation for immunization was associated with higher coverage.

What are the implications for public health practice?

Enhanced measures to implement provider RSV immunization recommendations are needed to protect infants from severe RSV disease.

Limitations

The findings in this report are subject to at least five limitations. First, this study consisted of a nonprobability sample, and results might not be generalizable to all pregnant women in the United States. Some self-selection bias or bias due to exclusion of women with no Internet access might have occurred. Second, maternal and infant immunization status was self-reported and might be subject to recall or social desirability bias. Maternal vaccination coverage estimates based on data from this survey were higher than were those based on electronic health record data from eight sites participating in the Vaccine Safety Datalink (VSD).** However, because VSD did not require continuous enrollment in the participating health care organizations for the duration of the pregnancy, recording of the vaccination status in VSD might have been incomplete, and the population served by the VSD sites might not be representative of the U.S. population of pregnant women (*9*,*10*). Nirsevimab coverage among infants in this study was similar to estimated coverage from the National Immunization Survey.†† Third, because of small sample sizes, immunization coverage could not be evaluated separately among some racial and ethnic groups. Fourth, statistical tests based on the assumption of probability were used to ascertain differences in immunization coverage among groups in this nonprobability sample. Finally, the survey sample is limited to infants born during August 2023–March 2024, and thus does not include all infants who would have been eligible for nirsevimab (i.e., those born during February 2023–March 2024).

** https://www.cdc.gov/rsvvaxview/dashboard/2023-24-pregnant-persons-coverage.html

†† https://www.cdc.gov/rsvvaxview/dashboard/2023-24-nirsevimab-coverage-infants.html

Implications for Public Health Practice

Recommendations from health care providers are critical to improving RSV immunization coverage for both pregnant women and their infants and reducing severe RSV disease among infants. CDC has resources to assist providers in effectively communicating the importance of vaccination, such as sharing specific reasons that recommended vaccines are right for the patient and highlighting positive personal or clinical experiences with vaccines.§§ In addition, the American College of Obstetricians and Gynecologists has an immunization toolkit¶¶ that includes communication strategies for providers. Expanded measures to implement RSV immunization recommendations are needed to protect infants from severe RSV disease.

§§ https://www.cdc.gov/vaccines-adults/hcp/imz-standards/

¶¶ https://www.acog.org/programs/immunization-for-women/physician-tools

Corresponding author: Hilda Razzaghi, HRazzaghi@cdc.gov.

[1]Immunization Services Division, National Center for Immunization and Respiratory Diseases, CDC; [2]Cherokee Nation Operational Solutions, Tulsa, Oklahoma; [3]Eagle Health Analytics, Atlanta, Georgia; [4]Coronavirus and Other Respiratory Viruses Division, National Center for Immunization and Respiratory Diseases, CDC.

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Decline in Vaccination Coverage by Age 24 Months and Vaccination Inequities Among Children Born in 2020 and 2021 — National Immunization Survey-Child, United States, 2021–2023

Holly A. Hill, MD, PhD[1]; David Yankey, PhD[1]; Laurie D. Elam-Evans, PhD[1]; Yi Mu, PhD[1]; Michael Chen, PhD[1]; Georgina Peacock, MD[1]; James A. Singleton, PhD[1]

Abstract

Data from the National Immunization Survey-Child (NIS-Child) were analyzed to estimate coverage with childhood vaccines recommended by the Advisory Committee on Immunization Practices among U.S. children by age 24 months. Coverage with nearly all vaccines was lower among children born in 2020 and 2021 than it was among those born in 2018 and 2019, with declines ranging from 1.3 to 7.8 percentage points. Analyses of NIS-Child data for earlier birth cohorts have not revealed such widespread declines in routine childhood vaccination coverage. Coverage among children born during 2020–2021 varied by race and ethnicity, health insurance status, poverty status, urbanicity, and jurisdiction. Compared with non-Hispanic White children, coverage with four of the 17 vaccine measures was lower among non-Hispanic Black or African American children as well as Hispanic or Latino (Hispanic) and non-Hispanic American Indian or Alaska Native children. Coverage was also generally lower among those covered by Medicaid or other nonprivate insurance, uninsured children, children living below the federal poverty level, and children living in rural areas. Coverage varied widely by jurisdiction, especially coverage with ≥2 doses of influenza vaccine. Children born during 2020–2021 were born during or after the period of major disruption of primary care from the COVID-19 pandemic. Providers should review children's histories and recommend needed vaccinations during every clinical encounter. Addressing financial barriers, access issues, vaccine hesitancy, and vaccine-related misinformation can also help to increase coverage, reduce disparities, and protect all children from vaccine-preventable diseases. Strategies that have been found effective include implementation of standing orders and reminder and recall systems, strong physician recommendations to vaccinate, and use of immunization information systems to identify areas of lower coverage that could benefit from targeted interventions to increase immunization rates.

Introduction

The Vaccine National Strategic Plan* has as its vision the elimination of vaccine-preventable diseases from the United States through safe and effective vaccination. The Advisory Committee on Immunization Practices (ACIP) currently recommends routine vaccination against 15 potentially serious illnesses for children by age 24 months (*1*). Since 1994, the National Immunization Survey-Child (NIS-Child) has monitored coverage with ACIP-recommended childhood vaccines.† NIS-Child data are used to calculate annual vaccination coverage estimates at the national and state levels, with additional estimates for some local areas (e.g., cities and counties) and three U.S. territories (Guam, Puerto Rico, and the U.S. Virgin Islands).§ This report assesses trends in vaccination coverage by year of birth and disparities in coverage by sociodemographic characteristics. In addition, this report provides a first look at children born in 2021 (during the COVID-19 pandemic) and reaching age 24 months toward or after the end of the COVID-19 public health emergency.

Methods

Data Collection

NIS-Child uses random-digit–dialing to identify U.S. households that include a child aged 19–35 months, and interviews are conducted via mobile telephone¶ with the parent or guardian (parent) most knowledgeable about the child's vaccination history. With parental consent, a questionnaire is mailed to each of the child's vaccine providers to obtain detailed information about vaccines received since birth. Provider-reported data are then synthesized to create a comprehensive vaccination history for each child. For the most recent survey

* https://www.hhs.gov/sites/default/files/HHS-Vaccines-Report.pdf

† Additional information about the National Immunization Surveys is available at https://www.cdc.gov/nis/about/index.html. Vaccination against COVID-19 was recommended for children aged 6 months–4 years in June 2022 (https://www.cdc.gov/acip-recs/hcp/vaccine-specific/covid-19.html). Because the recommendation was not in effect until midway through the 2022 data collection year, an accurate estimate of COVID-19 vaccine coverage cannot be calculated from the current NIS-Child data.

§ Vaccination coverage is calculated nationally and for U.S. Department of Health and Human Services regions, states, selected local areas, and the U.S. territories of Guam, Puerto Rico, and the U.S. Virgin Islands. Certain local areas that receive federal Section 317 vaccination funds are sampled separately and included in the NIS-Child sample every year (Chicago, Illinois; New York, New York; Philadelphia County, Pennsylvania; Bexar County, Texas; and Houston, Texas). National estimates in this report exclude U.S. territories.

¶ NIS-Child used a landline-only sampling frame during 1995–2010. During 2011–2017, the survey was conducted using a dual-frame design, with both mobile and landline sampling frames included. In 2018, NIS-Child returned to a single-frame design, with all interviews conducted by mobile telephone.

year (children identified in 2023), the household interview response rate** was 27.0%, and adequate provider data†† were available for 48.1% of children with completed interviews. Children born during 2020–2021 were identified using data collected during 2021–2023; a total of 28,688 subjects were available for analysis.

Data Analysis

All coverage estimates in this report are based upon information supplied by vaccination providers. Data were analyzed by birth cohort (year of birth), and for most vaccines, Kaplan-Meier techniques were used to estimate coverage by age 24 months. Exceptions include the birth dose of hepatitis B vaccine (HepB), assessed during the first 3 days of life, and the rotavirus vaccine series, which should be completed by age 8 months. Because of a change in ACIP recommendations in 2020 and a long period of eligibility for catch-up vaccination, coverage with ≥2 doses of hepatitis A vaccine (HepA) was estimated by age 35 months (the maximum age within the scope of NIS-Child data collection) as well as by age 24 months.§§ Differences in coverage estimates were evaluated using z-tests at an α-level of 0.05. Nationally and by jurisdiction, estimated coverage among children born in 2020 and 2021 was compared with estimated coverage among children born in 2018 and 2019. For data stratified by sociodemographic characteristics, subgroup estimates were compared with those for a designated referent group. Analyses used weighted data and were performed using SAS software (version 9.4; SAS Institute) and SUDAAN software (version 11; RTI International). This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy.¶¶

Results

Recent Trends in National Vaccination Coverage by Birth Year

Estimated coverage with all recommended childhood vaccines was lower among children born in 2020 and 2021 than among those born in 2018 and 2019, except for the HepB birth dose and ≥2 doses of HepA (Table 1). Most decreases ranged from 1.3 percentage points for ≥1 dose of varicella vaccine to 3.2 percentage points for the full series of *Haemophilus influenzae* type b conjugate vaccine (Hib) and the combined seven-vaccine series,*** with a larger (7.8 percentage point) drop in coverage with ≥2 doses of influenza vaccine. Longer term trends by single-year birth cohort reveal decreases in coverage with ≥2 doses of influenza vaccine from the 2019 to 2020 birth cohort and from the 2020 to 2021 birth cohort (Supplementary Figure, https://stacks.cdc.gov/view/cdc/162212). Aside from declines in influenza vaccine coverage, the largest observed declines in coverage were for those vaccines and vaccine doses with recommended series completion during the second year of life (i.e., the fourth dose of diphtheria and tetanus toxoids, and acellular pertussis vaccine [DTaP], the final dose in the full Hib series, and the fourth dose of pneumococcal conjugate vaccine [PCV]). Despite the decreases, coverage with several vaccines remained above 90%, including poliovirus vaccine (91.9%); ≥1 dose of measles, mumps, and rubella vaccine (MMR) (90.3%); and ≥3 doses of HepB (91.1%) (Table 1). The lowest estimated coverage was with ≥2 doses of HepA by 24 months (46.0%), and ≥2 doses of influenza vaccine (55.6%). The percentage of children who received no vaccinations by age 24 months remained low (1.2%).

Vaccination Coverage by Selected Sociodemographic Characteristics and Jurisdictions

Disparities in coverage by race and ethnicity were observed among children born during 2020–2021 (Table 2). Coverage with ≥4 doses of DTaP, ≥4 doses of PCV, rotavirus vaccine, and the combined seven-vaccine series was lower among non-Hispanic Black or African American (Black) children, Hispanic or Latino (Hispanic) children, and non-Hispanic American Indian or Alaska Native (AI/AN) children than among non-Hispanic White (White) children. Compared with coverage among White children, coverage with ≥2 doses of influenza vaccine was lower among Black and Hispanic children but higher among non-Hispanic Asian children.

** The Council of American Survey Research Organizations (CASRO) household response rate is calculated as the product of the resolution rate (percentage of the total telephone numbers called that were classified as nonworking, nonresidential, or residential), screening completion rate (percentage of known households that were successfully screened for the presence of age-eligible children), and the interview completion rate (percentage of households with one or more age-eligible children that completed the household survey). CASRO response rates and the proportions of children with household interviews that had adequate provider data for survey years 2015–2022 are available at https://www.cdc.gov/vaccines/imz-managers/nis/downloads/NIS-PUF22-DUG.pdf.

†† Children with at least one vaccination reported by a provider and those who had received no vaccinations were considered to have adequate provider data. "No vaccinations" indicates that the vaccination status is known because the parent indicated that the child had no vaccinations, and the providers returned no vaccination history forms or returned them indicating that no vaccinations had been administered.

§§ Before 2020, the first dose of HepA was recommended at age 12–23 months, with the second dose administered 6–18 months after the first, depending upon the product type received. During 2020, the recommendation was revised to 2 doses between ages 12 and 23 months, ≥6 months apart, with a catch-up period extending through age 18 years. Because children in this analysis were vaccinated under both recommendations, coverage estimates for both <24 months and <35 months are provided.

