Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
Weekly / Vol. 67 / No. 40
October 12, 2018

National Latinx AIDS Awareness Day — October 15, 2018

National Latinx AIDS Awareness Day (https://www.cdc.gov/Features/LatinoAIDSAwareness), October 15, is observed each year to focus on the continuing and disproportionate impact of human immunodeficiency virus (HIV) infection and acquired immunodeficiency syndrome (AIDS) on Hispanics/Latinos in the United States. The prevalence of diagnosed HIV infection among Hispanics/Latinos is approximately twice that among non-Hispanic whites (*1*). The percentage of persons with diagnosed infection who are virally suppressed (<200 copies of HIV RNA per mL of blood) is lower among Hispanics/Latinos than among non-Hispanic whites (*2*).

An analysis of clinical outcomes among Hispanic/Latino participants in CDC's Medical Monitoring Project (2013 and 2014 cycles) found that a significantly higher percentage of women (78%), compared with men (54%), were living in poverty (*3*). However, women and men were equally likely to have received prescriptions for antiretroviral therapy (95% versus 96%) and to have durable viral suppression (68% versus 73%) (*3*).

National Latinx AIDS Awareness Day is an opportunity to encourage increased HIV prevention activities among Hispanics/Latinos. CDC supports testing; linkage to, and engagement in, care and treatment; and other efforts to reduce the risk for acquiring or transmitting HIV infection among Hispanics/Latinos. Additional information is available at https://www.cdc.gov/hiv/group/racialethnic/hispaniclatinos/index.html.

References

1. CDC. HIV surveillance report, 2016; vol. 28. Atlanta, GA: US Department of Health and Human Services, CDC; 2017. https://www.cdc.gov/hiv/library/reports/hiv-surveillance.html
2. CDC. HIV surveillance supplemental report, 2018; vol. 23, no. 4. Atlanta, GA: US Department of Health and Human Services, CDC; 2018. https://www.cdc.gov/hiv/library/reports/hiv-surveillance.html
3. Luna-Gierke R, Shouse R, Luo Q, Frazier E, Chen G, Beer G. Differences in characteristics and clinical outcomes among Hispanic/Latino men and women receiving HIV medical care—United States, 2013–2014. MMWR Morb Mortal Wkly Rep 2018;67:1109–14.

Differences in Characteristics and Clinical Outcomes Among Hispanic/Latino Men and Women Receiving HIV Medical Care — United States, 2013–2014

Ruth E. Luna-Gierke, MPH[1]; R. Luke Shouse, MD[1]; Qingwei Luo, MS[1,2]; Emma Frazier, PhD[1]; Guangnan Chen, MD[1,2]; Linda Beer, PhD[1]

The prevalence of diagnosed human immunodeficiency virus (HIV) infection among Hispanics/Latinos in the United States is approximately twice that of non-Hispanic whites (*1*). Barriers to, and experiences with, medical care have been found to vary by sex (*2*). Describing characteristics of Hispanics/Latinos in care by sex can help identify disparities and inform delivery of tailored services to this underserved population. Data from

INSIDE

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

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

the 2013 and 2014 cycles of the Medical Monitoring Project (MMP) were analyzed to describe demographic, behavioral, and clinical characteristics among Hispanics/Latinos by sex. MMP is an annual cross-sectional, nationally representative surveillance system that, during 2013–2014, collected information about behaviors, medical care, and clinical outcomes among adults receiving outpatient HIV care. Hispanic/Latina women were significantly more likely than were men to live in poverty (78% versus 54%), report not speaking English well (38% versus 21%), and receive interpreter (27% versus 16%), transportation (35% versus 21%), and meal (44% versus 26%) services. There were no significant differences between Hispanic/Latino women and men in prescription of antiretroviral therapy (ART) (95% versus 96%) or sustained viral suppression (68% versus 73%). Although women faced greater socioeconomic and language-related challenges, the clinical outcomes among Hispanic/Latina women were similar to those among men, perhaps reflecting their higher use of ancillary services. Levels of viral suppression for Hispanics/Latinos are lower than those found among non-Hispanic whites (*3*) and lower than the national prevention goal of at least 80% of persons with diagnosed HIV infection. Providers should be cognizant of the challenges faced by Hispanics/Latinos with HIV infection in care and provide referrals to needed ancillary services.

MMP data were collected annually during 2013–2014 using three consecutive sampling stages (states and territories, outpatient HIV facilities, and patients), and response rates for the two cycle-years of data that were included in the analysis were 100% (states and territories), 85%–86% (outpatient HIV facilities) and 55%–56% (patients). Data were collected using face-to-face or telephone interviews and medical record abstraction from June 2013 through May 2015.

The analysis included 1,774 men and 577 women who self-identified as Hispanic or Latino, regardless of race. Data were self-reported from the interview and abstracted from the respondent's medical record. Data were weighted based on known probabilities of selection and adjusted for facility and patient non-response. Rao-Scott chi-square tests were used to assess differences by sex; p-values <0.05 were considered statistically significant. Selected sociodemographic and behavioral variables, use of ancillary services, and clinical outcomes are presented by sex. All analyses accounted for the complex sample design and weights.

Women were significantly more likely than were men to live in poverty (78% versus 54%), live in a household with ≥1 dependents aged <18 years (66% versus 37%), have public insurance coverage (72% versus 54%) and, among those living outside of Puerto Rico, report not speaking English well (38% versus 21%) (Table 1). Compared with men, women were less likely to have more than a high school education (28% versus 47%), be employed (29% versus 48%), have any private insurance (14% versus 22%), and have been born outside the United States (36% versus 45%). Women most often reported their country or region of origin in the Caribbean (including Puerto Rico) (38%), followed by the mainland United States

The *MMWR* series of publications is published by the Center for Surveillance, Epidemiology, and Laboratory Services, Centers for Disease Control and Prevention (CDC), U.S. Department of Health and Human Services, Atlanta, GA 30329-4027.

Suggested citation: [Author names; first three, then et al., if more than six.] [Report title]. MMWR Morb Mortal Wkly Rep 2018;67:[inclusive page numbers].

TABLE 1. Selected characteristics of Hispanics/Latinos receiving medical care for diagnosed HIV infection, by sex — United States, 2013–2014*

Characteristic	Total (N = 2,351)		Men (N = 1,774)		Women (N = 577)		Rao-Scott chi-square p-value comparing men and women
	No.	% (95% CI)†	No.	% (95% CI)†	No.	% (95% CI)†	
Educational attainment							
<High school	741	33.5 (29.4–37.7)	487	29.2 (25.4–33.0)	254	48.0 (38.5–57.4)	<0.0001
High school diploma or GED	571	24.1 (22.2–26.1)	435	24.3 (21.9–26.7)	136	23.6 (20.0–27.2)	
>High School	1,038	42.3 (37.8–46.8)	852	46.5 (42.2–50.8)	186	28.4 (19.6–37.3)	
Employment							
Employed	1,028	43.2 (39.3–47.1)	860	47.5 (43.9–51.1)	168	28.8 (24.2–33.3)	<0.0001
Unemployed	415	19.6 (17.2–21.9)	322	20.0 (17.7–22.3)	93	18.2 (13.2–23.1)	
Other	908	37.3 (32.7–41.8)	592	32.5 (28.9–36.2)	316	53.1 (46.1–60.0)	
Annual household income							
<$19,999	1,642	73.3 (70.0–76.5)	1,174	69.9 (66.5–73.3)	468	84.0 (80.9–87.1)	<0.0001
$20,000–$39,999	411	18.4 (16.1–20.6)	343	20.4 (18.0–22.7)	68	12.1 (9.1–15.0)	
≥$40,000	179	8.4 (6.7–10.0)	153	9.8 (7.7–11.8)	26	3.9 (2.5–5.4)	
No. of household dependents aged <18 years							
0	565	54.7 (50.7–58.7)	449	63.2 (58.6–67.9)	116	34.1 (25.8–42.3)	<0.0001
1–2	374	37.0 (33.4–40.5)	204	29.9 (25.7–34.2)	170	53.9 (46.6–61.2)	
≥3	85	8.4 (6.6–10.1)	49	6.8 (4.8–8.8)	36	12.1 (7.8–16.3)	
Household poverty level§							
Above	891	40.7 (36.2–45.2)	766	46.5 (42.3–50.8)	125	22.2 (18.1–26.3)	<0.0001
At or below	1,340	59.3 (54.8–63.8)	904	53.5 (49.2–57.7)	436	77.8 (73.7–81.9)	
Health coverage or coverage for medications							
Any private insurance	454	20.4 (17.7–23.2)	375	22.3 (19.2–25.3)	79	14.3 (11.1–17.5)	<0.0001
Public insurance only	1,363	57.9 (50.7–65.0)	954	53.6 (47.4–59.8)	409	72.2 (63.8–80.6)	
Uninsured or Ryan White HIV/AIDS Program coverage only	481	21.7 (15.3–28.0)	411	24.1 (18.2–30.1)	70	13.5 (6.3–20.7)	
Homeless¶	155	7.2 (5.7–8.7)	129	7.9 (6.3–9.6)	26	4.6 (2.9–6.4)	0.0015
HIV acquisition risk							
MSM	1,031	44.4 (39.4–49.4)	1,031	57.8 (53.8–61.8)	N/A	N/A	N/A
IDU	189	7.9 (6.3–9.6)	146	7.9 (5.7–10.1)	43	7.9 (5.5–10.4)	N/A
MSM and IDU	55	2.3 (1.5–3.1)	55	3.0 (2.0–4.0)	N/A	N/A	N/A
Heterosexual contact	405	16.3 (12.4–20.1)	119	7.0 (5.3–8.8)	286	46.8 (38.2–55.4)	N/A
Other**	671	29.1 (26.7–31.5)	423	24.2 (21.8–26.6)	248	45.3 (37.4–53.2)	N/A
Speaks English (mainland United States only)							
Well/Very well	1,400	75.4 (72.5–78.3)	1,153	79.0 (76.2–81.9)	247	62.0 (56.1–67.8)	<0.0001
Not well/Not well at all	473	24.6 (21.7–27.5)	317	21.0 (18.1–23.8)	156	38.0 (32.2–43.9)	
Foreign born	982	43.2 (33.1–53.4)	786	45.3 (36.4–54.2)	196	36.4 (22.6–50.2)	0.0007
Country or region of origin							
Mainland United States	751	35.5 (28.3–42.8)	586	36.4 (29.7–43.0)	165	32.8 (22.7–42.9)	<0.0001
Mexico and Central America	706	29.9 (21.7–38.2)	568	31.6 (24.3–38.8)	138	24.6 (13.1–36.0)	
South America	142	6.8 (4.5–9.1)	118	7.5 (5.1–9.8)	24	4.6 (1.9–7.3)	
Caribbean (including Puerto Rico)	741	27.8 (11.7–43.8)	492	24.6 (10.6–38.6)	249	38.1 (16.9–59.3)	
Median years of U.S. residence (range)††	—	19.7 (0–62)	—	19.7 (0–62)	—	19.3 (0–59)	—

Abbreviations: CI = confidence interval; GED = General Educational Development; HIV = human immunodeficiency virus; IDU = injection drug user; MSM = men who have sex with men; N/A = not applicable.

* Numbers might not sum to total because of missing data. Percentages might not sum to 100 because of rounding. All estimates are based on self-report from interview except where otherwise noted. All estimates are based on the 12 months preceding interview except where otherwise noted.

† Percentages are weighted percentages. 95% confidence intervals incorporate weighted percentages.

§ Poverty guidelines as defined by the Department of Health and Human Services (HHS). https://aspe.hhs.gov/poverty/faq.cfm.

¶ Living on the street, in a shelter, in a single-room-occupancy hotel, or in a car.

** Includes hemophilia, blood transfusion, perinatal exposure, and risk factor not reported or not identified.

†† Among persons who were foreign-born.

(33%). Men most often reported the mainland United States as their country or region of origin (36%), followed by Mexico and Central America (32%) (Table 1). Women were also less likely than were men to report using stimulants (3% versus 10%), non-injection drugs (8% versus 23%), injection drugs (0.4% versus 3%), or any opioids (0.8% versus 3%) (Table 2). Women were more likely than men to receive interpreter (27% versus 16%), transportation (35% versus 21%), and meal services (44% versus 26%). Women did not report a greater unmet need for these services than did men. Among women and men, prescription of antiretroviral therapy (95% versus 96%) and prevalence of sustained viral suppression (68% versus 73%) did not significantly differ.