¶¶ 45 C.F.R. part 46.102(l)(2); 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

*** The combined seven-vaccine series (4:3:1:3*:3:1:4) includes ≥4 doses of DTaP; ≥3 doses of poliovirus vaccine; ≥1 dose of measles-containing vaccine; ≥3 or ≥4 doses (depending upon product type) of Hib; ≥3 doses of HepB; ≥1 dose of VAR; and ≥4 doses of PCV.

By health insurance status, coverage with all vaccines was lower among children who were covered by Medicaid or other nonprivate insurance, and those who were uninsured, than among those covered solely by private insurance (Supplementary Table 1, https://stacks.cdc.gov/view/cdc/162213). Similarly, coverage with all vaccines was lower among children living below the federal poverty level than among those living at or above the poverty level, with percentage point differences ranging from 2.7 (≥1 dose of MMR) to 19.9 (≥2 doses of influenza vaccine) (Supplementary Table 2, https://stacks.cdc.gov/view/cdc/162214). No differences in coverage were observed between children living in a metropolitan statistical area (MSA)††† principal city and those living in an MSA nonprincipal city. However, coverage was lower among children living in a non-MSA compared with an MSA principal

††† MSA status (a measure of urbanicity) was determined based on household reported city and county of residence and was grouped into three categories: MSA principal city, MSA nonprincipal city, and non-MSA. MSAs and principal cities were as defined by the U.S. Census Bureau (https://www.census.gov/programs-surveys/metro-micro.html). Non-MSA areas include urban populations not located within an MSA as well as completely rural areas.

TABLE 1. Estimated vaccination coverage, by age 24 months* among children born during 2018–2019 and 2020–2021 for selected vaccines and doses — National Immunization Survey-Child, United States, 2019–2023

Vaccine/Dose	% (95% CI) Birth year† 2018–2019	2020–2021	Difference (2018–2019 to 2020–2021)
DTaP§			
≥3 doses	94.3 (93.8 to 94.7)	92.5 (91.8 to 93.2)	−1.8 (−2.6 to −1.0)¶
≥4 doses	81.8 (81.0 to 82.6)	79.3 (78.2 to 80.4)	−2.5 (−3.8 to −1.1)¶
Poliovirus (≥3 doses)	93.4 (92.9 to 93.9)	91.9 (91.2 to 92.6)	−1.5 (−2.4 to −0.6)¶
MMR (≥1 dose)**	92.0 (91.4 to 92.6)	90.3 (89.6 to 91.0)	−1.7 (−2.6 to −0.7)¶
Hib††			
Primary series	93.8 (93.3 to 94.3)	91.6 (90.8 to 92.3)	−2.2 (−3.1 to −1.3)¶
Full series	80.0 (79.2 to 80.9)	76.8 (75.7 to 77.9)	−3.2 (−4.6 to −1.8)¶
HepB			
Birth dose§§	80.3 (79.4 to 81.1)	79.5 (78.5 to 80.5)	−0.8 (−2.1 to 0.6)
≥3 doses	92.6 (92.0 to 93.1)	91.1 (90.3 to 91.8)	−1.5 (−2.4 to −0.6)¶
VAR (≥1 dose)**	91.2 (90.5 to 91.8)	89.9 (89.1 to 90.6)	−1.3 (−2.2 to −0.3)¶
PCV			
≥3 doses	93.4 (92.9 to 93.9)	91.6 (90.9 to 92.3)	−1.8 (−2.6 to −0.9)¶
≥4 doses	83.4 (82.7 to 84.2)	80.7 (79.6 to 81.8)	−2.7 (−4.1 to −1.4)¶
HepA¶¶			
≥1 dose	88.1 (87.4 to 88.8)	86.5 (85.6 to 87.4)	−1.6 (−2.7 to −0.4)¶
≥2 doses (by age 24 mos)	47.6 (46.5 to 48.6)	46.0 (44.8 to 47.2)	−1.6 (−3.2 to 0)
≥2 doses (by age 35 mos)	79.8 (78.6 to 81.0)	77.7 (76.1 to 79.2)	−2.1 (−4.1 to −0.1)¶
Rotavirus (by age 8 mos)***	77.1 (76.2 to 78.0)	75.1 (74.0 to 76.2)	−2.0 (−3.4 to −0.5)¶
Influenza (≥2 doses)†††	63.4 (62.4 to 64.4)	55.6 (54.4 to 56.8)	−7.8 (−9.4 to −6.2)¶
Combined seven-vaccine series§§§	70.1 (69.2 to 71.1)	66.9 (65.7 to 68.2)	−3.2 (−4.8 to −1.6)¶
No vaccinations¶¶¶	0.9 (0.8 to 1.1)	1.2 (1.0 to 1.4)	0.2 (0 to 0.5)

TABLE 1. (*Continued*) Estimated vaccination coverage, by age 24 months* among children born during 2018–2019 and 2020–2021 for selected vaccines and doses — National Immunization Survey-Child, United States, 2019–2023

Abbreviations: DTaP = diphtheria, tetanus toxoids, and acellular pertussis vaccine; HepA = hepatitis A vaccine; HepB = hepatitis B vaccine; Hib = *Haemophilus influenzae* type b conjugate vaccine; MMR = measles, mumps, and rubella vaccine; PCV = pneumococcal conjugate vaccine; VAR = varicella vaccine.

* Includes vaccinations received by age 24 months (before the day the child turns age 24 months), except for the HepB birth dose (at birth through age 3 days), rotavirus vaccination (by age 8 months), and ≥2 HepA doses (by age 35 months). For all vaccines except the HepB birth dose and rotavirus vaccination, the Kaplan-Meier method was used to estimate vaccination coverage to account for children whose vaccination history was ascertained before age 24 months (also at age 35 months for ≥2 HepA doses).

† Data for the 2018 birth year are from survey years 2019, 2020, and 2021; data for the 2019 birth year are from survey years 2020, 2021, and 2022; data for the 2020 birth year are from survey years 2021, 2022, and 2023; data for the 2021 birth year are considered preliminary and come from survey years 2022 and 2023 (data from survey year 2024 are not yet available).

§ Includes children who might have been vaccinated with diphtheria and tetanus toxoids vaccine or diphtheria, tetanus toxoids, and pertussis vaccine. Healthy People 2030 target for ≥4 doses of DTaP by age 2 years is 90%. https://health.gov/healthypeople/objectives-and-data/browse-objectives/vaccination/increase-coverage-level-4-doses-dtap-vaccine-children-age-2-years-iid-06

** Includes children who might have been vaccinated with measles, mumps, rubella, and varicella combination vaccine. Healthy People 2030 target for ≥1 dose of MMR by age 2 years is 90.8%. https://health.gov/healthypeople/objectives-and-data/browse-objectives/vaccination/maintain-vaccination-coverage-level-1-dose-mmr-vaccine-children-age-2-years-iid-03

†† Hib primary series: receipt of ≥2 or ≥3 doses, depending on product type received; full series: primary series and booster dose, which includes receipt of ≥3 or ≥4 doses, depending on product type received.

§§ One dose of HepB administered from birth through age 3 days.

¶¶ Before 2020, the first dose of HepA was recommended at age 12–23 months, with the second dose given 6–18 months after the first, depending upon the product type received. In 2020, the recommendation was revised to 2 doses between ages 12 and 23 months, ≥6 months apart. Because children in this analysis were vaccinated under both recommendations, coverage estimates for both age <24 months and age <35 months are provided.

*** Includes ≥2 doses of Rotarix (GSK) monovalent rotavirus vaccine, or ≥3 doses of RotaTeq (Merck & Co., Inc.) pentavalent rotavirus vaccine. (If any dose in the series is either RotaTeq or unknown, defaults to the 3-dose series.) The maximum age for the final rotavirus dose is 8 months, 0 days.

††† Doses must be ≥24 days apart (4 weeks with a 4-day grace period); doses could have been received during two influenza seasons.

§§§ The combined seven-vaccine series (4:3:1:3*:3:1:4) includes ≥4 doses of DTaP, ≥3 doses of poliovirus vaccine, ≥1 dose of measles-containing vaccine, the full series of Hib (≥3 or ≥4 doses, depending on product type), ≥3 doses of HepB, ≥1 dose of VAR, and ≥4 doses of PCV.

¶¶¶ Healthy People 2030 target for children who receive no recommended vaccines by age 2 years is ≤1.3%. https://health.gov/healthypeople/objectives-and-data/browse-objectives/vaccination/reduce-proportion-children-who-get-no-recommended-vaccines-age-2-years-iid-02

city for all vaccines except the full Hib series, the HepB birth dose, and ≥2 doses of HepA. Substantial jurisdictional variation in coverage estimates was also observed with selected vaccines (Table 3), especially ≥2-dose influenza vaccination coverage, which ranged from 25.6% in Mississippi to 80.3% in Rhode Island. Comparing the 2018–2019 and 2020–2021 birth cohorts by jurisdiction for each of eight vaccine measures identified 69 statistically significant differences in coverage estimates, 64 (92.8%) of which reflected lower vaccination coverage among the more recent (2020–2021) birth cohorts.

Discussion

Estimated coverage with most of the routinely recommended childhood vaccines monitored by NIS-Child by age 24 months was lower among children born in 2020 and 2021 compared with coverage among those born in 2018 and 2019. The Healthy People 2030[§§§] objective to reduce the proportion of children receiving no vaccines by age 24 months (≤1.3%) has been met, but the objectives for ≥1 dose of MMR (≥90.8%) and ≥4 doses of DTaP (≥90.0%) have not. After increasing for several years, coverage with ≥2 doses of influenza vaccine among children born in 2021 declined to 53.4%, more than 10 percentage points below the estimated 63.8% coverage for the 2019 birth cohort. Several studies have documented a negative effect associated with the COVID-19 pandemic on routine pediatric vaccination (*2*–*4*) that could have affected children born in 2020 and 2021. However, analyses of NIS-Child data for children born during 2017–2020 did not identify any consistent or persistent declines in vaccination coverage at the national level and only a few decreases among population subgroups.[¶¶¶] A recent analysis of trends in parental vaccine hesitancy during 2019–2022 found an increase in hesitancy among parents of children aged 5–11 years after authorization of COVID-19 vaccine, but not among parents of those aged 6 months–4 years (*5*). Parental vaccine hesitancy might be contributing to the low levels of influenza vaccination coverage, due to a higher degree of hesitancy among parents about

[§§§] No vaccines: https://health.gov/healthypeople/objectives-and-data/browse-objectives/vaccination/reduce-proportion-children-who-get-no-recommended-vaccines-age-2-years-iid-02; MMR: https://health.gov/healthypeople/objectives-and-data/browse-objectives/vaccination/maintain-vaccination-coverage-level-1-dose-mmr-vaccine-children-age-2-years-iid-03; and DTaP: https://health.gov/healthypeople/objectives-and-data/browse-objectives/vaccination/increase-coverage-level-4-doses-dtap-vaccine-children-age-2-years-iid-06.

[¶¶¶] https://www.cdc.gov/vaccines/imz-managers/coverage/childvaxview/pubs-presentations/nis-child-pandemic-effects-2018-2021.html.

TABLE 2. Estimated vaccination coverage, by age 24 months* among children born during 2020–2021,† by selected vaccines and doses and race and ethnicity§ — National Immunization Survey–Child, United States, 2021–2023

Vaccine/Dose	Race and ethnicity,§ % (95% CI)						
	White (referent) n = 16,656	Black or African American n = 2,324	Hispanic or Latino n = 5,331	AI/AN n = 316	Asian n = 1,460	NH/PI n = 89	Multiple races n = 2,492
DTaP¶							
≥3 doses	92.8(91.8–93.6)	92.1(90.0–94.0)	92.9(91.5–94.1)	87.9(82.0–92.6)	92.8(89.2–95.6)	88.0 (76.6–95.5)	90.8 (88.1–93.2)
≥4 doses	81.4(80.1–82.6)	76.1(72.3–79.6)**	77.5(74.8–80.0)**	72.4(64.2–80.1)**	83.1(78.8–86.9)	—††	78.5 (75.1–81.8)
Poliovirus (≥3 doses)	92.2(91.2–93.1)	91.6(89.3–93.5)	92.1(90.5–93.5)	88.9(83.2–93.3)	92.2(88.6–95.1)	88.0(76.6–95.5)	90.3 (87.6–92.6)
MMR (≥1 dose)§§	90.2(89.2–91.1)	89.2(87.1–91.2)	91.3(89.7–92.7)	87.7(81.5–92.7)	91.8(88.4–94.6)	—††	88.8(85.8–91.4)
Hib¶¶							
Primary series	91.8(90.7–92.8)	91.0(88.8–93.0)	92.2(90.8–93.4)	86.1(79.2–91.6)	91.5(87.8–94.4)	87.0(75.9–94.6)	89.9(87.0–92.5)
Full series	77.9(76.5–79.3)	73.7(70.1–77.3)**	76.1(73.6–78.5)	72.2(64.0–79.9)	80.6(76.5–84.3)	—††	76.4(72.9–79.8)
HepB							
Birth dose***	79.3(78.0–80.6)	77.6(74.3–80.6)	79.7(77.3–81.9)	78.6(69.4–85.6)	81.7(77.6–85.2)	—††	82.0(78.6–85.0)
≥3 doses	91.0(90.0–91.9)	91.2(89.0–93.2)	91.3(89.5–92.9)	90.6(85.4–94.4)	91.6(88.7–94.1)	—††	90.0(87.4–92.4)
VAR (≥1 dose)§§	89.8(88.7–90.7)	90.0(88.0–91.8)	91.0(89.3–92.4)	83.0(74.6–89.9)	88.6(84.8–91.9)	89.1(77.9–96.1)	88.1(85.0–90.8)
PCV							
≥3 doses	91.7(90.7–92.7)	91.3(89.0–93.3)	92.5(91.2–93.7)	85.1(77.2–91.4)	90.8(87.1–93.8)	87.4(75.9–95.1)	90.0(87.1–92.5)
≥4 doses	83.1(81.8–84.3)	77.9(74.2–81.4)**	78.4(76.0–80.8)**	74.2(65.6–82.1)**	83.0(79.0–86.7)	—††	80.2(76.9–83.3)
HepA†††							
≥1 dose	86.4(85.2–87.5)	83.9(80.4–87.1)	87.5(85.4–89.4)	81.9 (74.7–88.1)	88.6(85.1–91.6)	—††	87.2(84.2–89.9)
≥2 doses (by age 24 mos)	47.3(45.8–48.8)	40.5(37.1–44.2)**	45.8(43.0–48.7)	40.9 (32.2–51.0)	49.5(44.9–54.3)	—††	47.6(43.7–51.7)
≥2 doses (by age 35 mos)	79.8(78.0–81.6)	72.7(67.4–77.8)**	76.1(72.6–79.4)	—††	81.2(74.5–87.0)	—††	79.1(74.0–83.9)
Rotavirus (by age 8 mos)§§§	77.3(76.0–78.6)	71.4(67.7–74.7)**	72.9(70.3–75.4)**	67.2 (57.6–75.5)**	79.7(75.6–83.3)	—††	75.5(71.6–79.0)
Influenza ≥2 doses¶¶¶	59.6(58.0–61.1)	42.6(39.0–46.3)**	52.8(49.9–55.7)**	51.5 (42.7–61.1)	71.4(66.9–75.8)**	—††	55.6(51.8–59.5)
Combined seven-vaccine series****	68.8(67.3–70.2)	64.0(60.2–67.8)**	65.0(62.1–67.8)**	58.7 (49.7–67.9)**	70.0(65.4–74.5)	—††	67.9(64.2–71.6)
No vaccinations	1.4 (1.2–1.7)	0.9 (0.6–1.3)**	1.0 (0.7–1.4)	—††	—††	—††	—††

See table footnotes on the next page.

TABLE 2. (*Continued*) Estimated vaccination coverage, by age 24 months* among children born during 2020–2021,† by selected vaccines and doses and race and ethnicity§ — National Immunization Survey–Child, United States, 2021–2023

Abbreviations: AI/AN = American Indian or Alaska Native; DTaP = diphtheria, tetanus toxoids, and acellular pertussis vaccine; HepA = hepatitis A vaccine; HepB = hepatitis B vaccine; Hib = *Haemophilus influenzae* type b conjugate vaccine; MMR = measles, mumps, and rubella vaccine; NH/PI = Native Hawaiian or Pacific Islander; PCV = pneumococcal conjugate vaccine; VAR = varicella vaccine.

* Includes vaccinations received by age 24 months (before the day the child turns age 24 months), except for the HepB birth dose (at birth through age 3 days), rotavirus vaccination (by age 8 months), and ≥2 HepA doses (by age 35 months). For all vaccines except the HepB birth dose and rotavirus vaccination, the Kaplan-Meier method was used to estimate vaccination coverage to account for children whose vaccination history was ascertained before age 24 months (also at age 35 months for ≥2 HepA doses).

† Data for the 2020 birth year are from survey years 2021, 2022, and 2023; data for the 2021 birth year are considered preliminary and come from survey years 2022 and 2023 (data from survey year 2024 are not yet available).

§ Children's race and ethnicity was reported by the parent or guardian. Children identified in this report as AI/AN, Asian, Black or African American, NH/PI, White, or multiple races were reported by the parent or guardian as non-Hispanic. Children identified as being of multiple races had more than one race category selected. Children identified as Hispanic or Latino (Hispanic) might be of any race.

¶ Includes children who might have been vaccinated with diphtheria and tetanus toxoids vaccine or diphtheria, tetanus toxoids, and pertussis vaccine.

** Statistically significant (p<0.05) difference compared with the referent group.

†† Estimate not available because the unweighted sample size for the denominator was <30, or 95% CI half width / estimate >0.588, or 95% CI half-width was ≥10.

§§ Includes children who might have been vaccinated with measles, mumps, rubella, and varicella combination vaccine.

¶¶ Hib primary series: receipt of ≥2 or ≥3 doses, depending on product type received; full series: primary series and booster dose, which includes receipt of ≥3 or ≥4 doses, depending on product type received.

*** One dose of HepB administered from birth through age 3 days.

††† Before 2020, the first dose of HepA was recommended at age 12–23 months, with the second dose given 6–18 months after the first, depending upon the product type received. In 2020, the recommendation was revised to 2 doses between ages 12 and 23 months, ≥6 months apart. Because children in this analysis were vaccinated under both recommendations, coverage estimates for both age <24 months and age <35 months are provided.

§§§ Includes ≥2 doses of Rotarix (GSK) monovalent rotavirus vaccine, or ≥3 doses of RotaTeq (Merck & Co., Inc.) pentavalent rotavirus vaccine. (If any dose in the series is either RotaTeq or unknown, defaults to the 3-dose series.) The maximum age for the final rotavirus dose is 8 months, 0 days.

¶¶¶ Doses must be ≥24 days apart (4 weeks with a 4-day grace period); doses could have been received during two influenza seasons.

**** The combined seven-vaccine series (4:3:1:3*:3:1:4) includes ≥4 doses of DTaP, ≥3 doses of poliovirus vaccine, ≥1 dose of measles-containing vaccine, the full series of Hib (≥3 or ≥4 doses, depending on product type), ≥3 doses of HepB, ≥1 dose of VAR, and ≥4 doses of PCV.

TABLE 3. Estimated vaccination coverage with selected individual vaccines and a combined vaccine series,* by age 24 months† among children born during 2020–2021,§ by U.S. Department of Health and Human Services region, state, selected local area, and territory — National Immunization Survey-Child, United States, 2021–2023

U.S. national, HHS region, state or local area, or territory	No.	Vaccine/Vaccine series, % (95% CI)							
		MMR¶ (≥1 dose)	Poliovirus	DTaP** (≥4 doses)	HepB†† (birth dose)	HepA (≥2 doses by age 35 mos)	Rotavirus§§	Influenza¶¶ (≥2 doses)	Combined seven-vaccine series*
U.S. national	28,668	90.3 (89.6–91.0)***	91.9 (91.2–92.6)***	79.3 (78.2–80.4)***	79.5 (78.5–80.5)	77.7 (76.1–79.2)***	75.1 (74.0–76.2)***	55.6 (54.4–56.8)***	66.9 (65.7–68.2)***
HHS Region 1	2,578	94.9 (92.9–96.5)	96.4 (95.1–97.5)	87.8 (85.1–90.2)	83.8 (80.7–86.6)	90.0 (85.3–93.6)	85.8 (83.4–88.0)	75.0 (71.3–78.5)***	79.6 (76.3–82.7)
Connecticut	412	94.4 (90.4–97.2)	95.4 (91.4–97.9)	86.7 (81.2–91.3)	83.9 (78.1–88.3)	91.2 (83.6–96.2)	84.5 (78.9–88.9)	79.8 (73.7–85.3)	76.7 (70.5–82.5)
Maine	366	94.2 (90.7–96.7)	95.5 (92.5–97.5)	86.1 (81.0–90.5)	82.8 (77.3–87.2)	80.2 (72.6–86.8)	75.8 (69.6–81.0)	73.0 (66.8–78.8)	74.4 (68.4–80.0)
Massachusetts	443	94.9 (91.0–97.5)	97.1 (94.8–98.6)	88.5 (83.6–92.4)	85.2 (78.9–89.8)	93.8 (83.7–98.6)	89.4 (85.1–92.6)†††	72.4 (65.7–78.8)***	83.1 (77.0–88.4)
New Hampshire	315	95.5 (92.6–97.6)	96.5 (93.6–98.3)	89.4 (84.4–93.4)	81.4 (75.3–86.2)	78.9 (70.4–86.4)	80.8 (74.6–85.7)	72.5 (66.1–78.5)	77.2 (70.9–82.9)
Rhode Island	542	95.8 (93.1–97.7)	96.3 (93.4–98.2)	88.3 (84.1–91.7)	81.6 (76.6–85.8)	90.0 (82.4–95.2)	86.2 (81.4–89.9)	80.3 (75.4–84.8)	77.8 (72.8–82.3)
Vermont	500	95.2 (91.7–97.6)	95.6 (92.0–97.8)	86.4 (81.6–90.5)	78.6 (73.1–83.2)	84.9 (76.6–91.5)	82.0 (76.9–86.2)	75.7 (70.0–81.0)	75.6 (69.9–81.0)
HHS Region 2	1,462	89.6 (86.8–92.0)	92.8 (90.5–94.7)	82.1 (78.8–85.1)	78.0 (74.8–80.9)	73.7 (68.5–78.7)	74.8 (71.4–77.9)	62.1 (58.4–65.7)***	67.5 (64.0–71.1)
New Jersey	436	89.3 (83.6–93.7)	93.4 (89.2–96.3)	83.0 (76.8–88.4)	81.5 (76.0–86.0)	76.9 (67.0–85.5)	75.0 (68.6–80.4)	64.5 (58.0–70.9)***	63.7 (57.0–70.3)
New York	1,026	89.7 (86.6–92.3)***	92.5 (89.6–94.8)	81.6 (77.7–85.2)	76.3 (72.3–79.8)	72.2 (66.1–78.0)	74.7 (70.6–78.4)	60.8 (56.4–65.2)***	69.5 (65.3–73.6)
New York City	560	86.7 (82.1–90.6)***	92.0 (87.8–95.1)	80.7 (75.3–85.6)	72.8 (67.1–77.8)	68.7 (59.9–77.1)	73.3 (67.5–78.4)	62.2 (56.2–68.2)	68.0 (62.1–73.8)
New York, excluding New York City	466	92.1 (87.7–95.4)	92.9 (88.6–96.0)	82.3 (76.7–87.3)	79.2 (73.4–84.0)	75.0 (66.6–82.7)	75.9 (69.9–81.0)	59.6 (53.3–66.0)***	70.8 (64.8–76.5)

See table footnotes on page 851.