TABLE 2. Selected behaviors and clinical outcomes of Hispanics/Latinos receiving medical care for diagnosed HIV infection, by sex — United States, 2013–2014*

Behavior/Clinical outcome	Total (N = 2,351)		Men (N = 1,774)		Women (N = 577)		Rao-Scott chi-square p-value comparing men and women
	No.	% (95% CI)†	No.	% (95% CI)†	No.	% (95% CI)†	
Meets criteria for depression, past 2 weeks							
No	1,854	80.2 (78.4–81.9)	1,425	81.6 (79.8–83.4)	429	75.5 (71.9–79.1)	0.0058
Other depression	235	9.7 (8.2–11.1)	166	9.1 (7.7–10.6)	69	11.3 (8.6–14.0)	
Major depression	235	10.2 (8.6–11.7)	160	9.3 (7.7–10.8)	75	13.2 (9.7–16.7)	
Substance use							
Binge drinking in past 30 days	401	16.6 (14.7–18.6)	353	19.3 (16.9–21.6)	48	8.0 (4.9–11.1)	<0.0001
Non-IDU	423	19.5 (16.7–22.3)	380	23.1 (20.0–26.2)	43	7.7 (5.4–10.0)	<0.0001
IDU	58	2.3 (1.7–2.9)	54	2.9 (2.1–3.7)	4	0.4§ (0.1–0.7)	<0.0001
Stimulant use	197	8.5 (7.1–9.9)	178	10.2 (8.4–12.0)	19	2.9 (1.3–4.6)	<0.0001
Any opioid use	65	2.6 (1.9–3.2)	59	3.1 (2.3–3.9)	6	0.8§ (0.1–1.6)	0.002
Receipt of services							
Interpreter	420	18.9 (14.1–23.7)	283	16.4 (12.9–19.9)	137	27.1 (15.8–38.4)	0.0063
Transportation	550	24.5 (20.6–28.3)	364	21.4 (18.0–24.7)	186	34.8 (25.5–44.0)	0.0006
Meal	713	30.5 (27.4–33.7)	467	26.4 (23.4–29.4)	246	44.1 (39.4–48.8)	<0.0001
Unmet need for services							
Interpreter	23	0.8 (0.4–1.3)	16	0.8§ (0.3–1.3)	7	0.9§ (0.2–1.7)	0.7522
Transportation	224	9.4 (7.8–10.9)	165	9.2 (7.5–10.9)	59	10.0 (7.1–12.8)	0.5992
Meal	213	8.8 (7.5–10.2)	161	8.9 (7.4–10.3)	52	8.7 (6.2–11.2)	0.9237
STD screening¶							
Gonorrhea	1,334	54.1 (48.7–59.5)	1,020	55.0 (49.8–60.1)	314	51.2 (42.0–60.4)	0.3408
Chlamydia	1,325	53.9 (48.8–59.1)	1,013	54.7 (49.8–59.7)	312	51.2 (42.6–59.9)	0.3425
Syphilis	1,694	70.4 (67.2–73.7)	1,317	72.5 (69.1–75.8)	377	63.7 (57.3–70.2)	0.0069
ART prescribed¶	2,244	95.9 (95.1–96.7)	1,698	96.1 (95.2–97.0)	546	95.1 (93.2–97.1)	0.3652
Adherent, past 3 days**	1,939	88.5 (86.7–90.3)	1,461	88.1 (86.3–89.8)	478	90.1 (86.4–93.7)	0.3078
Sustained viral suppression¶	1,707	71.8 (69.4–74.2)	1,311	72.9 (70.2–75.6)	396	68.0 (62.7–73.3)	0.0888

Abbreviations: ART = antiretroviral therapy; CI = confidence interval; HIV = human immunodeficiency virus; IDU = injection drug use; STD = sexually transmitted disease.
* Numbers might not sum to total because of missing data. Percentages might not sum to 100 because of rounding. All estimates are based on self-report from interview except where otherwise noted. All estimates are based on the 12 months preceding interview except where otherwise noted.
† Percentages are weighted percentages. 95% confidence intervals incorporate weighted percentages.
§ Coefficient of variation >0.30; estimate might be unstable.
¶ Estimates from medical record abstraction. Abstractions were performed at the usual source of outpatient HIV medical care in the 12 months before the last care visit.
** Among persons taking ART, took 100% of ART doses in the past 3 days.

Discussion

Compared with men, more Hispanic/Latina women with HIV infection in care faced socioeconomic and language-related challenges than did men; however, they had similar prevalences of ART prescription and viral suppression. Hispanic/Latina women used ancillary services at higher rates than did Hispanic/Latino men, perhaps mitigating the effects of the noted challenges on their clinical outcomes.

The poverty rate among Hispanics or Latinos in the United States is approximately twice that of non-Hispanic whites, and women live in poverty at higher rates than do men (*4*). This study found that 78% of Hispanic/Latina women receiving HIV care lived at or below the federal household poverty level, compared with 54% of men. Poverty is known to affect management of HIV infection and is a paramount concern affecting all stages of the HIV care continuum (*5*). Some ART regimens require food; thus, lack of food might lead to nonadherence. Lack of transportation might pose barriers to attending medical appointments and obtaining medications. Women's higher receipt of meal and transportation services might have helped alleviate the negative consequences of food insecurity and lack of transportation on their clinical outcomes.

Among racial and ethnic groups in the United States, Hispanics/Latinos are the group least likely to have any health insurance coverage (*6*). In this study, 22% of Hispanic/Latino men and 14% of Hispanic/Latina women had any private health insurance. However, 72% of Hispanic/Latina women and 54% of men relied on public insurance only. Taken together, 87% of women and 76% of men had some type of coverage. The higher coverage among women might also have contributed to similar clinical outcomes between men and women. Moreover, the Ryan White HIV/AIDS Program provides comprehensive care as well as support services for persons living with HIV infection who have no insurance or are underinsured and is associated with improved clinical outcomes among persons in poverty (*7*).

Overall, 38% of women and 21% of men reported not speaking English well, which can affect ability to understand a provider's instructions and ability to navigate the health care system (*8*). In addition, the language barrier might prevent care

Summary

What is already known about this topic?

The prevalence of diagnosed human immunodeficiency virus (HIV) infection among Hispanics/Latinos in the United States is approximately twice that of non-Hispanic whites. Describing Hispanics/Latinos with HIV-infection in medical care by sex could inform service delivery.

What is added by this report?

During 2013–2014, among Hispanics/Latinos with HIV infection in care, women were significantly more likely than were men to live in poverty, have English language difficulties, and receive ancillary services. Prescription of antiretroviral therapy and sustained viral suppression did not significantly differ by sex.

What are the implications for public health practice?

Providers should be cognizant of the challenges faced by Hispanics/Latinos with HIV-infection in care and provide referrals to needed ancillary services.

providers from understanding the patient and could lead to missed opportunities to provide needed support or direction. Bilingual providers or interpreter services might have mitigated linguistic barriers.

Lower levels of substance abuse might also have contributed to better clinical outcomes among Hispanic/Latina women receiving HIV care. Persons who use drugs have been found to have lower levels of adherence (*9*) and, therefore, lower levels of sustained viral suppression, which is critical to reducing morbidity and mortality and preventing transmission to others.

Hispanics/Latinos in HIV care still have higher levels of unmet need for services when compared with other populations (*10*). Although no disparities between men and women in sustained viral suppression among Hispanics/Latinos were identified, levels are still lower than those found among non-Hispanic whites (*3*) and lower than the national prevention goal of at least 80% viral suppression for persons with diagnosed HIV infection.

Through partnerships that use a high-impact approach to advancing national HIV prevention goals, CDC works to improve health outcomes and reduce HIV transmission among all Americans. CDC provides support and assistance to health departments and community-based organizations deliver effective interventions to decrease HIV incidence among Hispanic/Latinos, improve their health outcomes, and reduce transmission. CDC also raises awareness about HIV among Hispanics/Latinos through Partnering and Communicating Together to Act Against AIDS (PACT),* which includes the National Hispanic Medical Association and is part of the larger Act Against AIDS initiative.

The findings in this report are subject to at least three limitations. First, the results might not be applicable to Hispanic/Latinos living with HIV infection who are not receiving medical care. Second, behavioral characteristics are self-reported and thus, might be subject to measurement error as well as reporting and social desirability biases. Finally, data were adjusted to minimize nonresponse bias based on known characteristics of sampled facilities and patients; however, the possibility of residual nonresponse bias exists.

Hispanic/Latino men and women with HIV-infection in care differ from one another in their behavioral and sociodemographic characteristics. Hispanic/Latina women receiving HIV care face more socioeconomic and language-related challenges than do men. However, rates of ART prescription and sustained viral suppression did not differ between Hispanic/Latino men and women, perhaps reflecting Hispanic/Latina women's greater use of ancillary services. It is important for providers to be cognizant of the challenges faced by this population and assist with access to needed ancillary services. Although the lack of disparity in viral suppression among Hispanic/Latino men and women in HIV care is encouraging, work still remains to decrease ethnic disparities and attain national prevention goals among this population.

Corresponding author: Ruth E. Luna-Gierke, RGierke@cdc.gov.

[1]Division of HIV/AIDS Prevention, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, CDC; [2]ICF International, Fairfax, Virginia.

All authors have completed and submitted the ICMJE form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

References

1. CDC. Diagnoses of HIV infection in the United States and dependent areas, 2016. HIV surveillance report; vol. 28. Atlanta, GA: US Department of Health and Human Services, CDC; 2017. https://www.cdc.gov/hiv/pdf/library/reports/surveillance/cdc-hiv-surveillance-report-2016-vol-28.pdf
2. US Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau. Women's health USA 2013. Rockville, MD: US Department of Health and Human Services, Health Resources and Services Administration, Maternal and Child Health Bureau; 2013. https://mchb.hrsa.gov/whusa13/
3. Beer L, Mattson CL, Bradley H, Skarbinski J; Medical Monitoring Project. Understanding cross-sectional racial, ethnic, and gender disparities in antiretroviral use and viral suppression among HIV patients in the United States. Medicine (Baltimore) 2016;95:e3171. https://doi.org/10.1097/MD.0000000000003171
4. Semega JL, Fontenot KR, Kollar MA. Income and poverty in the United States: 2016. Current population reports. Washington, DC: US Department of Commerce, US Census Bureau; 2017. https://www.census.gov/content/dam/Census/library/publications/2017/demo/P60-259.pdf
5. Pellowski JA, Kalichman SC, Matthews KA, Adler N. A pandemic of the poor: social disadvantage and the U.S. HIV epidemic. Am Psychol 2013;68:197–209. https://doi.org/10.1037/a0032694

* https://www.cdc.gov/actagainstaids/partnerships/pact.html.

6. Barnett JC, Berchick ER. Health insurance coverage in the United States: 2016. Current population reports. Washington, DC: US Department of Commerce, US Census Bureau; 2017. https://www.census.gov/content/dam/Census/library/publications/2017/demo/p60-260.pdf
7. Weiser J, Beer L, Frazier EL, et al. Service delivery and patient outcomes in Ryan White HIV/AIDS Program-funded and -nonfunded health care facilities in the United States. JAMA Intern Med 2015;175:1650–9. https://doi.org/10.1001/jamainternmed.2015.4095
8. Morales-Aleman MM, Sutton MY. Hispanics/Latinos and the HIV continuum of care in the Southern USA: a qualitative review of the literature, 2002–2013. AIDS Care 2014;26:1592–604. https://doi.org/10.1080/09540121.2014.936817
9. Gonzalez A, Barinas J, O'Cleirigh C. Substance use: impact on adherence and HIV medical treatment. Curr HIV/AIDS Rep 2011;8:223–34. https://doi.org/10.1007/s11904-011-0093-5
10. Korhonen LC, DeGroote NP, Shouse RL, Valleroy LA, Prejean J, Bradley H. Unmet needs for ancillary services among Hispanics/Latinos receiving HIV medical care—United States, 2013–2014. MMWR Morb Mortal Wkly Rep 2016;65:1104–7. https://doi.org/10.15585/mmwr.mm6540a3

Vaccination Coverage for Selected Vaccines and Exemption Rates Among Children in Kindergarten — United States, 2017–18 School Year

Jenelle L. Mellerson, MPH[1,2]; Choppell B. Maxwell, DrPH[1,2]; Cynthia L. Knighton[2]; Jennifer L. Kriss, PhD[2]; Ranee Seither, MPH[2]; Carla L. Black, PhD[2]

State and local school vaccination requirements exist to ensure that students are protected from vaccine-preventable diseases (*1*). This report summarizes vaccination coverage and exemption estimates collected by state and local immunization programs* for children in kindergarten (kindergartners) in 49 states and the District of Columbia (DC) and kindergartners provisionally enrolled (attending school without complete vaccination or exemption while completing a catch-up vaccination schedule) or in a grace period (a set interval during which a student may be enrolled and attend school without proof of complete vaccination or exemption) for 28 states. Median vaccination coverage† was 95.1% for the state-required number of doses of diphtheria and tetanus toxoids, and acellular pertussis vaccine (DTaP); 94.3% for 2 doses of measles, mumps, and rubella vaccine (MMR); and 93.8% for 2 doses of varicella vaccine. The median percentage of kindergartners with an exemption from at least one vaccine§ was 2.2%, and the median percentage provisionally enrolled or attending school during a grace period was 1.8%. Vaccination coverage among kindergartners remained high; however, schools can improve coverage by following up with students who are provisionally enrolled, in a grace period, or lacking complete documentation of required vaccinations.

Federally funded immunization programs collaborate with departments of education, school nurses, and other school personnel to assess vaccination coverage and exemption status of children enrolled in public and private kindergartens.¶ In accordance with state and local school entry requirements, parents and guardians submit children's vaccination records or exemption forms to schools, or schools obtain records from state immunization information systems. During the 2017–18 school year, 49 states and DC reported coverage for all state-required vaccines and exemption data among public school kindergartners; 48 states and DC reported on private school kindergartners.** Median vaccination coverage for the state-required number of doses of DTaP, 2 doses of MMR, and 2 doses of varicella vaccine are reported. Coverage with hepatitis B and poliovirus vaccines, which are required in most states but not included in this report, are presented on SchoolVaxView (*2*). Twenty-eight states reported data on kindergartners who, at the time of assessment, attended school under a grace period or provisional enrollment. Immunization programs in U.S. territories also receive public funding for immunization and report vaccination coverage and exemptions to CDC; however, national medians and summary measures reported here include only the U.S. states and DC.

Vaccination coverage and exemption estimates were adjusted according to survey type and response rates.†† During the 2017–18 school year, vaccination coverage data were reported for approximately 3,988,127 kindergartners, exemption data for approximately 3,634,631, and grace period and provisional

* Federally funded immunization programs are located in the 50 states and DC, five cities, and eight U.S territories and freely associated states (territories). Two cities reported data to CDC, which were included in their state data to calculate medians. Immunization programs in U.S. territories reported vaccination coverage and exemptions to CDC; however, these data were not included in median calculations.

† Median vaccination coverage was determined using estimates for 49 states and DC; Wyoming did not report data because of problems with the quality of data reported by schools. Data from cities were included with their state data. Data from territories were not included in median calculation.

§ Median exemption rate was determined using estimates for 45 states and DC; Wyoming did not report data because of problems with the quality of data reported by schools; Colorado, Illinois, Minnesota, and Missouri were included in the tables and figure but excluded from the median exemption rate because they did not collect information on the number of kindergartners with an exemption. Data from cities were included with their state data. Data from territories were not included in median calculation.

¶ Assessment date varied by state and area. Seven states assess on the first day of school; 18 states assess by December 31; 12 states assess by some other date, ranging from 30 days after admission to March 5; 12 states and DC assess on a rolling basis.