TABLE 3. (*Continued*) Estimated vaccination coverage with selected individual vaccines and a combined vaccine series,* by age 24 months† among children born during 2020–2021,§ by U.S. Department of Health and Human Services region, state, selected local area, and territory — National Immunization Survey-Child, United States, 2021–2023

U.S. national, HHS region, state or local area, or territory	No.	Vaccine/Vaccine series, % (95% CI)							
		MMR¶ (≥1 dose)	Poliovirus	DTaP** (≥4 doses)	HepB†† (birth dose)	HepA (≥2 doses by age 35 mos)	Rotavirus§§	Influenza¶¶ (≥2 doses)	Combined seven-vaccine series*
HHS Region 3	3,970	89.9 (88.0–91.6)***	92.1 (90.5–93.6)	80.5 (78.1–82.7)	80.0 (77.7–82.1)***	79.6 (76.2–82.8)	77.7 (75.3–79.9)	62.5 (59.8–65.2)***	69.0 (66.5–71.6)***
Delaware	293	91.0 (86.3–94.6)	90.5 (85.6–94.3)	81.1 (74.8–86.6)	80.7 (74.2–85.9)	84.9 (75.2–92.3)	71.1 (63.7–77.5)	58.7 (51.3–66.2)***	68.1 (60.9–75.1)
District of Columbia	463	88.4 (83.0–92.7)	90.1 (85.2–94.0)	80.3 (73.7–86.1)	78.2 (71.6–83.6)	74.5 (64.8–83.3)	75.9 (69.0–81.6)	67.9 (60.5–75.2)	71.2 (64.3–77.9)
Maryland	861	95.4 (93.0–97.1)	96.0 (93.7–97.7)	87.3 (83.7–90.5)	80.0 (75.6–83.8)	86.5 (80.9–91.1)	82.0 (77.9–85.5)	66.5 (61.9–71.1)	75.7 (71.4–79.9)
Pennsylvania	1,121	88.6 (85.0–91.6)***	91.2 (88.2–93.7)	77.9 (73.5–82.1)	83.5 (79.6–86.8)	78.8 (72.4–84.6)	79.0 (74.8–82.6)	61.7 (56.6–66.8)***	67.1 (62.4–71.9)***
Philadelphia	546	89.7 (85.2–93.3)	88.8 (84.2–92.6)	76.3 (70.4–81.9)	82.2 (76.8–86.5)	79.7 (71.1–87.1)	75.0 (69.0–80.1)	62.9 (56.7–69.0)	65.5 (59.2–71.7)
Pennsylvania, excluding Philadelphia	575	88.4 (84.3–91.9)***	91.6 (88.1–94.4)	78.2 (73.1–83.0)	83.8 (79.2–87.5)	78.7 (71.3–85.3)	79.7 (74.8–83.8)	61.5 (55.7–67.3)***	67.4 (61.9–72.9)
Virginia	804	88.0 (84.1–91.4)	91.6 (88.0–94.5)	79.8 (75.1–84.2)	75.2 (70.3–79.6)	75.3 (68.8–81.4)	74.7 (69.3–79.4)	63.7 (58.5–68.9)***	67.8 (62.8–72.7)***
West Virginia	428	87.6 (82.4–91.9)	88.3 (83.4–92.3)***	74.2 (68.2–79.9)	80.0 (74.2–84.7)	76.6 (69.7–83.0)	72.3 (65.8–78.0)	46.5 (40.6–52.9)	63.2 (57.0–69.4)
HHS Region 4	4,478	89.7 (88.2–91.2)***	92.2 (90.8–93.5)	79.6 (77.5–81.6)	78.5 (76.5–80.5)	76.3 (73.0–79.5)	72.7 (70.4–74.8)	43.0 (40.6–45.4)***	66.0 (63.6–68.3)***
Alabama	400	89.8 (84.6–93.8)	89.2 (83.8–93.4)	79.7 (73.6–85.2)	76.7 (70.3–82.1)	75.3 (66.9–82.9)	69.8 (62.6–76.1)	33.4 (27.2–40.5)	62.6 (55.7–69.5)
Florida	666	90.8 (87.2–93.8)	91.6 (87.9–94.5)	80.1 (75.0–84.8)	76.3 (71.1–80.8)	76.1 (67.0–84.2)	70.9 (65.3–75.9)	42.1 (36.5–48.1)	67.3 (61.5–72.9)
Georgia	593	84.3 (79.2–88.7)***	91.5 (87.8–94.5)	76.4 (70.8–81.5)	79.4 (74.1–83.8)	76.0 (67.7–83.5)	70.9 (64.8–76.3)	40.4 (34.6–46.7)	64.3 (58.3–70.3)
Kentucky	540	88.5 (84.0–92.1)	91.9 (87.9–94.9)	79.3 (73.9–84.2)	79.8 (74.8–84.1)	77.6 (70.8–83.7)	69.2 (63.6–74.4)***	45.9 (40.3–51.9)***	64.1 (58.3–69.9)***
Mississippi	505	87.9 (82.6–92.2)	88.0 (82.4–92.4)	74.3 (67.7–80.5)	79.0 (73.1–83.9)	—§§§	62.2 (55.3–68.6)	25.6 (20.7–31.3)***	64.8 (58.0–71.6)
North Carolina	764	94.1 (91.6–96.1)	96.6 (94.9–97.9)	81.4 (77.1–85.4)	84.9 (80.9–88.2)	76.5 (70.5–82.0)	80.0 (75.4–83.9)	49.5 (44.3–54.9)***	69.7 (64.7–74.5)
South Carolina	431	88.7 (83.8–92.7)	90.2 (85.5–93.9)	77.7 (71.8–83.1)	80.2 (74.7–84.8)	—§§§	78.1 (71.9–83.3)	37.8 (32.2–43.9)	64.5 (58.2–70.6)
Tennessee	579	91.1 (87.0–94.3)	93.9 (90.5–96.5)	83.3 (78.2–87.7)	73.0 (67.1–78.2)	83.9 (74.6–91.2)	74.2 (68.5–79.2)	55.7 (49.7–61.9)***	64.4 (58.4–70.3)
HHS Region 5	3,717	91.8 (90.4–93.1)	92.5 (91.1–93.7)	80.7 (78.7–82.7)	81.4 (79.4–83.1)	80.1 (77.1–82.9)	75.8 (73.7–77.8)	60.2 (57.9–62.5)***	68.7 (66.5–70.9)
Illinois	918	92.7 (89.6–95.1)	93.2 (90.4–95.3)	80.0 (75.9–83.8)	79.2 (75.2–82.8)	76.3 (70.1–82.0)	74.9 (70.6–78.8)	58.7 (54.2–63.2)	66.4 (62.0–70.7)
Chicago	280	91.6 (86.9–95.1)	91.9 (86.9–95.5)	81.8 (75.3–87.5)	81.6 (74.6–86.9)	74.2 (64.0–83.4)	75.9 (68.2–82.2)	64.4 (56.7–72.2)	63.9 (56.3–71.5)
Illinois, excluding Chicago	638	93.0 (89.1–95.9)	93.5 (90.2–96.0)	79.5 (74.5–84.1)	78.6 (73.7–82.8)	76.6 (69.3–83.3)	74.6 (69.4–79.2)	57.0 (51.7–62.4)	67.2 (61.9–72.4)
Indiana	369	91.9 (87.7–95.1)	93.5 (89.5–96.4)	81.7 (75.8–86.9)	81.4 (75.2–86.3)	80.1 (70.1–88.4)	72.7 (65.9–78.5)	50.5 (44.0–57.4)***	71.7 (65.3–77.8)
Michigan	771	93.4 (89.9–95.9)	92.4 (89.1–95.1)***	78.6 (73.3–83.5)	78.3 (73.3–82.6)	80.8 (74.4–86.5)***	78.7 (73.8–82.9)	64.4 (58.8–69.9)	67.7 (62.3–73.0)
Minnesota	415	92.0 (87.6–95.3)	92.8 (88.6–95.9)	82.0 (75.9–87.4)	81.3 (75.0–86.4)	—§§§	77.2 (70.7–82.6)	68.0 (61.5–74.3)	68.9 (62.4–75.3)
Ohio	759	90.2 (86.9–93.0)	91.5 (88.4–94.1)	82.0 (77.6–86.0)	84.8 (80.9–88.1)	80.3 (74.2–85.7)	74.9 (70.1–79.3)	56.4 (51.3–61.6)***	69.9 (65.1–74.5)
Wisconsin	485	90.9 (86.9–94.1)	91.1 (87.1–94.3)	80.0 (74.7–84.8)	83.8 (78.4–88.0)	85.6 (78.9–91.0)	77.6 (72.0–82.3)	69.1 (63.2–74.8)	68.4 (62.7–74.0)

See table footnotes on page 851.

TABLE 3. (*Continued*) Estimated vaccination coverage with selected individual vaccines and a combined vaccine series,* by age 24 months† among children born during 2020–2021,§ by U.S. Department of Health and Human Services region, state, selected local area, and territory — National Immunization Survey-Child, United States, 2021–2023

U.S. national, HHS region, state or local area, or territory	No.	Vaccine/Vaccine series, % (95% CI)							
		MMR¶ (≥1 dose)	Poliovirus	DTaP** (≥4 doses)	HepB†† (birth dose)	HepA (≥2 doses by age 35 mos)	Rotavirus§§	Influenza¶¶ (≥2 doses)	Combined seven-vaccine series*
HHS Region 6	3,492	91.7 (89.7–93.4)	91.8 (89.6–93.7)	79.5 (76.1–82.7)	81.6 (78.4–84.4)	78.3 (73.5–82.7)	75.7 (72.0–79.1)	48.7 (44.6–52.9)***	66.6 (62.7–70.5)
Arkansas	513	86.6 (80.9–91.2)	86.5 (81.0–91.1)	73.4 (67.0–79.5)	82.9 (77.5–87.3)	79.4 (71.2–86.6)	73.4 (67.1–78.9)	40.4 (34.0–47.5)	62.0 (55.4–68.6)
Louisiana	697	90.7 (87.1–93.7)	93.0 (89.6–95.6)	81.3 (76.4–85.8)†††	76.8 (71.8–81.2)	72.6 (65.0–79.7)	74.3 (68.9–79.1)†††	40.8 (35.5–46.6)	68.5 (62.7–74.0)
New Mexico	595	89.6 (85.2–93.2)***	90.1 (85.9–93.5)***	76.7 (71.1–81.8)	74.4 (69.1–79.1)	77.4 (70.7–83.5)	75.1 (69.6–79.9)***	55.4 (49.7–61.3)***	68.2 (62.5–73.7)
Oklahoma	446	88.0 (83.2–92.0)	92.6 (89.0–95.4)	78.2 (72.5–83.4)	77.2 (71.5–82.1)	78.5 (71.3–85.0)	73.9 (68.2–78.9)	44.0 (38.0–50.5)	64.9 (58.7–71.1)
Texas	1,241	92.8 (90.2–95.0)	92.1 (88.9–94.6)	80.0 (75.2–84.3)	83.1 (78.5–86.9)	79.3 (72.2–85.5)	76.4 (71.1–80.9)	50.8 (45.1–56.7)	66.8 (61.4–72.2)
Bexar County	313	86.4 (81.1–90.8)	88.2 (82.8–92.6)	76.9 (70.1–83.0)	73.4 (65.7–80.0)	73.5 (63.7–82.4)	73.1 (65.4–79.6)	47.7 (40.0–56.2)***	62.3 (54.5–70.1)
Houston	339	87.8 (82.1–92.3)	90.8 (85.4–94.9)	73.9 (66.2–81.0)	79.7 (72.9–85.1)	—§§§	75.4 (67.7–81.8)	56.8 (49.1–64.8)	65.7 (57.9–73.4)
Texas, excluding Bexar County and Houston	589	94.1 (90.9–96.5)	92.6 (88.7–95.5)	81.2 (75.4–86.3)	84.4 (78.8–88.8)	79.3 (70.8–86.7)	76.8 (70.4–82.2)	50.2 (43.4–57.4)	67.4 (60.8–73.8)
HHS Region 7	2,168	91.3 (89.4–92.9)	92.5 (90.8–94.1)	80.6 (77.9–83.2)	82.4 (79.9–84.6)	80.8 (76.8–84.5)	78.7 (76.0–81.2)	54.8 (51.7–57.9)***	67.5 (64.5–70.6)
Iowa	455	90.2 (85.2–94.0)***	92.7 (88.4–95.8)	80.4 (74.1–85.9)***	82.8 (77.1–87.4)	81.3 (71.4–89.3)	79.4 (73.0–84.6)	45.8 (39.4–52.8)	70.9 (64.2–77.3)***
Kansas	634	90.1 (86.2–93.2)	90.4 (86.7–93.4)	77.6 (72.3–82.4)	77.5 (72.1–82.1)	81.7 (73.7–88.4)	75.6 (70.1–80.4)	55.0 (49.5–60.7)	66.4 (60.9–71.9)
Missouri	657	91.7 (88.6–94.3)	92.9 (89.9–95.3)	79.7 (74.9–84.1)	85.0 (81.1–88.2)	80.1 (73.2–86.2)	79.7 (75.2–83.6)†††	54.0 (48.7–59.5)	68.6 (63.3–73.8)
Nebraska	422	93.6 (89.5–96.5)	94.7 (91.5–96.9)	88.2 (83.4–92.2)	81.3 (75.0–86.3)	81.9 (74.5–88.1)	79.4 (73.7–84.2)	70.5 (63.9–76.9)	61.2 (54.5–68.0)***
HHS Region 8	2,759	88.4 (85.9–90.6)***	90.7 (88.5–92.6)***	78.5 (75.6–81.2)***	81.1 (78.4–83.5)	79.0 (75.0–82.7)	73.7 (70.6–76.6)***	64.0 (60.8–67.2)***	68.0 (64.9–71.1)***
Colorado	482	86.0 (80.8–90.3)***	88.9 (84.1–92.7)***	77.0 (71.4–82.2)	80.5 (75.0–85.0)	78.8 (71.1–85.6)	71.9 (65.8–77.3)***	67.8 (61.9–73.6)	66.1 (60.2–71.9)
Montana	347	86.3 (81.6–90.4)	89.7 (85.4–93.2)	69.6 (63.2–75.7)***	71.7 (65.2–77.3)	62.7 (53.8–71.5)	65.5 (58.8–71.6)***	54.8 (48.3–61.6)***	57.8 (51.2–64.5)***
North Dakota	391	87.0 (81.6–91.5)***	90.3 (86.0–93.7)***	77.3 (70.9–83.1)***	86.9 (81.6–90.9)	79.7 (71.2–87.1)	77.6 (71.0–83.0)	67.3 (60.5–74.0)	71.9 (65.1–78.3)***
South Dakota	483	89.9 (84.9–93.8)	87.8 (82.0–92.4)***	71.9 (64.8–78.6)	81.8 (75.2–86.8)	82.6 (72.3–90.8)	76.6 (69.5–82.4)	62.9 (55.6–70.2)***	63.9 (56.6–71.1)
Utah	559	91.8 (88.2–94.7)	94.1 (91.7–96.0)	84.7 (80.4–88.5)	83.8 (79.3–87.5)	82.8 (77.2–87.7)	76.4 (71.1–81.0)***	62.1 (56.6–67.7)***	74.0 (68.7–79.0)
Wyoming	497	89.6 (84.8–93.4)	90.4 (86.1–93.8)	76.1 (70.0–81.7)	74.5 (68.2–79.8)	69.0 (61.3–76.3)	77.0 (71.1–82.0)	54.3 (47.9–60.9)	65.2 (58.8–71.5)
HHS Region 9	2,037	88.2 (84.8–91.1)***	89.5 (86.2–92.3)***	73.2 (68.2–77.9)***	74.1 (69.5–78.2)	73.5 (67.5–79.2)	72.5 (67.8–76.7)	57.8 (53.1–62.7)***	60.7 (55.8–65.7)***
Arizona	437	85.6 (80.3–90.1)***	88.2 (83.1–92.4)***	75.7 (69.3–81.6)***	80.5 (74.3–85.5)	76.2 (65.7–85.4)	69.6 (62.8–75.7)	48.8 (42.2–55.9)***	62.9 (56.3–69.5)***
California	687	88.6 (84.3–92.3)	89.8 (85.6–93.2)***	72.4 (66.1–78.5)***	72.2 (66.3–77.4)	73.7 (66.1–80.7)	73.1 (67.1–78.4)	60.6 (54.5–66.8)***	59.8 (53.6–66.1)***
Hawaii	353	87.6 (83.1–91.4)	88.9 (84.4–92.6)	81.4 (76.1–86.1)	83.9 (78.8–88.0)	73.1 (64.5–81.1)	73.1 (66.6–78.8)	62.7 (56.3–69.2)	69.1 (62.9–75.1)
Nevada	560	87.9 (83.2–91.8)	88.7 (84.0–92.6)	72.1 (66.2–77.8)***	77.8 (72.0–82.6)	70.0 (62.0–77.6)	70.3 (64.6–75.5)	42.5 (37.1–48.3)***	63.1 (57.1–69.0)***

See table footnotes on the next page.

TABLE 3. (*Continued*) Estimated vaccination coverage with selected individual vaccines and a combined vaccine series,* by age 24 months† among children born during 2020–2021,§ by U.S. Department of Health and Human Services region, state, selected local area, and territory — National Immunization Survey-Child, United States, 2021–2023

U.S. national, HHS region, state or local area, or territory	No.	Vaccine/Vaccine series, % (95% CI)							
		MMR¶ (≥1 dose)	Poliovirus	DTaP** (≥4 doses)	HepB†† (birth dose)	HepA (≥2 doses by age 35 mos)	Rotavirus§§	Influenza¶¶ (≥2 doses)	Combined seven-vaccine series*
HHS Region 10	2,007	90.0 (87.7–92.0)	91.0 (88.8–92.9)***	78.5 (75.4–81.4)***	83.3 (80.7–85.6)	78.9 (74.5–83.1)	75.0 (71.8–77.9)***	63.5 (60.1–66.8)***	69.2 (65.9–72.4)
Alaska	492	83.9 (78.9–88.3)	87.0 (82.1–91.1)	72.6 (66.5–78.3)	73.4 (67.7–78.4)	—§§§	71.2 (65.4–76.4)	57.6 (51.7–63.7)	59.8 (53.8–65.9)
Idaho	457	88.9 (84.0–92.8)	88.0 (82.5–92.4)	77.1 (71.0–82.8)	83.9 (78.5–88.1)†††	76.8 (66.9–85.5)	75.7 (69.2–81.3)	56.4 (49.8–63.2)	69.4 (63.0–75.6)
Oregon	351	89.0 (84.1–92.9)	90.6 (85.8–94.3)	77.1 (70.7–83.0)	83.1 (77.6–87.5)	80.7 (70.4–89.2)	71.7 (65.0–77.5)	59.9 (53.3–66.6)***	64.3 (57.5–71.0)
Washington	707	91.1 (87.7–93.9)	92.4 (89.3–94.9)	80.1 (75.5–84.3)	84.2 (80.3–87.5)	79.0 (73.2–84.2)	76.8 (72.1–80.9)	67.7 (62.7–72.7)***	72.4 (67.6–77.0)
Range of column values	NA	83.9–95.8	86.5–97.1	69.6–89.4	71.7–86.9	62.7–93.8	62.2–89.4	25.6–80.3	57.8–83.1
Territory									
Guam	161	77.3 (67.6–85.8)	—§§§	—§§§	84.4 (76.1–90.3)	—§§§	48.2 (38.4–58.2)	—§§§	—§§§
Puerto Rico	587	76.2 (70.8–81.3)†††	79.8 (74.8–84.5)	65.0 (59.0–70.9)†††	72.3 (66.4–77.5)	—§§§	61.5 (55.5–67.2)	16.8 (12.8–21.8)	53.5 (47.4–59.8)†††
U.S. Virgin Islands¶¶¶	58	—§§§	—§§§	—§§§	—§§§	—§§§	—§§§	—§§§	—§§§

Abbreviations: DTaP = diphtheria, tetanus toxoids, and acellular pertussis vaccine; HepA = hepatitis A vaccine; HepB = hepatitis B vaccine; HHS = U.S. Department of Health and Human Services; Hib = *Haemophilus influenzae* type b conjugate vaccine; MMR = measles, mumps, and rubella vaccine; NA = not applicable; PCV = pneumococcal conjugate vaccine; VAR = varicella vaccine.

* The combined seven-vaccine series (4:3:1:3*:3:1:4) includes ≥4 doses of DTaP, ≥3 doses of poliovirus vaccine, ≥1 dose of measles-containing vaccine, the full series of Hib (≥3 or ≥4 doses, depending on product type), ≥3 doses of HepB, ≥1 dose of VAR, and ≥4 doses of PCV.

† Includes vaccinations received by age 24 months (before the day the child turns age 24 months), except for the HepB birth dose (at birth through age 3 days), rotavirus vaccination (by age 8 months), and ≥2 HepA doses (by age 35 months). For all vaccines except the HepB birth dose and rotavirus vaccination, the Kaplan-Meier method was used to estimate vaccination coverage to account for children whose vaccination history was ascertained before age 24 months (also at age 35 months for ≥2 HepA doses).

§ Data for the 2020 birth year are from survey years 2021, 2022, and 2023; data for the 2021 birth year are considered preliminary and are from survey years 2022 and 2023 (2024 data are not yet available).

¶ Includes children who might have been vaccinated with measles, mumps, rubella, and varicella combination vaccine.

** Includes children who might have been vaccinated with diphtheria and tetanus toxoids vaccine or diphtheria, tetanus toxoids, and pertussis vaccine.

†† One dose HepB administered from birth through age 3 days.

§§ Includes ≥2 doses of Rotarix (GSK) monovalent rotavirus vaccine, or ≥3 doses of RotaTeq (Merck & Co., Inc.) pentavalent rotavirus vaccine. (If any dose in the series is either RotaTeq or unknown, defaults to the 3-dose series.) The maximum age for the final rotavirus dose is 8 months, 0 days.

¶¶ Doses must be ≥24 days apart (4 weeks with a 4-day grace period); doses could have been received during two influenza seasons.

*** Statistically significant decrease in estimated coverage compared with children born during 2018–2019 ($p<0.05$).

††† Statistically significant increase in estimated coverage compared with children born during 2018–2019 ($p<0.05$).

§§§ Estimate not available because the unweighted sample size for the denominator was <30, or 95% CI half width / estimate >0.588, or 95% CI half-width was ≥10.

¶¶¶ Sample size was too small to calculate reliable coverage estimates for the U.S Virgin Islands.

influenza vaccine compared with other routine childhood vaccines. Hesitancy about influenza vaccine has been observed to be more highly correlated with hesitancy about COVID-19 vaccine than with other childhood vaccines, indicating that parents might perceive influenza vaccine differently than they do other routine non–COVID-19 childhood vaccines (*6*).

This report documents persistent disparities in childhood vaccination coverage by race and ethnicity, poverty status, MSA status, and health insurance status. Vaccination coverage is lower among Black, Hispanic, and AI/AN children, those insured by Medicaid or other nonprivate insurance, children who are uninsured, children living in more rural areas, and children in families with incomes below the federal poverty level. Disparities such as these have been described in other analyses of NIS-Child data (*7*,*8*). In addition to parental vaccine hesitancy, adoption of nonstandard vaccination schedules, and increasing use of religious and philosophical belief exemptions are other significant barriers to the achievement of complete childhood immunization (*9*).