** Six states reported coverage and exemption data for at least some homeschooled kindergartners. California included data for 18 independent study schools and eight virtual schools in public school data and data for homeschools with six or more students in private school data. North Dakota reported some homeschool data separately. Oregon reported some homeschool data separately; children enrolled in public online homeschools were included in the public school data. Pennsylvania included all homeschooled students in their public school data. Utah included some homeschooled students in public and private school data. Vermont included homeschooled students in their public and private school data if the students were enrolled in one or more classes at a school; homeschooled children who were exclusively homeschooled were not subject to vaccination requirements and were not included in these estimates.

†† Most immunization programs that used census or voluntary response provided CDC with data aggregated at the state or local (city or territory) level. Coverage and exemption data based on a census or voluntary response were adjusted for nonresponse using the inverse of the response rate, stratified by school type (public, private, and homeschool, where available). Programs that used complex sample surveys provided CDC with deidentified data aggregated at the school or county level for weighted analysis. Weights were calculated to account for sample design and adjusted for nonresponse for data collected through complex sample design wherever possible.

enrollment data for approximately 2,825,691.[§§] Potentially achievable coverage for MMR was calculated for each state as the percentage of students vaccinated with 2 doses of MMR plus the percentage without 2 doses of MMR and no documented vaccination exemption. Nonexempt students included those provisionally enrolled, in a grace period, or otherwise without documentation of vaccination.

During the 2017–18 school year, vaccination assessments varied by immunization program because of differences in states' required vaccines and doses, vaccines assessed, assessment methods, and data reported. Among the 49 states and DC reporting kindergarten vaccination data, 36 used a census; nine used a sample; three used a voluntary school response; and two used a mix of sampling methods.[¶¶] All states used the same methods to collect both vaccination coverage and exemption data except Alaska, Kansas, Virginia, and Wisconsin, where a sample was used for vaccination coverage data and a census for exemption data. Kindergartners were considered up to date and included in the coverage estimate for a given vaccine if they received all doses required for school entry,[***] except in seven states[†††] that considered kindergartners up to date only if they received all doses of all vaccines required for school entry. Reporting of varicella vaccination status among kindergartners with a history of varicella disease varied within and among states; some were reported as vaccinated against varicella and others as medically exempt.

Among the 49 states and DC included in this analysis, median 2-dose MMR coverage was 94.3% (range = 81.3% [DC] to ≥99.4% [Mississippi]), 23 states reported coverage ≥95%, and three states and DC reported coverage <90% (Table 1). Median DTaP coverage was 95.1% (range = 79.7% [DC] to ≥99.4% [Mississippi]), 25 states reported coverage ≥95%, and three states and DC reported coverage <90%. Among the 41 states and DC that required and reported 2 doses of varicella vaccine, median coverage was 93.8% (range = 80.5% [DC] to ≥99.4% [Mississippi]), 17 states reported coverage ≥95%, and four states and DC reported coverage <90%.

The median percentage of kindergartners with an exemption from one or more required vaccines (not limited to MMR, DTaP, and varicella vaccines) was 2.2% (range = 0.1% [Mississippi] to 7.6% [Oregon]), compared with 2.0% during the 2016–17 school year (Table 2). The median percentage of medical exemptions was 0.2% (range = <0.1% [Hawaii] to 0.8% [Alaska]); the median percentage of nonmedical exemptions was 2.0% (range = <0.1% [California] to 7.5% [Oregon]). Among the 29 states and DC with an increase in exemptions in 2017–18, vaccination coverage was ≥95% in 15 states for MMR, 16 states for DTaP, and 11 states for 2 doses of varicella.

The median reported percentage of kindergartners attending school during a grace period or provisionally enrolled was 1.8% (range = 0.2% [Georgia and Hawaii] to 8.5% [Arkansas]) (Table 2). In 11 of 28 states reporting for the 2017–18 school year, the percentage of children provisionally enrolled or within a grace period at the time of the assessment exceeded the percentage of children with exemptions from ≥1 vaccines. Among the 26 states and DC with MMR coverage <95%, 20 could potentially achieve ≥95% coverage if all nonexempt students who were provisionally enrolled, in a grace period, or otherwise without evidence of complete vaccination were vaccinated (Figure).

Discussion

During the 2017–18 school year, median kindergarten vaccination coverage was close to 95% for MMR, DTaP, and varicella vaccine. The number of states with coverage ≥95% increased from 20 to 23 (MMR), 23 to 25 (DTaP), and 15 to 17 (2 varicella vaccine doses) since the 2016–17 school year (*2*,*3*). Coverage increases in selected states might result from modifications to state programs. For example, Pennsylvania reduced its provisional enrollment period from 240 days to 5 days with a medical certificate indicating the scheduling of missing vaccine doses. The Indiana State Department of Health initiated report cards for schools displaying kindergarten vaccination coverage rates and built a bidirectional interface that increased the amount of data in their immunization information system. Kentucky removed the provider signature requirement when printing a certificate of immunization status, allowing school nurses to use the immunization information system certificate to document vaccination history. In Virginia, the number of local health departments participating in back-to-school immunization clinics for children entering school

[§§] The kindergarten population is an approximation provided by each immunization program. The totals reported here are the summations of the kindergarten population among programs reporting data for coverage, exemptions, and grace periods or provisional enrollment. Data from cities and territories were not included in these totals.

[¶¶] States using a census attempted to collect data from all kindergartners at all schools and succeeded in collecting data for ≥90% of kindergartners. The type of sample employed by the nine states using a sample to collect coverage data varied and included a stratified two-stage cluster sample (eight states) and a stratified one-stage cluster sample (one state). A voluntary response of schools was defined as a census survey with a response rate <90% of the known population of kindergartners. A mix of methods included two or more described sampling methods (a census for one school type and voluntary response for the other).

[***] All 49 reporting states and DC required 2 doses of a measles-containing vaccine. Local DTaP requirements varied. Nebraska required 3 doses, four states (Illinois, Maryland, Virginia, and Wisconsin) required 4 doses, and all other states required 5 doses, unless the fourth dose was administered on or after the fourth birthday. The reported coverage estimates represent the percentage of kindergartners with the state-required number of DTaP doses, except for Kentucky, which required 5 doses of DTaP by age 5 years, but reported 4-dose coverage for kindergartners. Nine states required 1 dose of varicella vaccine; 41 states and DC required 2 doses.

[†††] Alabama, Florida, Georgia, Iowa, Mississippi, New Hampshire, and New Jersey considered kindergartners up to date only if they had received all doses of all vaccines required for school entry.

TABLE 1. Estimated vaccination coverage* for MMR, DTaP, and varicella vaccines among children enrolled in kindergarten, by vaccine and immunization program — United States and territories, 2017–18 school year

Immunization program	Kindergarten population†	No. (%) surveyed	Type of survey conducted§	Local data available online¶	MMR** 2 doses (%)	DTaP†† 4 or 5 doses (%)	Varicella 1 dose (%)	Varicella 2 doses (%)
Median§§					**94.3**	**95.1**	**96.2**	**93.8**
Alabama¶¶	57,245	57,245 (100.0)	Census	Yes	≥92.7	≥92.7	≥92.7	NReq
Alaska***,†††	9,692	707 (7.3)	Stratified 2-stage cluster sample	No	91.6	91.1	NA	91.3
Arizona¶¶	81,710	81,710 (100.0)	Census	Yes	93.4	93.5	96.2	NReq
Arkansas§§§	39,630	38,242 (96.5)	Census (public), voluntary response (private)	No	91.9	91.3	NA	91.6
California§§§	574,702	564,121 (98.2)	Census	Yes	96.9	96.4	98.2	NReq
Colorado¶¶	65,718	65,718 (100.0)	Census	Yes	88.7	88.6	NA	87.7
Connecticut¶¶	39,174	39,174 (100.0)	Census	No	96.5	96.5	NA	96.3
Delaware	10,988	1,053 (9.6)	Stratified 2-stage cluster sample	No	96.7	96.9	NA	96.7
District of Columbia¶¶	8,205	8,205 (100.0)	Census	No	81.3	79.7	NA	80.5
Florida¶¶,***	222,397	222,397 (100.0)	Census	Yes	≥93.7	≥93.7	NA	≥93.7
Georgia¶¶	131,459	131,459 (100.0)	Census	No	≥93.4	≥93.4	NA	≥93.4
Hawaii	16,325	1,040 (6.4)	Stratified 2-stage cluster sample	No	95.6	95.4	96.2	NReq
Idaho	22,553	22,458 (99.6)	Census	Yes	89.5	89.3	NA	88.6
Illinois¶¶	144,858	144,858 (100.0)	Census	Yes	95.2	95.3	NA	94.8
Indiana	84,296	70,857 (84.1)	Voluntary response	Yes	90.4	94.3	NA	90.2
Iowa¶¶	39,632	39,632 (100.0)	Census	Yes	≥93.0	≥93.0	NA	≥93.0
Kansas***,†††,§§§	38,484	8,728 (22.7)	Stratified 2-stage cluster sample	Yes	89.1	89.5	NA	88.3
Kentucky***,§§§	55,152	50,538 (91.6)	Census	Yes	92.6	93.7	NA	91.7
Louisiana¶¶	58,277	58,277 (100.0)	Census	Yes	96.1	97.7	NA	95.6
Maine	13,255	12,527 (94.5)	Census	Yes	94.3	95.3	96.5	NReq
Maryland§§§	68,528	67,747 (98.9)	Census	No	98.6	99.0	NA	98.6
Massachusetts¶¶,§§§	63,377	63,377 (100.0)	Census	Yes	96.3	96.4	NA	96.0
Michigan¶¶	119,028	119,028 (100.0)	Census	Yes	95.0	95.3	NA	94.7
Minnesota***	69,807	67,372 (96.5)	Census	Yes	92.5	92.8	NA	92.2
Mississippi¶¶	39,284	39,284 (100.0)	Census	Yes	≥99.4	≥99.4	NA	≥99.4
Missouri¶¶	73,113	73,113 (100.0)	Census	No	95.2	95.3	NA	95.0
Montana¶¶	12,188	12,188 (100.0)	Census	No	93.2	92.6	NA	91.6
Nebraska§§§	26,313	25,796 (98.0)	Census	No	96.2	96.7	NA	95.5
Nevada	37,178	1,769 (4.8)	Stratified 2-stage cluster sample	No	93.0	92.6	NA	92.6
New Hampshire	12,165	11,939 (98.1)	Census	No	≥92.4	≥92.4	NA	≥92.4
New Jersey¶¶	107,630	107,630 (100.0)	Census	Yes	≥96.1	≥96.1	≥96.1	NReq
New Mexico	26,896	1,256 (4.7)	Stratified 2-stage cluster sample	No	94.8	94.9	NA	94.5
New York (including New York City)¶¶	226,456	226,456 (100.0)	Census	Yes	97.2	96.9	NA	96.9
New York City¶¶	100,466	100,466 (100.0)	Census	No	97.8	97.3	NA	97.4
North Carolina***,§§§	127,197	120,827 (95.0)	Census	No	97.0	96.8	NA	96.8
North Dakota	10,365	10,293 (99.3)	Census	Yes	94.2	94.1	NA	93.9
Ohio	138,753	132,763 (95.7)	Census	No	92.1	92.1	NA	91.5
Oklahoma***	53,898	48,481 (89.9)	Census (public), voluntary response (private)	No	92.6	93.9	96.8	NReq
Oregon¶¶,§§§	45,818	45,818 (100.0)	Census	Yes	93.2	92.4	94.4	NReq
Pennsylvania	141,571	123,377 (87.1)	Voluntary response	Yes	96.7	97.0	NA	97.0
Rhode Island¶¶,***,§§§	11,025	11,025 (100.0)	Census	Yes	96.4	96.2	NA	96.0
South Carolina	58,458	16,174 (27.7)	Stratified 1-stage cluster sample	No	96.3	96.6	NA	96.1
South Dakota	12,125	12,112 (99.9)	Census	Yes	96.6	95.9	NA	95.8
Tennessee¶¶,***	78,743	78,743 (100.0)	Census	Yes	96.9	96.7	NA	96.8
Texas (including Houston)***,§§§	387,981	378,008 (97.4)	Census	Yes	96.9	96.8	NA	96.4
Houston***,§§§	43,340	38,343 (88.5)	Voluntary response (public), Census (private)	No	95.1	95.2	NA	94.7

See table footnotes on next page

TABLE 1. (*Continued*) Estimated vaccination coverage* for MMR, DTaP, and varicella vaccines among children enrolled in kindergarten, by vaccine and immunization program — United States and territories, 2017–18 school year

Immunization program	Kindergarten population†	No. (%) surveyed	Type of survey conducted§	Local data available online¶	MMR** 2 doses (%)	DTaP†† 4 or 5 doses (%)	Varicella 1 dose (%)	Varicella 2 doses (%)
Utah¶¶	48,827	48,827 (100.0)	Census	Yes	93.4	93.2	NA	93.7
Vermont¶¶	6,255	6,255 (100.0)	Census	Yes	94.1	94.0	NA	93.2
Virginia†††	100,581	4,224 (4.2)	Stratified 2-stage cluster sample	Yes	95.5	98.2	NA	93.3
Washington***	85,118	79,977 (94.0)	Census	Yes	90.6	90.7	NA	89.4
West Virginia****	19,519	15,120 (77.5)	Voluntary response	Yes	98.4	98.0	NA	98.1
Wisconsin***,†††,§§§	66,178	1,223 (1.8)	Stratified 2-stage cluster sample	No	91.8	96.5	NA	91.2
Wyoming	NA	NA	Not conducted	No	NA	NA	NA	NA
Territories and associated states								
American Samoa¶¶,****	758	758 (100.0)	Census	No	90.9	81.8	NReq	NReq
Federated States of Micronesia¶¶	1,886	1,886 (100.0)	Census	No	94.0	75.8	NReq	NReq
Guam	2,625	700 (26.7)	Stratified 2-stage cluster sample	No	85.0	92.0	NReq	NReq
Marshall Islands¶¶	1,086	1,086 (100.0)	Census	No	96.6	67.7	NReq	NReq
Northern Mariana Islands¶¶	876	876 (100.0)	Census	No	92.8	75.6	NA	92.6
Palau¶¶,¶¶¶	313	313 (100.0)	Census	No	100.0	100.0	NReq	NReq
Puerto Rico††††	NA	NA	Not conducted	No	NA	NA	NA	NA
U.S. Virgin Islands††††	NA	NA	Not conducted	No	NA	NA	NA	NA

Abbreviations: DTaP/DT = diphtheria and tetanus toxoids (DT) and acellular pertussis vaccine; MMR = measles, mumps, and rubella vaccine; NA = not available; NReq = not required for school entry.