Limitations

The findings in this report are subject to at least three limitations. First, the low household interview response rates (21%–27% during survey years 2019–2023) and the availability of adequate provider data for only 48%–54% of those with completed interviews during those survey years increases the possibility of selection bias. Such bias might persist to some degree even after survey weighting adjustments, potentially resulting in under- or overestimation of vaccination coverage. Second, potential bias related to noncoverage of households without

Summary

What is already known about this topic?

The Advisory Committee on Immunization Practices currently recommends routine vaccination against 15 potentially serious illnesses for children by age 24 months.

What is added by this report?

Estimated coverage with most childhood vaccines was lower among children born during 2020–2021 (during or after the height of the health care disruption from the COVID-19 pandemic) compared with those born during 2018–2019. Disparities by race and ethnicity, health insurance status, poverty status, and urbanicity persist. Coverage also varied widely by jurisdiction, especially for influenza vaccine.

What are the implications for public health practice?

Financial barriers, access issues, vaccine hesitancy, and vaccine-related misinformation all need to be overcome to increase coverage, ensure full recovery from the impact of the COVID-19 pandemic, eliminate disparities, and protect all children from vaccine-preventable diseases.

telephones might also have been incompletely controlled for by the use of weighting in the analysis. If phoneless households are more common among lower income families, the result would be higher observed vaccination coverage. Finally, incompleteness of provider-reported vaccination histories during the most recent survey year could have biased coverage estimates downward. Contractual issues led to a shortened time frame for collecting information from vaccination providers, likely resulting in underascertainment of some administered vaccines. In addition, the vaccination history questionnaire mailed to providers was changed from one to two pages, possibly leading to additional reporting errors owing to lack of familiarity with the new questionnaire format. Assessment of total survey error for the 2023 survey year demonstrated that coverage was underestimated by 2.0 percentage points for ≥1 dose of MMR, 4.3 percentage points for the HepB birth dose, 5.1 percentage points for ≥4 doses of DTaP, and 9.4 percentage points for the combined seven-vaccine series.[****] An analysis that evaluated coverage in children from the same monthly birth cohorts who appeared in two different survey years indicated 2–3 percentage point lower estimates based on the 2023 compared with the 2022 samples, indicating a possible change in bias between 2022 and 2023, consistent with the lower provider response rates in 2023.

[****] Error profile for the 2023 NIS-Child. https://www.cdc.gov/childvaxview/media/pdfs/2024/09/Error-Profile-2023-NIS-Child.pdf

Implications for Public Health Practice

Recent decreases in coverage with most of the ACIP-recommended childhood vaccines could lead to a resurgence of vaccine-preventable diseases such as measles, varicella, and rotavirus and their associated morbidity and mortality. During January 1–August 15, 2024, a total of 219 measles cases were reported in the United States, exceeding the number of cases reported annually during 2020–2023 (range = 13 [2020]–121 [2022]). Of the 219 cases in 2024, 190 (86%) were among persons who were unvaccinated or had unknown vaccination status.[††††] Because children born during or after the period of major disruption of primary care from the COVID-19 pandemic might have missed some vaccinations, providers should review children's histories and recommend needed vaccinations during every clinical encounter. Addressing financial barriers and other access issues along with vaccine hesitancy and misinformation concerns is important to increasing vaccination coverage and reducing disparities. Higher provider participation in the Vaccines for Children (VFC)[§§§§] program would help to alleviate some of the financial barriers by increasing access to no-cost vaccines. Other activities that have been found to be effective include reminder/recall systems, implementation of standing orders and clinician prompts, encouraging providers to make strong vaccination recommendations to patients, administering vaccines in alternative settings, and coordination with Immunization Information Systems to identify communities with suboptimal vaccination coverage (*8*,*10*). Implementation of these interventions can increase vaccination coverage, reduce disparities, and bring the nation closer to eliminating vaccine-preventable diseases for all young children.

[††††] https://www.cdc.gov/measles/data-research/ (Accessed September 1, 2024).

[§§§§] VFC-eligible children include those aged ≤18 years who are Medicaid-eligible, uninsured, AI/AN, or insured by health plans that do not fully cover routine vaccination (if vaccination is received at a federally qualified health center or a rural health clinic). https://www.cdc.gov/vaccines-for-children/about/index.html

Corresponding author: Holly A. Hill, hhill@cdc.gov.

[1]Immunization Services Division, National Center for Immunization and Respiratory Diseases, CDC.

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Vaccination Coverage by Age 24 Months Among Children Born During 2017–2021 — U.S.-Affiliated Pacific Islands

Ashley Tippins, MPH[1]; E.M. Boyd, MHCA[2]; Kelsey C. Coy, MPH[2]; Glodi Mutamba, MD[2]; Jennifer L. Kriss, PhD[1]

Abstract

Childhood vaccination is one of the most successful public health interventions to improve life expectancy, decrease health care costs, and reduce the spread of preventable diseases. Using data from jurisdictional immunization information systems, vaccination coverage by age 24 months among children born during 2017–2021 in the U.S.-affiliated Pacific Islands was estimated for all vaccines included in jurisdictional programs. Progress toward the U.S. Healthy People 2030 and World Health Organization Immunization Agenda 2030 vaccination goals of ≥90% coverage by age 24 months with recommended vaccines was inconsistently met across jurisdictions. For example, coverage by age 24 months with ≥1 dose of measles, mumps, and rubella vaccine ranged from 68.2% to 91.6% by birth cohort in Federated States of Micronesia and from 87.4% to 96.6% in Palau; coverage with ≥4 doses of diphtheria and tetanus toxoids and acellular pertussis vaccine (DTaP) ranged from 39.6% to 60.6% in Federated States of Micronesia and from 73.4% to 85.4% in Palau. Coverage as of June 1, 2024, increased for all vaccines across all jurisdictions and birth cohorts, indicating catch-up vaccination after age 24 months. For example, coverage with ≥4 doses of DTaP by June 1, 2024, ranged from 74.0% to 84.4% in American Samoa by birth cohort and from 91.6% to 94.8% in Palau. This report is the first comprehensive analysis of trends in childhood vaccination coverage in the U.S.-affiliated Pacific Islands; data in this report can be used to determine where additional efforts are needed to assess reasons for delayed vaccination of children and strategies to mitigate vaccination delays, specific to each jurisdiction.

Introduction

Childhood vaccination is one of the most successful public health interventions to improve life expectancy, decrease health care costs, and reduce the spread of preventable diseases (*1*). The U.S Healthy People 2030 and the World Health Organization (WHO) Immunization Agenda 2030 have established 90% vaccination targets* for the following childhood vaccines: diphtheria and tetanus toxoids and acellular pertussis vaccine (DTaP); measles, mumps, and rubella vaccine (MMR); and pneumococcal conjugate vaccine (PCV) (*2*,*3*).

All six of the U.S.-affiliated Pacific Islands† (USAPI) participate in the U.S. domestic immunization program. CDC collaborates with USAPI immunization programs to monitor vaccination coverage with all vaccines included in jurisdictional programs. This report describes vaccination coverage by age 24 months in five of the six USAPI jurisdictions§ among children born during 2017–2021.

Methods

Data Sources and Inclusion and Exclusion Criteria

Patient-level data from jurisdictional immunization information systems (IISs) were aggregated at the jurisdiction level. Patients were grouped by calendar year of birth (i.e., birth cohort) and were included in the denominator if they had an active patient status¶ in IIS. Patients with an inactive or deceased status were excluded from all analyses. To mitigate potential denominator inflation, patients with no vaccine doses recorded in IIS were also excluded, consistent with the Modeling of Immunization Registry Operations Workgroup's guidance for assessment at the jurisdiction level (*4*).

Estimation of Vaccination Coverage

Coverage estimates included all vaccine doses received as of the day before each child reached age 24 months (i.e.,

*The U.S. Healthy People 2030 and WHO's Immunization Agenda 2030 vaccination objectives include ≥90% coverage by age 2 years with ≥1 dose of the measles, mumps, and rubella vaccine and ≥4 doses of diphtheria and tetanus toxoids and acellular pertussis vaccine. WHO's Immunization Agenda 2030 goals also include an objective of ≥90% coverage with ≥3 doses of pneumococcal conjugate vaccine.

† USAPI comprises three U.S. territories (American Samoa, Guam, and Northern Mariana Islands) and three freely associated states (Federated States of Micronesia, Marshall Islands, and Palau). All jurisdictions receive Section 317 Immunization Program funding, which is a discretionary program to purchase vaccines and support immunization infrastructure. The U.S. territories also receive funding through the Vaccines for Children program, which is an entitlement program that provides vaccines at no cost to eligible children and adolescents aged ≤18 years through enrolled health care providers.

§ Jurisdictions reviewed in this report include American Samoa, Northern Mariana Islands, Federated States of Micronesia, Marshall Islands, and Palau. Vaccination coverage among children in Guam has been assessed via the National Immunization Survey since 2013; IIS-based coverage assessment was not conducted for Guam. Information on childhood vaccination coverage in Guam is available online. https://www.cdc.gov/vaccines/imz-managers/coverage/childvaxview/interactive-reports/index.html

¶ Patient active status in an IIS establishes a classification of individual patients within a health care organization. Health care providers are responsible for vaccinating patients with an active status within their clinic population or geographic catchment area. Patient status is changed to inactive when the patient changes providers, moves, or is lost to follow-up, or deceased if patient death is confirmed through manual review or system linkage with vital statistics or other health records. https://repository.immregistries.org/files/resources/5835adc2dad8d/mirow_pais_mini-guide.pdf

on-time vaccination) so that coverage by age 24 months could be assessed, with the exception of rotavirus vaccine, which is assessed by age 8 months because of the upper age limit for receipt of this vaccine. Coverage estimates included the following vaccines: DTaP, poliovirus, MMR, *Haemophilus influenzae* type b (Hib), hepatitis B (HepB), PCV, rotavirus, and the combined six-vaccine series (4:3:1:3*:3:4).** Hepatitis A vaccine (HepA) and varicella vaccine were included for jurisdictions where these vaccines have been introduced into the vaccination program, and for 2 doses of MMR in jurisdictions where 2 doses are recommended by age 24 months.†† To assess catch-up vaccination after age 24 months, all doses received as of June 1, 2024, were included in coverage estimates. SAS software (version 9.4; SAS Institute) was used to conduct all analyses. This activity was reviewed by CDC, deemed not research, and was conducted consistent with applicable federal law and CDC policy.§§

Results

Jurisdictional Vaccination Coverage by Age 24 Months

Coverage by age 24 months was ≥90% among one or more birth cohorts with each of the following vaccines: ≥3 doses of DTaP, ≥3 doses of poliovirus vaccine, and ≥3 doses of HepB (Northern Mariana Islands and Palau), ≥1 dose MMR and Hib primary series¶¶ (Northern Mariana Islands, Federated States of Micronesia, and Palau); HepB birth dose*** (American Samoa, Northern Mariana Islands, Marshall Islands, and Palau); and ≥3 doses of PCV (Palau) (Table 1). Coverage with ≥4 doses of DTaP, the Hib full series, ≥4 PCV doses, and rotavirus (by age 8 months) was <90% in all jurisdictions.††† Coverage with the 4:3:1:3*:3:4 series was <75% across all jurisdictions. Coverage with HepA and varicella vaccine among the U.S. territories (American Samoa and Northern Mariana Islands), and with ≥2 doses of MMR among the freely associated states (Federated States of Micronesia, Marshall Islands, and Palau) was <90% (Supplementary Table, https://stacks.cdc.gov/view/cdc/162211).

Trends in Vaccination Coverage by Birth Cohort

Vaccination coverage by age 24 months fluctuated by birth cohort across jurisdictions; for example, coverage by age 24 months with ≥1 dose of MMR ranged from 68.2% to 91.6% in Federated States of Micronesia by birth cohort and from 87.4% to 96.6% in Palau; coverage with ≥4 doses of DTaP ranged from 39.6% to 60.6% in Federated States of Micronesia and from 73.4% to 85.4% in Palau (Table 1). Across all jurisdictions and for most vaccines, coverage was higher among children born in 2018 than among those born in 2017. Coverage with most vaccines was lower among children born in 2019 and 2020 than among those born in 2018. Compared with children born in 2020, among those born in 2021, coverage with some vaccines began to increase. For example, coverage with MMR was 5.5 percentage points higher in American Samoa, 16.5 percentage points higher in Federated States of Micronesia, and 9.2 percentage points higher in Palau; however, the magnitude and direction of coverage varied across vaccines and jurisdictions.