* Estimates are adjusted for nonresponse and weighted for sampling where appropriate. Estimates based on a completed vaccine series (i.e., not vaccine-specific) use the "≥" symbol. Coverage might include history of disease or laboratory evidence of immunity.

† The kindergarten population is an approximation provided by each program.

§ Sample designs varied by state or area: census = program attempted to include all schools (public and private) and all children within schools in the assessment and had a student response rate of ≥90%; 1-stage or 2-stage cluster sample = schools were randomly selected, and all children in the selected schools were assessed (1-stage), or a random sample of children within the schools was selected (2-stage); voluntary response = a census with a student response rate of <90% (does not imply that participation was optional).

¶ Some programs publish kindergarten vaccination data online that are more detailed than the state-level estimates in this table. Examples of more detailed data include county, parish, school district, and school-level estimates.

** Most states require 2 doses of MMR; Alaska, New Jersey, and Oregon require 2 doses of measles, 1 dose of mumps, and 1 dose of rubella vaccines. Georgia, New York, New York City, North Carolina, and Virginia require 2 doses of measles and mumps and 1 dose of rubella vaccines. Iowa requires 2 doses of measles and 2 doses of rubella vaccines.

†† Pertussis vaccination coverage might include some diphtheria, tetanus toxoids, and pertussis vaccine (DTP) vaccinations if administered in another country or by a vaccination provider who continued to use DTP after 2000. Most states require 5 doses of DTaP for school entry, or 4 doses if the fourth dose was received on or after the fourth birthday; Illinois, Maryland, Virginia, and Wisconsin require 4 doses; Nebraska requires 3 doses. The reported coverage estimates represent the percentage of kindergartners with the state-required number of DTaP doses, except for Kentucky, which requires ≥5 but reports ≥4 doses of DTaP.

§§ Medians calculated from data from 49 states and the District of Columbia (i.e., does not include Wyoming, Houston, New York City, American Samoa, Federated States of Micronesia, Guam, Marshall Islands, Northern Mariana Islands, Palau, Puerto Rico, or U.S. Virgin Islands). Coverage data were reported for 3,988,127 kindergartners.

¶¶ The percentage surveyed likely was <100%, but is reported as 100% based on incomplete information about the actual current enrollment.

*** Did not include some types of schools, such as online schools or those located on military bases or in correctional facilities.

††† Kindergarten vaccination coverage data were collected from a sample, and exemption data were collected from a census of kindergartners.

§§§ Counted some or all vaccine doses received regardless of Advisory Committee on Immunization Practices recommended age and time interval; vaccination coverage rates reported might be higher than those for valid doses.

¶¶¶ For Palau, estimates represent coverage among children in first grade.

**** Reported public school data only.

†††† Puerto Rico and U.S. Virgin Islands did not report data for the 2017–18 school year because of widespread logistical issues caused by Hurricane Maria.

increased, with most local health departments following up with parents about missing vaccinations before the clinics (J Mellerson, CDC, unpublished data, 2018).

Although the overall percentage of children with an exemption was low, this was the third consecutive school year that a slight increase was observed (*2*). Reasons for the increase cannot be determined from the data reported to CDC but could include the ease of the procedure for obtaining exemptions (*4*) or parental vaccine hesitancy (*5*). Reported exemptions do not distinguish between exemptions for one vaccine versus all vaccines. Previous studies indicate that most children with exemptions have received at least some vaccines (*6–8*).

Recent data from the National Immunization Survey indicate the percentage of children reaching age 2 years without having received any vaccinations has increased gradually, from 0.9% for children born in 2011 to 1.3% for children born in 2015

TABLE 2. Estimated number and percentage* of children enrolled in kindergarten with reported type of exemption from vaccination, and grace period/provisional enrollment, by immunization program† — United States and territories, 2017–18 school year

		Nonmedical exemptions			Any exemption				
Immunization program	Medical exemptions, no. (%)	Religious no.	Philosophical no.	Total no. (%)	2017–18, no.	2017–18 %	2016–17 %	Percentage point difference (2016–17 to 2017–18)	Grace period or provisional enrollment§ no. (%)
Median¶	**(0.2)**	—	—	**(2.0)**	—	**2.2**	**2.0**	**0.2**	**(1.8)**
Alabama	59 (0.1)	460	—**	460 (0.8)	519	0.9	0.7	0.2	None
Alaska	75 (0.8)	549	—**	549 (6.1)	624	7.0	6.8	0.2	NR
Arizona	400 (0.5)	—††	4,336	4,336 (5.3)	4,736	5.8	5.1	0.7	NR
Arkansas	14 (0.1)	213	428	641 (1.6)	655	1.7	1.4	0.3	3,379 (8.5)
California	4,190 (0.7)	—§§	—§§	5 (<0.1)	4,195	0.7	1.1	-0.4	10,568 (1.8)
Colorado	—¶¶	—¶¶	—¶¶	—¶¶	—¶¶	—¶¶	—¶¶	—¶¶	NR
Connecticut	126 (0.3)	764	—**	764 (2.0)	890	2.3	2.1	0.2	None
Delaware	3 (0.1)	148	—**	148 (1.3)	151	1.4	1.2	0.2	NR
District of Columbia	58 (0.7)	352	—**	352 (4.3)	410	5.0	1.1	3.9	NR
Florida	1,051 (0.5)	5,394	—**	5,394 (2.4)	6,445	2.9	2.5	0.4	7,349 (3.3)
Georgia	102 (0.1)	3,480	—**	3,480 (2.6)	3,582	2.7	2.8	-0.1	287 (0.2)
Hawaii	4 (<0.1)	514	—**	514 (3.1)	518	3.1	2.8	0.3	37 (0.2)
Idaho	93 (0.4)	—§§	—§§	1,504 (6.7)	1,597	7.1	6.5	0.6	408 (1.8)
Illinois	—¶¶	—¶¶	—¶¶	—¶¶	—¶¶	—¶¶	—¶¶	—¶¶	NR
Indiana	156 (0.2)	579	—**	579 (0.7)	735	0.9	1.0	-0.1	NR
Iowa	93 (0.2)	694	—**	694 (1.8)	787	2.0	1.8	0.2	1,356 (3.4)
Kansas	125 (0.3)	544	—**	544 (1.4)	669	1.7	1.8	-0.1	NR
Kentucky	174 (0.3)	623	—**	623 (1.1)	797	1.4	1.1	0.3	NR
Louisiana	61 (0.1)	49	552	601 (1.0)	662	1.1	0.8	0.3	NA
Maine	34 (0.3)	58	608	666 (5.0)	700	5.3	5.0	0.3	186 (1.4)
Maryland	390 (0.6)	614	—**	614 (0.9)	1,005	1.5	1.4	0.1	NR
Massachusetts	166 (0.3)	687	—**	687 (1.1)	853	1.3	1.3	0.0	None
Michigan	251 (0.2)	1,095	3,658	4,753 (4.0)	5,004	4.2	3.7	0.5	719 (0.6)
Minnesota	—¶¶	—¶¶	—¶¶	—¶¶	—¶¶	—¶¶	—¶¶	—¶¶	NR
Mississippi	38 (0.1)	—††	**	—**,††	38	0.1	0.1	0.0	165 (0.4)
Missouri	—¶¶	—¶¶	—¶¶	—¶¶	—¶¶	—¶¶	—¶¶	—¶¶	NR
Montana	48 (0.4)	478	—**	478 (3.9)	526	4.3	3.7	0.6	211 (1.7)
Nebraska	192 (0.7)	394	—**	394 (1.5)	586	2.2	2.0	0.2	463 (1.8)
Nevada	26 (0.1)	1,170	—**	1,170 (3.1)	1,196	3.2	4.4	-1.2	600 (1.6)
New Hampshire	22 (0.2)	334	—**	334 (2.7)	357	2.9	3.2	-0.3	573 (4.7)
New Jersey	171 (0.2)	2,148	—**	2,148 (2.0)	2,319	2.2	1.9	0.3	991 (0.9)
New Mexico	51 (0.2)	394	—**	394 (1.5)	445	1.7	2.3	-0.6	679 (2.5)
New York (incl. New York City)	349 (0.2)	2,199	—**	2,199 (1.0)	2,548	1.1	1.0	0.1	4,170 (1.8)
New York City	85 (0.1)	581	—**	581 (0.6)	666	0.7	0.6	0.1	1,173 (1.2)
North Carolina	284 (0.2)	2,323	—**	2,323 (1.8)	2,607	2.0	1.8	0.2	2,248 (1.8)
North Dakota	31 (0.3)	74	244	318 (3.1)	350	3.4	3.4	0.0	NR
Ohio	336 (0.2)	—§§	—§§	3,207 (2.3)	3,543	2.6	2.4	0.2	7,367 (5.3)
Oklahoma	91 (0.2)	333	657	991 (1.8)	1,182	2.2	1.9	0.3	NR
Oregon	62 (0.1)	—§§	—§§	3,427 (7.5)	3,489	7.6	6.7	0.9	NR
Pennsylvania	638 (0.5)	1,600	1,779	3,379 (2.4)	4,017	2.8	2.3	0.5	3,124 (2.2)
Rhode Island	10 (0.1)	110	—**	110 (1.0)	120	1.1	1.2	-0.1	NR
South Carolina	119 (0.2)	1,028	—**	1,028 (1.8)	1,147	2.0	2.0	0.0	328 (0.6)
South Dakota	23 (0.2)	238	—**	238 (2.0)	261	2.2	2.0	0.2	NR
Tennessee	114 (0.1)	1,085	—**	1,085 (1.4)	1,199	1.5	1.3	0.2	1,124 (1.4)
Texas (incl. Houston)	780 (0.2)	—§§	—§§	7,044 (1.8)	7,825	2.0	1.8	0.2	6,811 (1.8)
Houston	66 (0.2)	—§§	—§§	459 (1.1)	525	1.2	1.0	0.2	NR
Utah	80 (0.2)	19	2,507	2,526 (5.2)	2,606	5.3	5.1	0.2	1,039 (2.1)
Vermont	13 (0.2)	227	—**	227 (3.6)	240	3.8	3.9	-0.1	321 (5.1)
Virginia	384 (0.4)	1,125	—**	1,125 (1.1)	1,508	1.5	1.2	0.3	NR
Washington	621 (0.7)	202	3,142	3,344 (3.9)	3,966	4.7	4.8	-0.1	1,396 (1.6)
West Virginia***	32 (0.2)	—††	—**	—**,††	32	0.2	0.3	-0.1	809 (4.1)
Wisconsin	164 (0.2)	291	3,122	3,413 (5.2)	3,577	5.4	5.5	-0.1	1,907 (2.9)
Wyoming	NA	NA	NA	NA	NA	NA	NA	NA	NA

See table footnotes on next page

TABLE 2. (*Continued*) Estimated number and percentage* of children enrolled in kindergarten with reported type of exemption from vaccination, and grace period/provisional enrollment, by immunization program† — United States and territories, 2017–18 school year

Immunization program	Medical exemptions, no. (%)	Nonmedical exemptions			Any exemption				Grace period or provisional enrollment§ no. (%)
		Religious no.	Philosophical no.	Total no. (%)	2017–18, no.	2017–18 %	2016–17 %	Percentage point difference (2016–17 to 2017–18)	
Territories and associated states									
American Samoa	0 (0.0)	0	—**	0 (0.0)	0	0	0	0	None
Federated States of Micronesia	0 (0.0)	0	0	0 (0.0)	0	0	0	0.0	NR
Guam	0 (<0.1)	10	—**	10 (0.4)	10	0.4	0.2	0.2	NR
Marshall Islands	0 (0.0)	—††	—**	0 (0.0)	0	0	0	0.0	NR
Northern Mariana Islands	0 (0.0)	0	0	0 (0.0)	0	0	0	0.0	NR
Palau†††	0 (0.0)	—§§	—§§	0 (0.0)	0	0	0	0.0	NR
Puerto Rico§§§	NA	NA	NA	NA	NA	NA	NA	NA	NA
U.S. Virgin Islands§§§	NA	NA	NA	NA	NA	NA	NA	NA	NA

Abbreviations: NA = not available (i.e., not collected); None = state does not allow grace period or provisional enrollment; NR = not reported to CDC.

* Estimates are adjusted for nonresponse and weighted for sampling where appropriate.

† Medical exemptions, nonmedical exemptions, and grace period or provisional enrollment status might not be mutually exclusive. Some children might have both medical and nonmedical exemptions, and some enrolled under a grace period or provisional enrollment might be exempt from one or more vaccinations.

§ A grace period is a set number of days during which a student can be enrolled and attend school without proof of complete vaccination or exemption. Provisional enrollment allows a student without complete vaccination or exemption to attend school while completing a catch-up vaccination schedule. In states with one or both of these policies, the estimates represent the number of kindergartners within a grace period, provisionally enrolled, or some combination of these categories.

¶ Medians calculated from data from 45 states and District of Columbia; states excluded were Colorado, Illinois, Minnesota, Missouri, and Wyoming. Houston, New York City, American Samoa, Federated States of Micronesia, Guam, Marshall Islands, Northern Mariana Islands, Palau, Puerto Rico, and U.S. Virgin Islands also were excluded. Exemption data were reported for 3,634,631 kindergartners. Grace period or provisional enrollment median was calculated from data from 28 states; data were reported for 2,825,691 kindergartners.

** Philosophical exemptions were not allowed.

†† Religious exemptions were not allowed.

§§ Religious and philosophical exemptions were not reported separately.

¶¶ Program did not report the number of children with exemptions, but instead reported the number of exemptions for each vaccine, which could count some children more than once. Lower bounds of the percentage of children with any exemptions estimated using the individual vaccines with the highest number of exemptions are for Colorado, 0.2% with medical exemptions, 0.3% with religious exemptions, 4.2% with philosophical exemptions, and 4.7% with any exemptions; for Illinois, 0.2% with medical exemptions, 1.4% with religious exemptions, and 1.6% with any exemptions; for Minnesota, 0.2% with medical exemptions, 3.4% with nonmedical exemptions, and 3.5% with any exemptions; and for Missouri, 0.2% with medical exemptions, 2.1% with religious exemptions, and 2.3% with any exemptions.