Coverage with all vaccines increased across all jurisdictions and birth cohorts when vaccination status was assessed as of June 1, 2024, indicating catch-up vaccination after age 24 months. For example, among the 2021 birth cohort, coverage with ≥4 doses of DTaP (Palau), ≥3 doses of poliovirus vaccine (Marshall Islands), ≥1 dose of MMR (American Samoa, Federated States of Micronesia, and Marshall Islands), ≥3 doses of HepB (Northern Mariana Islands, Federated States of Micronesia, and Marshall Islands), and the full Hib series (Palau) increased from <90% by age 24 months to ≥90% as of June 1, 2024 (Figure). Coverage increases by June 1, 2024, were highest for ≥4 doses of DTaP (range = 9.2–20.7 percentage points); coverage with ≥4 doses of DTaP by June 1, 2024, ranged from 74.0% to 84.4% by birth cohort in American Samoa and from 91.6% to 94.8% in Palau (Table 2).

Discussion

Vaccination coverage of ≥90% by age 24 months for vaccines included in USAPI immunization programs has been inconsistently met, and coverage was substantially lower than U.S. national estimates (*5*). USAPI immunization program staff members have cited the following barriers to vaccine delivery and vaccination coverage: lack of access to reliable transportation for vaccine delivery to remote populations, lack of technical expertise to create data-driven vaccination delivery outreach plans, and issues related to governance and release of timely funding to

** The combined six-vaccine series (4:3:1:3*:3:4) includes ≥4 doses of DTaP; ≥3 doses of poliovirus vaccine; ≥1 dose of measles-containing vaccine; ≥3 or ≥4 doses (depending upon product type) of Hib; ≥3 doses of HepB; and ≥4 doses of PCV.

†† American Samoa and Northern Mariana Islands have included HepA and varicella vaccine in their vaccination programs. The Federated States of Micronesia, Marshall Islands, and Palau recommend the second dose of MMR 4 weeks after receipt of the first dose, which is recommended at age 12 months.

§§ 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

¶¶ Hib primary series = receipt of ≥2 or ≥3 doses, depending on product type received; full series = primary series and booster dose, which includes receipt of ≥3 or ≥4 doses, depending on product type received.

*** The birth dose of HepB is measured as the proportion of children who received a dose of HepB by age 3 days.

††† Includes ≥2 doses of Rotarix monovalent rotavirus vaccine (GSK) or ≥3 doses of RotaTeq pentavalent rotavirus vaccine (Merck and Co., Inc.); if any dose in the series is either RotaTeq or unknown, the default is to a 3-dose series. Rotavirus is assessed at age 8 months to reflect the maximum age at administration.

TABLE 1. Estimated vaccination coverage with selected vaccines and vaccine series by age 24 months among children born during 2017–2021,* by jurisdiction and year of birth — U.S.-affiliated Pacific Islands

Jurisdiction/ Birth year (n)	%											
	DTaP				Hib†		Hep B		PCV			
	≥3 doses	≥4 doses	Poliovirus ≥3 doses	MMR ≥1 dose	Primary series	Full series	Birth dose§	≥3 doses	≥3 doses	≥4 doses	Rotavirus¶	Combined six-vaccine series (4:3:1:3*:3:4)**
American Samoa												
2017 (1,254)	79.2	52.0	77.4	70.4	70.3	25.0	94.6	76.6	71.1	49.5	5.2	18.3
2018 (1,162)	80.1	53.8	78.5	85.1	73.8	34.9	93.3	70.6	72.6	52.5	3.7	26.0
2019 (1,028)	81.4	53.5	80.0	81.5	72.9	29.0	87.7	78.8	73.7	54.6	3.7	21.7
2020 (860)	84.9	51.9	84.1	77.2	78.4	33.4	96.4	86.6	74.3	54.8	4.5	26.3
2021 (832)	81.5	53.4	80.4	82.7	72.7	31.4	96.9	84.3	70.1	47.7	4.9	23.8
Northern Mariana Islands												
2017 (715)	87.8	67.3	87.3	88.7	84.1	51.9	89.7	91.0	84.8	62.9	53.7	46.3
2018 (723)	92.1	74.0	91.4	90.5	90.5	65.7	94.1	92.9	89.6	68.7	60.4	60.0
2019 (746)	92.0	71.3	91.6	87.0	92.4	71.0	95.0	89.5	89.5	67.2	68.0	64.6
2020 (651)	92.0	68.0	91.4	86.5	92.2	68.7	94.3	92.8	89.2	66.2	72.0	61.8
2021 (603)	86.1	66.8	85.4	83.1	86.4	65.0	95.9	88.9	83.6	62.9	60.9	60.0
Federated States of Micronesia												
2017 (2,139)	77.5	50.5	77.0	83.2	87.6	66.8	71.9	83.9	70.4	42.9	31.8	37.4
2018 (2,097)	85.6	60.6	85.1	91.6	91.3	77.2	73.2	89.1	81.7	54.6	37.1	49.3
2019 (1,920)	79.0	45.6	79.0	76.0	89.2	67.3	72.8	84.9	77.4	48.1	40.9	37.7
2020 (1,906)	69.5	39.6	69.2	68.2	81.0	56.0	66.3	74.9	66.7	40.5	42.9	31.5
2021 (1,855)	75.7	45.7	75.3	84.7	85.1	65.2	76.3	80.7	71.4	46.1	38.7	37.3
Marshall Islands												
2017 (1,074)	74.9	55.9	74.5	78.3	68.3	4.6	82.1	79.7	60.1	32.7	41.9	2.2
2018 (1,142)	79.6	63.9	79.3	88.7	75.4	6.6	69.9	84.1	61.9	35.6	45.7	3.4
2019 (1,072)	82.2	62.4	81.6	84.4	74.9	3.5	87.8	87.1	63.2	33.3	49.9	1.8
2020 (1,004)	86.1	61.9	85.7	82.7	72.4	3.8	87.0	89.0	60.9	31.5	54.5	1.1
2021 (994)	84.5	58.4	84.2	84.9	69.2	4.2	90.0	87.9	60.6	26.0	45.1	1.6
Palau												
2017 (232)	92.7	76.7	93.5	89.2	91.8	81.5	94.0	94.0	83.6	67.7	72.4	61.6
2018 (268)	95.9	85.4	95.1	95.1	96.6	89.9	96.6	96.3	90.3	76.9	82.1	72.4
2019 (234)	94.0	78.6	94.0	89.3	96.2	88.5	94.0	95.3	91.9	75.6	80.3	69.2
2020 (214)	92.5	73.4	92.5	87.4	95.3	85.5	95.8	93.0	89.3	79.9	82.7	69.6
2021 (206)	97.1	84.5	97.1	96.6	98.5	89.3	98.1	98.1	93.7	67.0	55.3	61.7

Abbreviations: DTaP = diphtheria, tetanus toxoids, and acellular pertussis vaccine; HepB = hepatitis B vaccine; Hib = *Haemophilus influenzae* type b conjugate vaccine; MMR = measles, mumps, and rubella vaccine; PCV = pneumococcal conjugate vaccine.

* Vaccination status includes vaccine doses received by age 24 months (i.e., before the day the child turns age 24 months), except for the HepB birth dose and rotavirus vaccination by age 8 months. The denominator includes patients with an active patient status in an immunization information system as of June 1, 2024. Patient active status in an immunization information system establishes a classification of individual patients within a health care organization. Health care providers are responsible for vaccinating patients with an active status within their clinic population or geographic catchment area. Patient status is changed to inactive when the patient changes providers, moves, or is lost to follow-up, or deceased if patient death is confirmed through manual review or system linkage with vital statistics or other health records. https://repository.immregistries.org/files/resources/5835adc2dad8d/mirow_pais_mini-guide.pdf

† Hib primary series = receipt of ≥2 or ≥3 doses, depending on product type received; full series = primary series and booster dose, which includes receipt of ≥3 or ≥4 doses, depending on product type received.

§ One dose of HepB administered from birth through age 3 days.

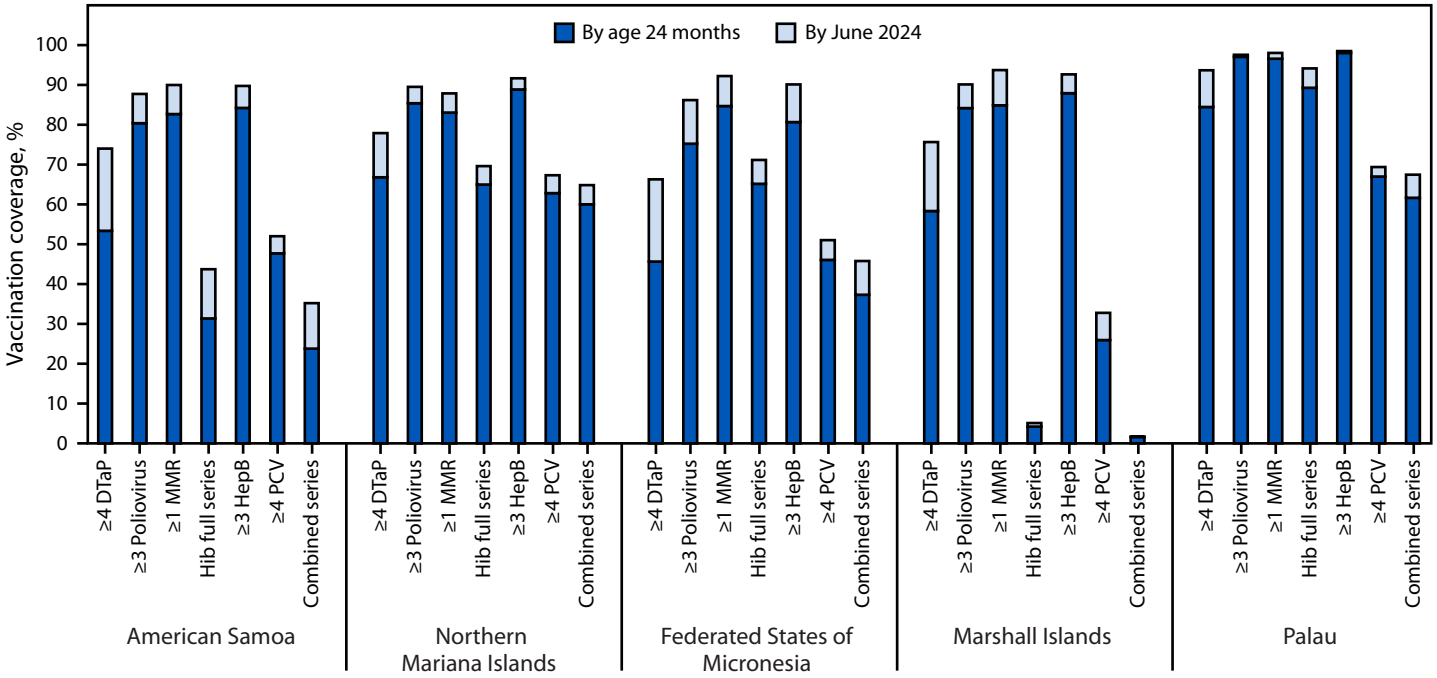
¶ Includes ≥2 doses of Rotarix monovalent rotavirus vaccine (GSK) or ≥3 doses of RotaTeq pentavalent rotavirus vaccine (Merck and Co., Inc.); if any dose in the series is either RotaTeq or unknown, the default is to a 3-dose series. The maximum age for the final rotavirus dose is 8 months, 0 days.

** The combined six-vaccine series (4:3:1:3*:3:4) includes ≥4 doses of DTaP, ≥3 doses of poliovirus vaccine, ≥1 dose of measles-containing vaccine, the full Hib series (≥3 or ≥4 doses, depending on product type), ≥3 doses of HepB, and ≥4 doses of PCV.

support activities, among other barriers (*6*,*7*). Coverage as of June 1, 2024, indicates that catch-up vaccination occurred after age 24 months, particularly as children reached school entry age. Annual analyses of age at vaccination suggest that delays in initiating and completing recommended vaccination series on time have been common (A Tippins, CDC, unpublished data, 2021–2024). This phenomenon might be further evidenced by this assessment, indicated by large increases in coverage assessed after age 24 months. Gaps in immunization coverage identified across USAPI can be used to pinpoint where further efforts are needed to evaluate the jurisdiction-specific reasons for, and ways to improve, on-time vaccination.

Differences in funding among jurisdictions might affect vaccine access and program operations; however, empiric research on facilitators and barriers specific to each jurisdiction is lacking. Further, the COVID-19 pandemic might have had an additional negative impact on vaccination coverage. Coverage with most vaccines among children reaching age 24 months during 2020 (i.e., born in 2018) was higher than that among those reaching age 24 months after 2020. Existing

FIGURE. Estimated vaccination coverage with selected individual vaccines* and a combined vaccine series† by age 24 months§ and catch-up coverage among children born in 2021, by jurisdiction — U.S.-affiliated Pacific Islands, June 1, 2024¶



Abbreviations: DTaP = diphtheria, tetanus toxoids, and acellular pertussis vaccine; HepB = hepatitis B vaccine; Hib = *Haemophilus influenzae* type b conjugate vaccine; MMR = measles, mumps, and rubella vaccine; PCV = pneumococcal conjugate vaccine.

* Hib primary series = receipt of ≥2 or ≥3 doses, depending on product type received; full series = primary series and booster dose, which includes receipt of ≥3 or ≥4 doses, depending on product type received.

† The combined six-vaccine series (4:3:1:3*:3:4) includes ≥4 doses of DTaP, ≥3 doses of poliovirus vaccine, ≥1 dose of measles-containing vaccine, the full series of Hib (≥3 or ≥4 doses, depending on product type), ≥3 doses of HepB, and ≥4 doses of PCV.

§ Vaccination status includes vaccine doses received by age 24 months (i.e., before the day the child turns age 24 months). The denominator includes patients with an active patient status in an immunization information system as of June 1, 2024. Patient active status in an immunization information system establishes a classification of individual patients within a health care organization. Health care providers are responsible for vaccinating patients with an active status within their clinic population or geographical catchment area. Patient status is changed to inactive when the patient changes providers, moves, or is lost to follow-up, or deceased if patient death is confirmed through manual review or system linkage with vital statistics or other health records. https://repository.immregistries.org/files/resources/5835adc2dad8d/mirow_pais_mini-guide.pdf

¶ Vaccination status includes all vaccine doses received by June 1, 2024. The denominator includes patients with an active patient status in an immunization information system as of June 1, 2024. Patient active status in an immunization information system establishes a classification of individual patients within a health care organization. Health care providers are responsible for vaccinating patients with an active status within their clinic population or geographical catchment area. Patient status is changed to inactive when the patient changes providers, moves, or is lost to follow-up, or deceased if patient death is confirmed through manual review or system linkage with vital statistics or other health records. https://repository.immregistries.org/files/resources/5835adc2dad8d/mirow_pais_mini-guide.pdf

challenges with adherence to an recommended schedule might have been amplified because of the pandemic, particularly as limited human resources were further stretched to mitigate the pandemic threat.

Catch-up campaigns are recommended to address existing lags in coverage among children born during 2017–2021.§§§ However, although catch-up campaigns increase coverage in the short term, mathematical models indicate that reaching and maintaining optimal levels of vaccination coverage through routine access to vaccination services is a more cost-effective long-term strategy (*8*). Evidence-based approaches to increasing vaccination coverage include strong health care provider recommendations, advocating for vaccines at every opportunity, and use of reminder and recall notices (*9*). In jurisdictions with remote populations, additional strategies related to increasing the frequency of vaccine delivery services to outer islands need to be considered. Further, lessons learned from recent successful vaccination campaigns, such as the COVID-19 vaccine rollout, can be applied to routine vaccination services to improve vaccine access and coverage (*6*,*7*).

Limitations

The findings in this report are subject to at least three limitations. First, accuracy of coverage estimates depends on completeness and accuracy of jurisdictional IIS data. Evaluations conducted since 2016 have found high levels of completeness and accuracy of vaccination data across the five

§§§ Recommendation consistent with WHO's The Big Catch Up: Essential Immunization Recovery Plan for 2023 and Beyond. https://iris.who.int/bitstream/handle/10665/371801/9789240075511-eng.pdf?sequence = 1

TABLE 2. Estimated vaccination coverage with selected vaccines and vaccine series among children born during 2017–2021,* by jurisdiction and year of birth — U.S.-affiliated Pacific Islands, June 2024

Jurisdiction/ Birth year (n)	% DTaP ≥3 doses	DTaP ≥4 doses	Poliovirus ≥3 doses	MMR ≥1 dose	Hib† Primary series	Hib† Full series	HepB (≥3 doses)	PCV ≥3 doses	PCV ≥4 doses	Combined six-vaccine series (4:3:1:3*:3:4)**
American Samoa										
2017 (1,254)	88.4	82.0	88.0	86.4	78.9	41.1	87.4	76.6	57.7	33.8
2018 (1,162)	89.8	82.4	88.7	89.4	80.6	50.7	88.4	78.3	59.3	43.9
2019 (1,028)	87.7	82.1	87.0	90.5	83.2	46.7	87.8	79.3	62.2	39.0
2020 (860)	93.5	84.4	93.4	92.0	88.5	55.5	93.7	81.4	64.5	45.8
2021 (832)	88.2	74.0	87.7	90.0	78.6	43.8	89.8	75.4	52.0	35.2
Northern Mariana Islands										
2017 (715)	97.2	95.5	96.9	98.2	89.7	59.2	97.6	90.2	70.6	53.4
2018 (723)	96.8	93.4	96.8	96.0	92.3	71.5	97.1	92.9	73.7	65.8
2019 (746)	95.6	89.5	94.9	94.2	94.5	82.7	96.5	92.6	78.4	77.1
2020 (651)	95.5	85.7	95.2	92.6	94.2	78.3	95.9	92.6	76.3	73.3
2021 (603)	89.6	77.9	89.6	87.9	89.4	69.7	91.7	87.4	67.3	64.8
Federated States of Micronesia										
2017 (2,139)	94.6	91.1	94.3	96.1	91.7	79.1	95.0	82.8	55.6	54.7
2018 (2,097)	95.4	91.1	95.3	97.9	93.3	82.1	96.7	87.2	60.2	59.3
2019 (1,920)	93.2	82.1	92.7	94.9	93.9	82.8	94.9	87.3	59.2	56.5
2020 (1,906)	88.9	74.8	88.6	93.6	88.7	72.6	91.1	78.9	54.2	50.5
2021 (1,855)	86.5	66.3	86.2	92.2	89.1	71.2	90.1	77.6	51.1	45.8
Marshall Islands										
2017 (1,074)	93.0	89.7	92.7	93.7	85.4	6.9	92.3	69.0	41.7	3.2
2018 (1,142)	95.3	90.7	94.9	95.3	87.4	8.1	94.7	68.6	40.6	4.2
2019 (1,072)	94.7	89.7	94.3	95.2	87.2	5.5	94.9	71.5	39.2	2.4
2020 (1,004)	94.1	87.3	93.9	96.2	85.9	5.5	94.5	70.6	37.7	2.0
2021 (994)	90.9	75.7	90.1	93.8	81.7	5.1	92.7	65.2	32.8	1.7
Palau										
2017 (232)	96.6	94.8	97.0	97.0	94.0	83.2	97.0	88.8	71.6	66.8
2018 (268)	98.5	93.7	98.5	97.0	97.0	90.7	98.5	90.7	78.0	76.1
2019 (234)	97.0	94.0	97.0	96.6	97.9	91.9	97.9	94.9	81.2	79.1
2020 (214)	95.8	91.6	96.3	96.3	97.7	91.6	95.8	92.5	85.5	80.8
2021 (206)	97.6	93.7	97.6	98.1	98.5	94.2	98.5	95.6	69.4	67.5

Abbreviations: DTaP = diphtheria, tetanus toxoids, and acellular pertussis vaccine; HepB = hepatitis B vaccine; Hib = *Haemophilus influenzae* type b conjugate vaccine; MMR = measles, mumps, and rubella vaccine; PCV = pneumococcal conjugate vaccine.

* Vaccination status includes all vaccine doses received by June 1, 2024. The denominator includes patients with an active patient status in the immunization information system as of June 1, 2024. Patient active status in an immunization information system establishes a classification of individual patients within a health care organization. Health care providers are responsible for vaccinating patients with an active status within their clinic population or geographic catchment area. Patient status is changed to inactive when the patient changes providers, moves, or is lost to follow-up, or deceased if patient death is confirmed through manual review or system linkage with vital statistics or other health records. https://repository.immregistries.org/files/resources/5835adc2dad8d/mirow_pais_mini-guide.pdf

† Hib primary series = receipt of ≥2 or ≥3 doses, depending on product type received; full series = primary series and booster dose, which includes receipt of ≥3 or ≥4 doses, depending on product type received.

§ The combined six-vaccine series (4:3:1:3*:3:4) includes ≥4 doses of DTaP, ≥3 doses of poliovirus vaccine, ≥1 dose of measles-containing vaccine, the full Hib series (≥3 or ≥4 doses, depending on product type), ≥3 doses of HepB, and ≥4 doses of PCV.

USAPI IISs (i.e., dose dates and product types between paper and IIS records matched [A Tippins, CDC, unpublished data, 2016–2023]). Second, the active patient population size in IISs can be inflated compared with census estimates because of difficulties tracking out-migration and deaths. These difficulties can lead to an underestimation of vaccination coverage. Recent census data were not available for denominator estimation for all jurisdictions included in this assessment. For this reason, the Modeling of Immunization Registry Operations Workgroup exclusion criteria (*4*) were applied to classify likely active-patient status of patients in IIS. Finally, vaccination coverage for Guam is assessed via the National Immunization Survey and was not included in this analysis (*10*). Differences in vaccination coverage estimation methods might mean that results for Guam are not directly comparable with IIS-based estimates for the other USAPI presented in this report.

Implications for Public Health Practice

Vaccination coverage data can support evaluation of activities by USAPI immunization programs and their partners to increase on-time vaccination of children by age 24 months. The gaps in immunization coverage identified in this report can be used in future research and evaluation to systematically identify determinants of on-time vaccination by jurisdiction. Qualitative research, such as key informant interviews with immunization program stakeholders, might help identify

Summary

What is already known about this topic?

Childhood vaccination is one of the most successful public health interventions. The U.S.-affiliated Pacific Islands (USAPI) immunization programs and CDC collaborate to monitor vaccination coverage in their jurisdictions.

What is added by this report?

This report is the first comprehensive analysis of trends in childhood vaccination coverage in USAPI. Coverage of ≥90% by age 24 months with recommended vaccines was inconsistently met across jurisdictions.

What are the implications for public health practice?

Gaps in coverage identified in this report can be used to identify where evaluation of jurisdiction-specific reasons for lagging on-time vaccination is needed. Monitoring of vaccination coverage can be used to guide intervention implementation and evaluate effectiveness of interventions.

facilitators and barriers to immunization program operations by jurisdiction and to examine the feasibility of implementing evidence-based interventions to improve vaccination service delivery while mitigating identified barriers. Continued monitoring of vaccination coverage can be used to guide intervention implementation and evaluate effectiveness of interventions.

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Corresponding author: Ashley Tippins, ikp9@cdc.gov.

[1]Immunization Services Division, National Center for Immunization and Respiratory Diseases, CDC; [2]Eagle Health Analytics, San Antonio, Texas.

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