*** Reported public school data only.

††† For Palau, estimates represent exemptions among children in first grade.

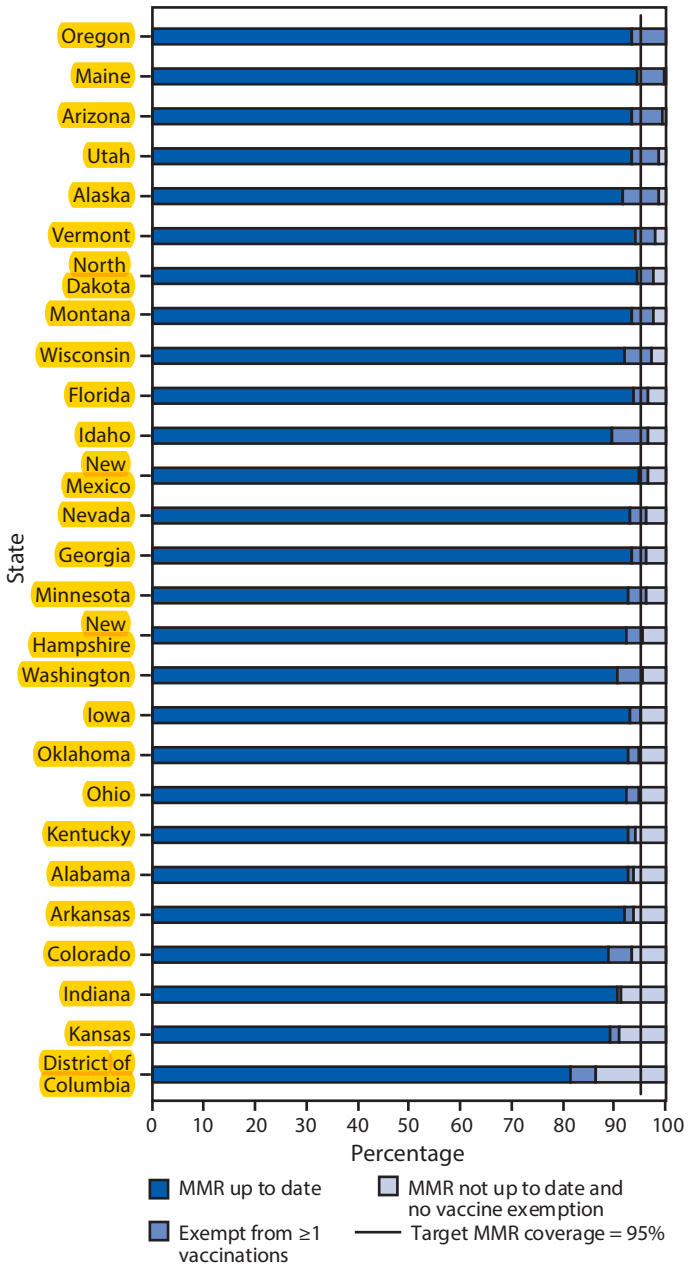
§§§ Puerto Rico and U.S. Virgin Islands did not report data for the 2017–18 school year because of widespread logistical issues caused by Hurricane Maria.

(*9*). Two of the 10 states with <90% coverage for ≥1 dose of MMR among children aged 19–35 months in the 2014 National Immunization Survey (*10*) (the approximate cohort of children entering kindergarten in the 2017–18 school year) also had <90% coverage for ≥2 doses of MMR among kindergartners in 2017–18; in eight states, coverage with ≥2 doses of MMR was <95%, indicating that some children who were undervaccinated in early childhood do not catch up before kindergarten entry. This highlights the importance of school entry vaccination requirements to ensure catch-up vaccination of unvaccinated and undervaccinated children.

In 11 of the 28 states reporting 2017–18 grace period or provisional enrollment data, the percentage of kindergartners in these groups at the time of assessment exceeded the percentage with an exemption from one or more vaccines, representing a group of children who could be fully vaccinated with appropriate follow-up. CDC encourages programs to collect and use these data to identify populations of undervaccinated students. Almost all states could achieve ≥95% vaccination coverage if undervaccinated nonexempt children were vaccinated in accordance with local and state vaccination policies.

The findings in this report are subject to at least five limitations. First, comparability is limited because of variation in states' requirements, data collection methods, and definitions of grace period and provisional enrollment. Second, representativeness might be negatively affected because of data collection methodologies that miss some schools or students or assess vaccination status at different times. Third, actual vaccination coverage, exemption rates, or both might be underestimated or overestimated because of inaccurate or absent documentation. Fourth, median coverage estimates include only 49 of 50 states and DC, median exemption estimates include only 45 states and DC, and the median grace period or provisional enrollment estimate includes only 28 states for the 2017–18

FIGURE. Estimated percentage of kindergartners with documented up-to-date vaccination for measles, mumps, and rubella vaccine (MMR)*; exempt from one or more vaccines†,§; and not up-to-date with MMR and not exempt,¶ — selected states and District of Columbia, 2017–18 school year**



* Estimates are based on completed vaccine series and are not MMR-specific for Alabama, Florida, Georgia, Iowa, and New Hampshire. Up-to-date coverage reported here is the lower bound of possible MMR coverage.

† Most states report the number of kindergartners with an exemption from one or more vaccines. Estimates reported here might include exemptions from vaccines other than MMR, except in Colorado and Minnesota where MMR-specific exemptions are reported.

§ Coverage estimates are based on a sample of kindergartners, and exemption estimates are based on a census for Alaska, Kansas, and Wisconsin.

¶ Includes nonexempt students provisionally enrolled, in a grace period, or otherwise without documentation of complete MMR vaccination.

** Figure includes all states with reported MMR coverage for the 2017–18 school year of <95%, the *Healthy People 2020* target for MMR vaccination coverage among kindergartners. http://www.healthypeople.gov.

Summary

What is already known about this topic?

Immunization programs conduct annual kindergarten vaccination assessments to monitor school-entry vaccination coverage for all state-required vaccines.

What is added by this report?

Median vaccination coverage was 94.3% for 2 doses of measles, mumps, and rubella vaccine; 95.1% for the state-required number of doses of diphtheria and tetanus toxoids and acellular pertussis vaccine; and 93.8% for 2 doses of varicella vaccine. Although the median exemption rate gradually increased for the third year in a row to 2.2%, most undervaccinated children did not have exemptions.

What are the implications for public health practice?

School assessment allows immunization programs to target interventions to schools with undervaccinated kindergartners to increase compliance with state and local vaccination requirements.

school year. Finally, because most states do not report vaccine-specific exemptions, estimates of potentially achievable MMR coverage are approximations. However, if reported exemptions were for a vaccine or vaccines other than MMR, estimates of potentially achievable MMR coverage would be higher than those presented.

Kindergarten vaccination requirements help ensure that students are fully vaccinated with age-appropriate vaccines upon school entry. Although overall vaccination coverage is high, coverage could be improved in many states. CDC works with immunization programs to collect and report data on school vaccination coverage, exemption rates, and grace period and provisional enrollment each year. Immunization programs can use these data to understand and address undervaccination among kindergartners and to identify schools and communities where focused interventions could improve coverage with required vaccines.

Corresponding author: Jenelle Mellerson, evx9@cdc.gov, 404-639-8308.

[1]Certified Technical Experts Inc., Montgomery, Alabama; [2]National Center for Immunization and Respiratory Disease, Immunization Services Division, CDC.

All authors have completed and submitted the ICMJE form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

References

1. Omer SB, Salmon DA, Orenstein WA, deHart MP, Halsey N. Vaccine refusal, mandatory immunization, and the risks of vaccine-preventable diseases. N Engl J Med 2009;360:1981–8. https://doi.org/10.1056/NEJMsa0806477
2. CDC, National Center for Immunization and Respiratory Disease. SchoolVaxView. Atlanta, GA: US Department of Health and Human Services, CDC, National Center for Immunization and Respiratory Disease; 2017. https://www.cdc.gov/vaccines/imz-managers/coverage/schoolvaxview/data-reports/index.html

3. Seither R, Calhoun K, Street EJ, et al. Vaccination coverage for selected vaccines, exemption rates, and provisional enrollment among children in kindergarten—United States, 2016–17 school year. MMWR Morb Mortal Wkly Rep 2017;66:1073–80. https://doi.org/10.15585/mmwr.mm6640a3
4. Blank NR, Caplan AL, Constable C. Exempting schoolchildren from immunizations: states with few barriers had highest rates of nonmedical exemptions. Health Aff (Millwood) 2013;32:1282–90. https://doi.org/10.1377/hlthaff.2013.0239
5. Siddiqui M, Salmon DA, Omer SB. Epidemiology of vaccine hesitancy in the United States. Hum Vaccin Immunother 2013;9:2643–8
6. Salmon DA, Sotir MJ, Pan WK, et al. Parental vaccine refusal in Wisconsin: a case-control study. WMJ 2009;108:17–23.
7. Salmon DA, Moulton LH, Omer SB, DeHart MP, Stokley S, Halsey NA. Factors associated with refusal of childhood vaccines among parents of school-aged children: a case-control study. Arch Pediatr Adolesc Med 2005;159:470–6. https://doi.org/10.1001/archpedi.159.5.470
8. Smith PJ, Shaw J, Seither R, et al. Vaccine exemptions and the kindergarten vaccination coverage gap. Vaccine 2017;35:5346–51. https://doi.org/10.1016/j.vaccine.2017.08.036
9. Hill HA, Elam-Evans LD, Yankey D, Singleton JA, Kang Y. Vaccination coverage among children aged 19–35 months—United States, 2017. MMWR Morb Mortal Wkly Rep 2018;67:1123–8.
10. Hill HA, Elam-Evans LD, Yankey D, Singleton JA, Kolasa M. National, state, and local vaccination coverage among children aged 19–35 months—United States, 2015. MMWR Morb Mortal Wkly Rep 2015;64:889–96. https://doi.org/10.15585/mmwr.mm6433a1

Vaccination Coverage Among Children Aged 19–35 Months — United States, 2017

Holly A. Hill, MD, PhD[1]; Laurie D. Elam-Evans, PhD[1]; David Yankey, PhD[1]; James A. Singleton, PhD[1]; Yoonjae Kang, MPH[1]

The Advisory Committee on Immunization Practices (ACIP) recommends routine vaccination by age 24 months against 14 potentially serious illnesses (*1*). CDC used data from the 2017 National Immunization Survey-Child (NIS-Child) to assess vaccination coverage at national, state, territorial, and selected local levels among children aged 19–35 months in the United States. Coverage remained high and stable overall, exceeding 90% for ≥3 doses of poliovirus vaccine, ≥1 dose of measles, mumps, and rubella vaccine (MMR), ≥3 doses of hepatitis B vaccine (HepB), and ≥1 dose of varicella vaccine. Although the proportion of children who received no vaccine doses by age 24 months was low, this proportion increased gradually from 0.9% for children born in 2011 to 1.3% for children born in 2015. Coverage was lower for most vaccines among uninsured children and those insured by Medicaid, compared with those having private health insurance, and for children living outside of metropolitan statistical areas* (MSAs), compared with those living in MSA principal cities. These disparities could be reduced with greater awareness and use of the Vaccines for Children† (VFC) program, eliminating missed opportunities to vaccinate children during visits to health care providers, and minimizing interruptions in health insurance coverage.

The NIS-Child is a random-digit–dialed telephone (cellular and landline) survey of parents/guardians of children aged 19–35 months in the 50 states, the District of Columbia, selected local areas, and U.S. territories.§ NIS-Child coverage estimates are based on a provider-reported vaccination history. Interviewers request contact information for all the child's vaccination providers and permission to contact each provider to obtain vaccination records for that child. All identified providers are mailed an immunization history questionnaire to record dates and types of vaccines administered; data from responding providers are combined to create a synthesized vaccination history for each child. NIS-Child methods, including weighting procedures, have been described.¶ In 2017, the overall response rate** to the telephone interview portion of the survey was 26.1%. Adequate provider-reported vaccination data†† were available for 53.9% of children with a completed household interview, resulting in a sample size of 15,333 children. T-tests on weighted data were used to evaluate differences in coverage estimates by sociodemographic characteristics; differences were considered statistically significant for p-values <0.05. CDC assessed changes in survey accuracy, estimated components of difference between the 2016 and 2017 NIS-Child estimates, and estimated linear trends in vaccination coverage by month and year of birth using weighted linear regression.§§ No evidence for change in survey accuracy from 2016 to 2017 was detected (*2*).

2017 Vaccination Coverage

Coverage was >90% for vaccination with ≥3 doses of poliovirus vaccine (92.7%), ≥1 dose of MMR (91.5%), ≥3 doses of HepB (91.4%), and ≥1 dose of varicella vaccine (91.0%) (Table 1). Children were least likely to be up-to-date with ≥2 doses of hepatitis A vaccine (HepA) (59.7%), the combined 7-vaccine series¶¶ (70.4%), and rotavirus vaccination (73.2%). Coverage with HepB birth dose was also low (73.6%).

* MSA status was determined on the basis of 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/geo/reference/gtc/gtc_cbsa.html). Non-MSA areas include urban populations not located within an MSA as well as completely rural areas.

† https://www.cdc.gov/vaccines/programs/vfc/index.html.

§ Estimates for states, selected local areas, and the territory of Guam are available online (https://www.cdc.gov/vaccines/imz-managers/coverage/childvaxview/data-reports/index.html). The local areas sampled separately for the 2017 NIS included areas that receive federal Section 317 immunization funds and are included in the NIS sample every year (Chicago, Illinois; New York, New York; Philadelphia County, Pennsylvania; Bexar County, Texas; and Houston, Texas) and three additional sample areas (El Paso County, Texas; Dallas County, Texas; and Travis County, Texas). The 2017 NIS-Child was also conducted in Guam, Puerto Rico, and U.S. Virgin Islands; however, data collection in Puerto Rico and U.S. Virgin Islands was suspended because of the severity of the 2017 hurricane season, resulting in insufficient data for estimation of vaccination coverage. National estimates in this report exclude all territories.

¶ Details regarding the statistical methodology of NIS-Child are available in the NIS-Child Data User's Guide 2016. https://www.cdc.gov/vaccines/imz-managers/nis/datasets.html.

** 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). The CASRO household response rate is equivalent to the American Association for Public Opinion Research type 3 response rate. http://www.aapor.org/AAPOR_Main/media/publications/Standard-Definitions20169theditionfinal.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.

§§ https://www.cdc.gov/vaccines/imz-managers/coverage/childvaxview/pubs-presentations/NIS-vax-trends-2012-2016.html.

¶¶ The combined 7-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 Hep-B; ≥1 dose of varicella vaccine; and ≥4 doses of PCV.

TABLE 1. Estimated vaccination coverage among children aged 19–35 months, by selected vaccines and doses — National Immunization Survey-Child, United States, 2013–2017*

Vaccine/Dose	Survey year % (95% CI)				
	2013	2014	2015	2016	2017
DTaP†					
≥3 doses	94.1 (93.2–95.0)	94.7 (94.0–95.4)	95.0 (94.4–95.5)	93.7 (92.8–94.5)§	94.0 (93.3–94.7)
≥4 doses	83.1 (81.8–84.3)	84.2 (83.0–85.4)	84.6 (83.5–85.7)	83.4 (82.1–84.6)	83.2 (82.0–84.3)
Poliovirus (≥3 doses)	92.7 (91.6–93.6)	93.3 (92.5–94.1)	93.7 (93.0–94.3)	91.9 (90.9–92.9)§	92.7 (91.9–93.5)
MMR (≥1 dose)¶	91.9 (90.9–92.7)	91.5 (90.6–92.4)	91.9 (91.0–92.7)	91.1 (90.1–92.0)	91.5 (90.6–92.3)
Hib					
Primary series**	93.7 (92.7–94.5)	93.3 (92.5–94.1)	94.3 (93.7–94.9)	92.8 (91.8–93.6)§	92.8 (91.9–93.6)
Full series**	82.0 (80.7–83.3)	82.0 (80.7–83.2)	82.7 (81.5–83.8)	81.8 (80.5–83.0)	80.7 (79.4–82.0)
HepB					
≥3 doses	90.8 (89.7–91.7)	91.6 (90.7–92.4)	92.6 (91.9–93.3)	90.5 (89.3–91.5)§	91.4 (90.5–92.3)
Birth dose††	74.2 (72.8–75.7)§	72.4 (70.9–73.9)	72.4 (71.0–73.7)	71.1 (69.5–72.7)	73.6 (72.0–75.2)§
Varicella (≥1 dose)¶	91.2 (90.2–92.1)	91.0 (90.1–91.9)	91.8 (91.0–92.5)	90.6 (89.6–91.5)	91.0 (90.1–91.8)
PCV					
≥3 doses	92.4 (91.4–93.3)	92.6 (91.8–93.4)	93.3 (92.5–94.0)	91.8 (90.8–92.7)§	91.9 (90.9–92.8)
≥4 doses	82.0 (80.6–83.3)	82.9 (81.6–84.2)	84.1 (83.0–85.2)	81.8 (80.4–83.1)§	82.4 (81.1–83.6)
HepA					
≥1 dose	83.1 (81.9–84.3)§	85.1 (84.0–86.2)§	85.8 (84.7–86.8)	86.1 (84.9–87.2)	86.0 (84.8–87.1)
≥2 doses§§	54.7 (53.1–56.3)	57.5 (55.9–59.1)§	59.6 (58.1–61.0)	60.6 (59.1–62.2)	59.7 (58.2–61.3)
Rotavirus¶¶	72.6 (71.1–74.0)§	71.7 (70.1–73.2)	73.2 (71.8–74.6)	74.1 (72.6–75.5)	73.2 (71.6–74.7)
Combined 7-vaccine series***	70.4 (68.8–71.9)	71.6 (70.2–73.1)	72.2 (70.9–73.6)	70.7 (69.2–72.2)	70.4 (68.9–71.9)
No vaccinations	0.7 (0.5–1.1)	0.8 (0.6–1.0)	0.8 (0.6–1.0)	0.8 (0.6–1.0)	1.1 (0.9–1.4)§

Abbreviations: CI = confidence interval; 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.

* For 2013, children born during January 2010–May 2012; for 2014, children born during January 2011–May 2013; for 2015, children born during January 2012–May 2014; for 2016, children born during January 2013–May 2015; and for 2017, children born during January 2014–May 2016.

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

§ Statistically significant ($p<0.05$) change in coverage compared with previous survey year.

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

** Hib primary series: ≥2 or ≥3 doses, depending on product type received; full series includes 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.

§§ Estimates of ≥2 doses of HepA are likely underestimates because a child could be on schedule but not receive a second dose of HepA until age 41 months. This dose would not be collected by NIS-Child, which includes children aged 19–35 months only.

¶¶ Includes ≥2 doses of Rotarix monovalent rotavirus vaccine (RV1), or ≥3 doses of RotaTeq pentavalent rotavirus vaccine (RV5). The maximum age for the final rotavirus dose is 8 months, 0 days.

*** The combined 7-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 varicella vaccine, and ≥4 doses of PCV.

Vaccination Coverage by Selected Characteristics

Coverage was lower (range = 2.6–6.9 percentage points) for children living in non-MSAs than among those living in MSA principal cities for most vaccines (Table 2). Children living in non-MSAs had a higher prevalence of having received no vaccinations (1.9%) compared with children in MSA principal cities (1.0%).

Coverage among children insured by Medicaid was lower (2.5–15.0 percentage points, depending on vaccine) than that among those with private insurance for all vaccines assessed except the HepB birth dose (Table 2). The same pattern was observed among uninsured children: coverage was substantially lower (14.7–30.3 percentage points) than that among those privately insured. Prevalence of uninsured children in the 2017 NIS-Child was 2.8%. This lower vaccination coverage among the uninsured, Medicaid-insured, and those living outside of MSAs was especially evident for diphtheria and tetanus toxoids and acellular pertussis vaccine (DTaP), the full series of *Haemophilus influenzae* type b conjugate vaccine (Hib), and pneumococcal conjugate vaccine (PCV), that require a booster dose in the second year of life. In addition, the proportion of uninsured children who had received no vaccinations (7.1%) was higher than that among those with private insurance (0.8%). The proportion of unvaccinated children was similar among children insured by Medicaid and those with private insurance. Among unvaccinated children in the 2017 NIS-Child, 17.2% were uninsured.

Differences in vaccination coverage by race/ethnicity and poverty status in 2017 were similar to those observed in previous years (Supplementary Table 1, https://stacks.cdc.gov/view/cdc/59414) (*3*). Vaccination coverage also varied by state (Supplementary Table 2, https://stacks.cdc.gov/view/

TABLE 2. Estimated vaccination coverage among children aged 19–35 months, by selected vaccines and doses, metropolitan statistical area (MSA) status,* and health insurance status† — National Immunization Survey-Child, United States, 2017§

	MSA status % (95% CI)			Health insurance status % (95% CI)			
Vaccine/Dose	MSA, principal city (referent) (n = 6,689)	MSA, non-principal city (n = 5,846)	Non-MSA (n = 2,798)	Private only (referent) (n = 8,536)	Any Medicaid (n = 5,714)	Other insurance (n = 644)	Uninsured (n = 439)
DTaP¶							
≥3 doses	94.6 (93.4–95.6)	94.1 (92.9–95.0)	91.6 (89.1–93.6)**	96.5 (95.7–97.2)	92.6 (91.2–93.8)**	93.7 (90.7–95.8)**	78.2 (71.3–83.8)**
≥4 doses	85.0 (83.3–86.5)	82.6 (80.6–84.5)	78.1 (74.9–80.9)**	86.9 (85.2–88.5)	80.8 (78.9–82.5)**	83.6 (79.3–87.2)	62.4 (55.0–69.1)**
Poliovirus (≥3 doses)	93.2 (91.9–94.4)	92.9 (91.7–93.9)	90.1 (87.4–92.2)**	95.2 (94.3–96.0)	91.2 (89.6–92.5)**	92.7 (89.5–95.0)	77.9 (71.0–83.6)**
MMR†† (≥1 dose)	92.5 (91.2–93.6)	90.9 (89.3–92.3)	89.9 (88.0–91.6)**	93.7 (92.3–94.8)	90.4 (89.1–91.6)**	91.0 (87.5–93.6)	74.6 (67.5–80.6)**
Hib							
Primary series§§	93.4 (92.2–94.5)	92.6 (91.1–93.9)	91.2 (88.7–93.2)	95.5 (94.6–96.2)	91.1 (89.5–92.5)**	92.2 (88.8–94.7)**	78.0 (71.1–83.7)**
Full series§§	81.6 (79.6–83.4)	80.7 (78.6–82.7)	77.3 (74.1–80.2)**	85.1 (83.2–86.9)	77.7 (75.6–79.7)**	78.8 (73.8–83.1)**	62.0 (54.6–68.9)**
HepB							
≥3 doses	92.6 (91.3–93.7)	90.4 (88.7–91.9)**	90.7 (88.8–92.3)	93.3 (91.9–94.4)	90.4 (88.8–91.7)**	92.5 (89.4–94.7)	78.6 (71.8–84.1)**
Birth dose¶¶	73.6 (71.1–76.0)	72.8 (70.3–75.1)	76.6 (73.6–79.3)	73.0 (70.9–75.0)	74.7 (72.0–77.2)	71.8 (66.2–76.8)	68.7 (61.9–74.8)
Varicella†† (≥1 dose)	92.3 (91.0–93.4)	90.4 (88.7–91.8)	88.3 (86.2–90.1)**	92.9 (91.5–94.1)	90.4 (89.1–91.6)**	91.3 (88.0–93.8)	69.5 (62.2–76.0)**
PCV							
≥3 doses	92.2 (90.5–93.6)	91.9 (90.4–93.2)	90.6 (88.0–92.6)	94.5 (92.9–95.7)	90.5 (88.9–91.8)**	91.0 (87.6–93.5)**	75.2 (67.9–81.2)**
≥4 doses	83.6 (81.7–85.4)	82.0 (79.9–84.0)	79.1 (75.9–81.9)**	87.6 (85.8–89.3)	78.9 (76.8–80.8)**	81.3 (76.8–85.2)**	59.0 (51.6–66.1)**
HepA							
≥1 dose	87.2 (85.3–88.9)	85.7 (83.9–87.4)	82.5 (80.1–84.6)**	88.1 (86.5–89.6)	85.3 (83.5–87.0)**	86.1 (81.7–89.5)	63.3 (55.7–70.3)**
≥2 doses	61.1 (58.7–63.4)	59.2 (56.7–61.6)	56.5 (53.3–59.7)**	63.2 (61.0–65.2)	57.7 (55.2–60.2)**	61.1 (55.2–66.7)	35.7 (29.1–42.9)**
Rotavirus* **	73.8 (71.3–76.2)	73.3 (70.7–75.7)	70.5 (67.3–73.6)	81.8 (79.8–83.6)	66.8 (64.2–69.4)**	67.4 (61.0–73.3)**	51.5 (44.2–58.7)**
**Combined 7-vaccine series††† **	71.9 (69.7–74.1)	69.8 (67.4–72.2)	66.8 (63.6–69.9)**	76.0 (73.9–77.9)	66.5 (64.1–68.9)**	69.2 (63.6–74.2)**	48.5 (41.2–55.8)**
No vaccinations	1.0 (0.7–1.3)	1.1 (0.8–1.5)	1.9 (1.3–2.7)**	0.8 (0.6–1.1)	1.0 (0.7–1.4)	—§§§	7.1 (4.6–10.8)**

Abbreviations: CI = confidence interval; DTaP = diphtheria and 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.

* MSA status was determined on the basis of household-reported county and city of residence and was grouped into three categories: MSA principal city, MSA nonprincipal city, and non-MSA. MSA and principal city were as defined by the U.S. Census Bureau (https://www.census.gov/geo/reference/gtc/gtc_cbsa.html). Non-MSA areas include urban populations not located within an MSA as well as completely rural areas.

† Children's health insurance status was reported by parent or guardian. "Other insurance" includes the Children's Health Insurance Program, military insurance, coverage via the Indian Health Service, and any other type of health insurance not mentioned elsewhere.

§ Children in the 2017 National Immunization Survey-Child were born during January 2014–May 2016.

¶ 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.

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

§§ Hib primary series: ≥2 or ≥3 doses, depending on product type received; full series includes 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 or ≥3 doses, depending on product type received (≥2 doses for Rotarix [RV1] or ≥3 doses for RotaTeq [RV5]).

††† The combined 7-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 of vaccine), ≥3 doses of HepB, ≥1 dose of varicella, and ≥4 doses of PCV.

§§§ Estimate not available because the 95% CI was ≥20.

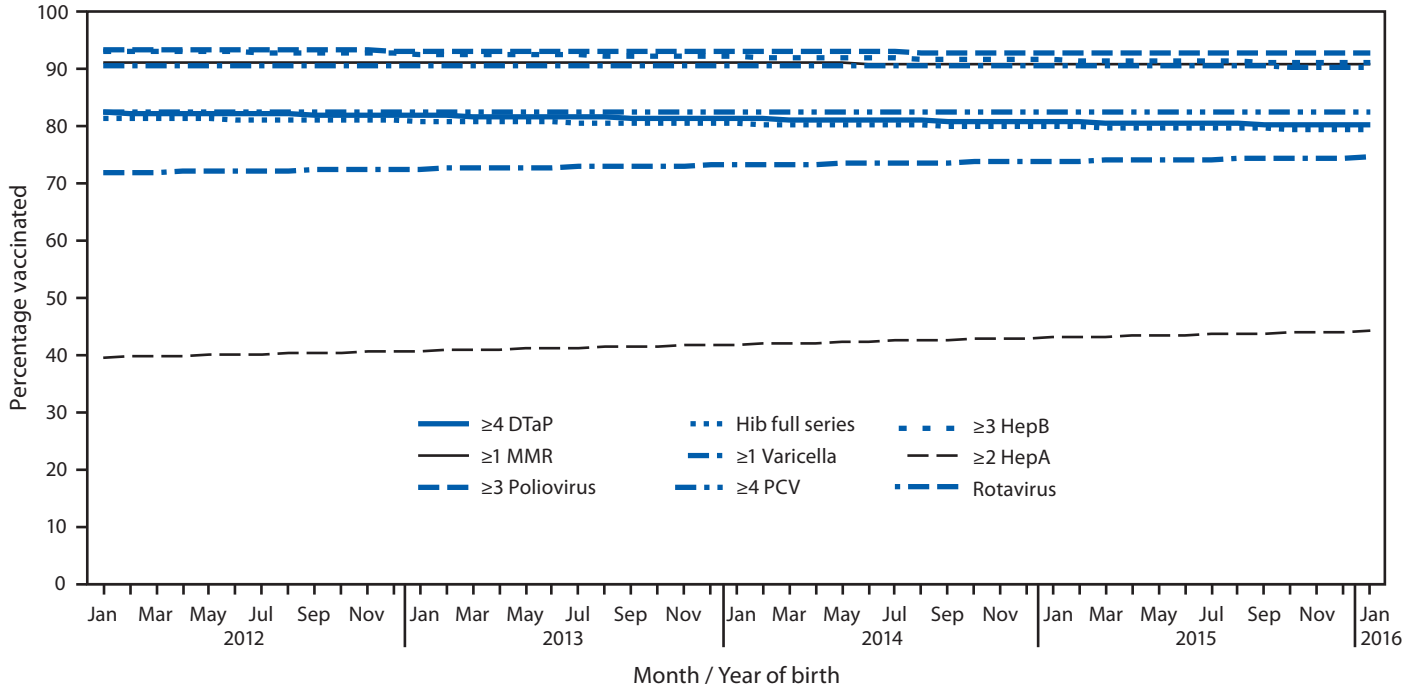
cdc/59415). For example, estimated rotavirus coverage ranged from 64.7% in California to 85.1% in Rhode Island. Coverage with MMR ranged from 85.8% in Missouri to 98.3% in Massachusetts; MMR coverage was <90% for 11 states in 2017.

Trends in Vaccination Coverage

Coverage by month and year of birth remained stable during January 2012–January 2016 for most vaccines (Figure) (*2*). Coverage by age 2 years over 12 consecutive birth months declined by 0.5 percentage points for ≥3 HepB doses and increased by 1.1 percentage points for ≥2 HepA doses (*2*). Coverage with ≥2 HepA doses was higher by age 35 months than by age 24 months (e.g., 75.3% versus 39.6% for children born January 2012) (*2*).

HepB birth dose coverage was higher in 2017 (73.6%) than in 2016 (71.1%) (Table 1). Analysis of trends in HepB birth dose coverage by month and year of birth during January 2012–May 2016 indicated no change in coverage, although an increasing trend was estimated for more recent births (January 2014–May 2016) (*2*). The percentage of unvaccinated

FIGURE. Estimated linear trend in coverage with selected vaccines* by age 24 months,† by month and year of birth§ — National Immunization Survey-Child, United States, 2013–2017



Abbreviations: CI = confidence interval; 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.

* Hib full series: ≥3 or ≥4 doses, depending on product type received (primary series and booster dose). Rotavirus: ≥2 or ≥3 doses, depending on product type received (≥2 doses for Rotarix [RV1] or ≥3 doses for RotaTeq [RV5]).

† Except for rotavirus, vaccination coverage was assessed before the child reached his/her 24-month birthday. The Kaplan-Meier method was used to account for censoring vaccination status for children assessed before age 24 months. Rotavirus vaccination was assessed before the child reached his/her 8-month birthday.

§ Estimated linear relationship between month and year of birth and vaccination coverage, based on weighted linear regression analysis using the inverse of the estimated variance of each point estimate to construct the weights. Estimated percentage point change over 12 birth months: ≥4 DTaP -0.55 (95% CI = -1.20 to 0.10); ≥3 poliovirus -0.17 (-0.52 to 0.18); ≥1 MMR -0.11 (-0.58 to 0.35); Hib full series -0.51 (-1.13 to 0.11); ≥3 HepB -0.53 (-0.97 to -0.09); ≥1 varicella -0.05 (-0.53 to 0.42); ≥4 PCV 0.0 (-0.69 to 0.68); ≥2 HepA 1.13 (0.30 to 1.97); rotavirus 0.68 (-0.09 to 1.45).

children increased from 0.8% in 2016 to 1.1% in 2017. By annual birth cohort, the percentage of children with no vaccinations by age 2 years increased from 0.9% for children born in 2011 to 1.3% (47,700 children) for those born in 2015 (Supplementary Figure, https://stacks.cdc.gov/view/cdc/59413), representing an additional 18,400 unvaccinated children.

Discussion

Overall vaccination coverage among young children remained high and stable in the United States in 2017. However, the findings from this survey highlight several opportunities for improvement. Coverage was lower for most vaccines among uninsured and Medicaid-insured children and among children living outside of MSAs. These disparities were larger for vaccines that require a booster dose in the second year of life (e.g., DTaP, Hib, and PCV). Although the number of children who have received no vaccinations by age 24 months has been gradually increasing, most children are still routinely vaccinated. Continued evaluation of prevalence and reasons for nonvaccination is needed, as are improvements in access to and delivery of age-appropriate vaccinations to all children. CDC continues to examine barriers to early childhood vaccination, including assessing obstacles to and parents' experiences with accessing vaccination services.

Vaccination coverage differences by insurance status are concerning, given that children insured by Medicaid and uninsured children are eligible for the VFC program, which was designed to remove financial barriers by providing free vaccines to program participants. However, other issues, such as unfamiliarity with the VFC program and how to access it, transportation, child care, and convenience of clinic hours might also need to be addressed if the goals of this important element of the immunization safety net are to be fully realized. Lack of geographic proximity to vaccination providers, including those who participate in the VFC program, can be a barrier to vaccination. The shortage of health care providers, especially pediatricians, might partially explain the lower coverage among children living in rural areas (*4*).

Vaccination coverage could be increased and sociodemographic and geographic disparities reduced with increased administration of all recommended vaccines during provider visits. A study of potentially achievable coverage estimated that 90% coverage would have been attained many years ago for the recommended number of doses of DTaP, PCV, and Hib for children aged 19–35 months if missed opportunities for administration of the final doses of these vaccines had been eliminated (*5*). Reducing missed opportunities would promote timely receipt of all recommended vaccine doses and decrease the amount of time that children remain vulnerable to vaccine-preventable diseases.

The percentage of children who have received no vaccines has increased, reaching 1.3% for children born in 2015, compared with 0.3% among those 19–35 months when surveyed in 2001 (*6*). Some children might be unvaccinated because of choices made by parents, whereas for others, lack of access to health care or health insurance might be factors. Unvaccinated children in the 2017 NIS-Child were disproportionately uninsured: 17.2% of unvaccinated children were uninsured, compared with 2.8% of all children. Evidence-informed strategies addressing parents' decisions about vaccinating their children could focus on both programs and individual patients, such as vaccine delivery through school programs, strong recommendations by providers to parents to vaccinate their children, and reinforcement of the importance of community protection through vaccination (*7*).

Variation in coverage by health insurance and MSA status and the increasing percentage of unvaccinated children raise concerns about possible pockets of susceptibility in which children are not as well protected as national coverage estimates might indicate. Measles was declared eliminated from the United States in 2000, yet outbreaks caused by imported cases continue to occur each year; 118 measles cases were reported in 2017 (https://www.cdc.gov/measles/cases-outbreaks.html) (*8*). The continued occurrence of measles outbreaks in the United States underscores the need to ensure high MMR coverage among all young children.

The findings in this report are subject to at least two limitations. First, low response rates and lack of access to phoneless households could result in selection bias, which might persist even with application of survey weights designed to minimize such bias. Second, vaccination histories might be incomplete if not all providers were identified or some of those identified chose not to participate. Bias in vaccination coverage estimates has been evaluated in a sensitivity analysis accounting for these potential errors, with results indicating underestimation of actual vaccination coverage by 4 to 5 percentage points (*9*).

Vaccination coverage among young children could be improved through higher participation by both children and providers in the Vaccines for Children program. Consistent access to health insurance is another important element of the immunization safety net. Barriers to participation in the VFC program should be identified and eliminated so that all eligible children have the opportunity to access recommended vaccines. A number of evidence-based strategies have also been described that could enhance these efforts to increase vaccination coverage, such as notifying parents when children are due for a vaccination, establishing standing orders or policies that allow nonphysician personnel to administer vaccines, and enhancing computerized immunization information systems for tracking vaccinations (https://www.thecommunityguide.org/topic/vaccination) (*10*). Continued vaccination coverage assessment using the NIS-Child can guide efforts to improve vaccination coverage and protect children from vaccine-preventable diseases and better understand the low but increasing prevalence of nonvaccination.

Summary

What is already known about this topic?

The Advisory Committee on Immunization Practices recommends routine vaccination by age 24 months against 14 potentially serious illnesses.

What is added by this report?

In 2017, coverage with most recommended vaccines among children aged 19–35 months remained stable and high but was lower in more rural areas and among uninsured or Medicaid-insured children. A small but increasing proportion of children received no vaccines by age 24 months.

What are the implications for public health practice?

Collaboration with state immunization programs, eliminating missed immunization opportunities, and minimizing interruptions in insurance coverage are important to understand and address coverage disparities among children eligible for the Vaccines for Children program and those in rural areas.

Corresponding author: Holly A. Hill, hhill@cdc.gov, 404-639-8044.

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

All authors have completed and submitted the ICMJE form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

References

1. Robinson CL, Romero JR, Kempe A, Pellegrini C; Advisory Committee on Immunization Practices (ACIP) Child/Adolescent Immunization Work Group. Advisory Committee on Immunization Practices recommended immunization schedule for children and adolescents aged 18 years or younger—United States, 2017. MMWR Morb Mortal Wkly Rep 2017;66:134–5. PubMed https://doi.org/10.15585/mmwr.mm6605e1

2. CDC. Evaluating vaccination coverage trends with the National Immunization Survey-Child (NIS-Child), 2013–2017, United States. Atlanta, GA: US Department of Health and Human Services, CDC; 2018. https://www.cdc.gov/vaccines/imz-managers/coverage/childvaxview/pubs-presentations/NIS-vax-trends-2013-2017.html
3. Hill HA, Elam-Evans LD, Yankey D, Singleton JA, Kang Y. Vaccination coverage among children age 19–35 months—United States, 2016. MMWR Morb Mortal Wkly Rep 2017;66:1171–7. PubMed https://doi.org/10.15585/mmwr.mm6643a3
4. Shipman SA, Lan J, Chang CH, Goodman DC. Geographic maldistribution of primary care for children. Pediatrics 2011;127:19–27. PubMed https://doi.org/10.1542/peds.2010-0150
5. Zhao Z, Smith PJ, Hill HA. Evaluation of potentially achievable vaccination coverage with simultaneous administration of vaccines among children in the United States. Vaccine 2016;34:3030–6. PubMed https://doi.org/10.1016/j.vaccine.2016.04.097
6. Smith PJ, Chu SY, Barker LE. Children who have received no vaccines: who are they and where do they live? Pediatrics 2004;114:187–95. PubMed https://doi.org/10.1542/peds.114.1.187
7. MacDonald NE, Butler R, Dubé E. Addressing barriers to vaccine acceptance: an overview. Hum Vaccin Immunother 2018;14:218–24. PubMed https://doi.org/10.1080/21645515.2017.1394533
8. Hall V, Banerjee E, Kenyon C, et al. Measles outbreak—Minnesota April–May 2017. MMWR Morb Mortal Wkly Rep 2017;66:713–7. PubMed https://doi.org/10.15585/mmwr.mm6627a1
9. Wolter KM, Pineau VJ, Skalland B, et al. Total survey error assessment for sociodemographic subgroups in the 2012 U.S. National Immunization Survey. In: Biemer PP, de Leew E, Eckman S, Edwards B, Kreuter F, Lyberg LE, eds. Total survey error in practice. New York, NY: John Wiley and Sons; 2017.
10. Murthy N, Rodgers L, Pabst L, Fiebelkorn AP, Ng T. Progress in childhood vaccination data in immunization information systems—United States, 2013–2016. MMWR Morb Mortal Wkly Rep 2017;66:1178–81. PubMed https://doi.org/10.15585/mmwr.mm6643a4

Notes from the Field

Exported Case of Sin Nombre Hantavirus Pulmonary Syndrome — Israel, 2017

Aaron Kofman, MD[1,2]; Galia Rahav, MD[3,4]; Del Yazzie, MPH[5]; Herman Shorty[5]; Hayley D. Yaglom, MS, MPH[6]; Dallin Peterson, MPH[7]; Melissa Peek-Bullock[8]; Mary J. Choi, MD[2]; Anat Wieder-Finesod, MD[3]; John D. Klena, PhD[2]; Heather Venkat, DVM[5]; Cheng-Feng Chiang, PhD[2]; Barbara Knust, DVM[2]; Marlene Gaither, MPA, MSEV[9]; Matthew Maurer, MPH[10]; Donald R. Hoeschele, MS[11]; Stuart T. Nichol, PhD[2]

In November 2017, CDC confirmed Sin Nombre virus (SNV) infection in a previously healthy man aged 47 years who was admitted to a hospital in Israel. The patient had traveled with his family on vacation to the southwestern United States (Arizona, Nevada, and Utah) during October 3–9, 2017. During this time, he and his family hiked and biked the southern rim of the Grand Canyon and Zion National Park and took a guided tour through Antelope Cave. On November 7, approximately 3 weeks after his return to Israel, he was hospitalized with fever, cough, and shortness of breath requiring bilevel positive airway pressure. A chest radiograph indicated diffuse reticulonodular infiltrates with consolidations at the right costophrenic angle and in the retrocardiac space. Based upon the patient's travel history and clinical findings, hantavirus pulmonary syndrome was suspected. A blood specimen collected on November 9 tested positive for SNV using nested reverse transcription–polymerase chain reaction; he had an immunoglobulin M titer of ≥1:6,400 and an immunoglobulin G titer of ≥1:6,400. Hantavirus pulmonary syndrome has a mortality rate of approximately 36%.* The patient was treated with supportive care and discharged from the hospital on November 19. No illness was reported in any family member who traveled with him.

SNV is a species of hantavirus that is transmitted to humans primarily through contact with the infected urine or droppings of a deer mouse (*Peromyscus maniculatus*). Deer mice are present throughout most of the continental United States, but transmission is most common in the "Four Corners" region (Arizona, Colorado, New Mexico, and Utah) (*1*–*3*). The average incubation period is 1–5 weeks after exposure. There is no human-to-human transmission of SNV, and clustering of cases is uncommon. The patient did not report any known contact with rodents, rodent nests, or rodent droppings either in his places of lodging or during the course of his recreational activities.

* https://www.cdc.gov/hantavirus/surveillance/annual-cases.html.

An environmental investigation conducted by the Arizona Department of Health Services and the Utah Department of Health did not find any evidence of rodent infestation at the inns and hotels where the patient and his family stayed during their travels. In Antelope Cave, evidence of rodent burrowing was identified in areas around the canyon entrances as well as at the juncture of the canyon floor and walls. In addition, tour guides are known to throw sand from the canyon floor into the air to better illuminate the sunlight beams entering the canyon for photography, which could expose visitors to aerosolized rodent feces.

This case represents the first confirmed instance of SNV infection exported from the United States. Although no clear source of the patient's exposure was found, it likely occurred during the course of his recreational outdoor activities. Clinicians and public health practitioners should be aware of hantavirus pulmonary syndrome as a potential illness among travelers returning from the southwestern United States. Travelers to this region of the United States should also be informed of the risk factors for hantavirus exposure and methods for risk reduction through public health education materials at popular tourist sites, and tour guide operators should be encouraged to leave the canyon floor undisturbed during their programs.

Corresponding author: Aaron Kofman, akofman@cdc.gov, 404-639-8257.

[1]Epidemic Intelligence Service, CDC; [2]Division of High-Consequence Pathogens and Pathology, National Center for Emerging and Zoonotic Infectious Diseases, CDC; [3]Sheba Medical Center, Tel Hashomer, Israel; [4]Sackler Medical School, Tel Aviv University, Israel; [5]Navajo Department of Health, Window Rock, Arizona; [6]Arizona Department of Health Services; [7]Utah Department of Health; [8]Nevada Department of Health and Human Services; [9]Northern Arizona Healthcare, Flagstaff, Arizona; [10]Coconino County Public Health Services District, Flagstaff, Arizona; [11]National Park Service, Washington, DC.

All authors have completed and submitted the ICMJE form for disclosure of potential conflicts of interest. No disclosures were reported.

References

1. Knust B, Rollin PE. Twenty-year summary of surveillance for human hantavirus infections, United States. Emerg Infect Dis 2013;19:1934–7. https://doi.org/10.3201/eid1912.131217
2. CDC. Hantavirus disease, by state of exposure. Atlanta, GA: US Department of Health and Human Services, CDC; 2017. https://www.cdc.gov/hantavirus/surveillance/state-of-exposure.html
3. Childs JE, Ksiazek TG, Spiropoulou CF, et al. Serologic and genetic identification of *Peromyscus maniculatus* as the primary rodent reservoir for a new hantavirus in the southwestern United States. J Infect Dis 1994;169:1271–80. https://doi.org/10.1093/infdis/169.6.1271

Notes from the Field

Large Cluster of Verona Integron-Encoded Metallo-Beta-Lactamase–Producing Carbapenem-Resistant *Pseudomonas aeruginosa* Isolates Colonizing Residents at a Skilled Nursing Facility — Chicago, Illinois, November 2016–March 2018

Whitney J. Clegg, MD[1]; Massimo Pacilli, MS, MPH[1]; Sarah K. Kemble, MD[1]; Janna L. Kerins, VMD[1,2]; Ahmed Hassaballa, MBBCH[1]; Alexander J. Kallen, MD[3]; Maroya S. Walters, PhD[3]; Alison Laufer Halpin, PhD[3]; Richard A. Stanton, PhD[3]; Sandra Boyd[3]; Paige Gable[3]; Jonathan Daniels, MS[3]; Michael Y. Lin, MD[4]; Mary K. Hayden, MD[4]; Karen Lolans[4]; Deb P. Burdsall, PhD[5]; Mary Alice Lavin, MJ[5]; Stephanie R. Black, MD[1]

On November 1, 2016, a point prevalence survey conducted at a Chicago skilled nursing facility with ventilated residents (vSNF A) to understand the prevalence of carbapenemase-producing organisms in health care facilities in the Chicago region identified 20 patients with Verona integron-encoded metallo-beta-lactamase–producing carbapenem-resistant *Pseudomonas aeruginosa* (VIM-CRPA) colonization. To determine the extent of VIM-CRPA colonization at vSNF A and provide infection control recommendations, the Chicago Department of Public Health conducted an investigation.

The first VIM-CRPA outbreak reported in the United States occurred in a Chicago acute care hospital in 2003 (*1*). Other outbreaks have been described; however, none was associated with a single skilled nursing facility (*2*–*5*). Carbapenemase-producing CRPA are uncommon in the United States; a surveillance pilot for CRPA at five U.S. sites identified only two carbapenemase-producing CRPA among 129 isolates tested (CDC, unpublished data, 2017).

To determine whether ongoing transmission was occurring at vSNF A, the Chicago Department of Public Health conducted 10 additional point prevalence surveys during November 2016–March 2018. Rectal specimens were collected from all residents, and tracheostomy site specimens were collected from residents with tracheostomies. vSNF A is a licensed 312-bed facility; point prevalence surveys were conducted on a floor with standard skilled nursing (SN floor) and on a floor housing residents with a tracheostomy or who were mechanically ventilated (VT floor).

During November 2016–March 2018, collection of 903 screening swabs from 209 residents identified 38 residents with VIM-CRPA colonization. One additional colonized resident was identified by a rectal screening culture collected on admission to an acute care hospital. Among the 39 residents, four (10%) resided on the SN floor and 35 (90%) on the VT floor. Thirty (77%) had positive rectal swabs, four (10%) had positive tracheostomy swabs, and five (13%) had positive swabs from both sites.

Floor prevalence was calculated by dividing the number of VIM-CRPA–positive residents present on the day of the point prevalence survey by the total number of residents present. Prevalences ranged from 0% to 6% on the SN floor and 21% to 43% on the VT floor during November 2016–March 2018 (Table). Among the 18 additional residents with VIM-CRPA identified after the November 2016 point prevalence survey, 17 (94%) previously had screened negative at vSNF A, representing probable incident transmission events (Table). No additional residents with VIM-CRPA were identified during the last two consecutive point prevalence surveys on the SN floor and the last four on VT floors.

During November 2016–July 2017, point prevalence surveys were conducted at six other vSNFs and six long-term acute care hospitals in the Chicago region. Twelve additional VIM-CRPA positive patients were identified at five vSNFs and one long-term acute care hospital; facility prevalences ranged from 1% to 4%.

Whole genome sequencing performed on 26 isolates from five different facilities, including 19 from vSNF A, and two historical isolates from 2003 found that all contained the VIM-2 allelic variant, and 25 were multilocus sequence type (ST) 233 (others were ST 277, 708, and 875).* The ST233 isolates were identified across the five facilities and, using a core genome multilocus sequence typing analysis, clustered separately from epidemiologically unlinked ST233 isolates from CDC's reference collection. In addition, clusters of highly related isolates (differences ranging from one to 10 single nucleotide polymorphisms) were consistent with transmission in vSNF A. These results suggest that a common strain of VIM-CRPA has had a longstanding presence in this region, with recent transmission in vSNF A.

The Chicago Department of Public Health provided ongoing on-site assessments to monitor infection control practices. Improvements were made in hand hygiene and isolation precautions compliance, resident cohorting, bathing practices, and environmental cleaning. The facility also stopped rinsing respiratory equipment with tap water in sinks in residents' rooms.

This is the largest health care–associated cluster of VIM-CRPA isolates colonizing residents reported in the United States to date. Although centered in one vSNF, this investigation highlights the interconnectedness of health care facilities

* Raw sequencing reads were placed under BioProject ID PRJNA474674.

TABLE. Summary of Verona integron-encoded metallo-beta-lactamase–producing carbapenem-resistant *Pseudomonas aeruginosa* (VIM-CRPA) point prevalence surveys at vSNF A — Chicago, Illinois, November 2016 to March 2018

Floor	Date of PPS	Total no. of residents on day of PPS	Newly identified VIM-CRPA	Newly positive, no previous screening	Newly positive, previously screened negative	Previously known VIM-CRPA	Total no. of residents positive on day of PPS	Prevalence, %
SN	11/1/16	72	4	4	0	0	4	6
	1/17/17	67	0	0	0	3	3	4
	7/10/17	71	0	0	0	0	0	0
VT	11/1/16	69	16	16	0	0	16	23
	1/9/17	66	2	0	2	12	14	21
	2/27/17	73	3	0	3	19	22	30
	5/10/17	73	4	1	3	19	23	32
	6/19/17	69	9	0	9	21	30	43
	7/5/17	74	0	0	0	30	30	41
	7/24/17	68	0	0	0	28	28	41
	11/20/17	67	0	0	0	28	28	42
	3/28/18	56	0	0	0	24	24	43
Total	—	—	**38**	**21**	**17**	—	—	—

Abbreviations: PPS = point prevalence survey; SN = standard skilled nursing floor; vSNF = skilled nursing facility with ventilated residents; VT = floor housing residents with tracheostomies or who were mechanically ventilated.

through patient sharing and how prolonged, undetected transmission can result in spread through a region. Application of CDC's multidrug-resistant organisms containment guidance (*6*), including comprehensive on-site assistance and colonization screening, limited transmission at the index facility despite continued high prevalence. Improved availability of carbapenem resistance mechanism testing and screening tests are critical for early identification of and response to similar clusters. These resources are now available through CDC's Antibiotic Resistance Laboratory Network.

Corresponding author: Massimo Pacilli, massimo.pacilli@cityofchicago.org, 312-746-6225.

[1]Chicago Department of Public Health; [2]Epidemic Intelligence Service, CDC; [3]Division of Healthcare Quality Promotion, National Center for Emerging and Zoonotic Infectious Diseases, CDC; [4]Rush University Medical Center; Chicago, Illinois; [5]APIC Consulting Services, Arlington, Virginia.

All authors have completed and submitted the ICMJE form for disclosure of potential conflicts of interest. Michael Lin reports receiving research support in the form of contributed product from OpGen and Sage Products, and an investigator-initiated grant from CareFusion Foundation (now part of BD). Mary Hayden reports receiving support in the form of contributed product from Sage (now Stryker) and from Molnlycke. Deb Burdsall and Mary Alice Lavin report receiving personal fees from APIC Consulting Services. No other potential conflicts of interest were disclosed.

References

1. Lolans K, Queenan AM, Bush K, Sahud A, Quinn JP. First nosocomial outbreak of *Pseudomonas aeruginosa* producing an integron-borne metallo-ß-lactamase (VIM-2) in the United States. Antimicrob Agents Chemother 2005;49:3538–40. https://doi.org/10.1128/AAC.49.8.3538-3540.2005
2. Rankin D, Caicedo L, Dotson N, Gable P, Chu A. Notes from the field: Verona integron-encoded metallo-beta-lactamase–producing *Pseudomonas aeruginosa* outbreak in a long-term acute care hospital—Orange County, Florida, 2017. MMWR Morb Mortal Wkly Rep 2018;67:611–2. https://doi.org/10.15585/mmwr.mm6721a6
3. Tsakris A, Pournaras S, Woodford N, et al. Outbreak of infections caused by *Pseudomonas aeruginosa* producing VIM-1 carbapenemase in Greece. J Clin Microbiol 2000;38:1290–2.
4. Crespo MP, Woodford N, Sinclair A, et al. Outbreak of carbapenem-resistant *Pseudomonas aeruginosa* producing VIM-8, a novel metallo-beta-lactamase, in a tertiary care center in Cali, Colombia. J Clin Microbiol 2004;42:5094–101. https://doi.org/10.1128/JCM.42.11.5094-5101.2004
5. Hammami S, Boutiba-Ben Boubaker I, Ghozzi R, Saidani M, Amine S, Ben Redjeb S. Nosocomial outbreak of imipenem-resistant *Pseudomonas aeruginosa* producing VIM-2 metallo-ß-lactamase in a kidney transplantation unit. Diagn Pathol 2011;6:106. https://doi.org/10.1186/1746-1596-6-106
6. CDC. Interim guidance for a public health response to contain novel or targeted multidrug-resistant organisms (MDROs). Atlanta, GA: US Department of Health and Human Services, CDC; 2017. https://www.cdc.gov/hai/outbreaks/mdro/index.html

Notes from the Field

Rubella Infection in an Unvaccinated Pregnant Woman — Johnson County, Kansas, December 2017

Tiffany Wallin[1]; Elizabeth Holzschuh, MS[2]; Caitlin Kintner, MPH[1]

On December 14, 2017, a school nurse notified the Johnson County (Kansas) Department of Health and Environment (JCDHE) that a student's mother (patient) had received a diagnosis of rubella. The school nurse learned of the patient's diagnosis when the patient picked up her daughter at school the day of the diagnosis. Follow-up by JCDHE revealed that the U.S.-born patient, aged 27 years, was 19 weeks pregnant and had not been vaccinated against rubella because of personal choice. She had tested negative for rubella by immunoglobulin G (IgG) serology during her first trimester of pregnancy.

On December 6, the patient visited a hospital emergency department complaining of palpitations, a burning, itchy rash, and fever. On December 9, she visited a second emergency department and was told she was having an allergic reaction. After conducting an Internet search, she suspected her symptoms might be caused by rubella and contacted her obstetrician, who referred her to a primary care provider. On December 12, the primary care provider submitted a blood specimen to a commercial laboratory for rubella immunoglobulin M (IgM) testing, which was reported as positive on December 14; the provider informed the patient but did not notify JCDHE.

JCDHE determined the patient had no travel history. When the patient was 15 weeks pregnant (17 days before her rash onset), her unvaccinated U.S.-born brother, aged 22 years, stayed in her home after returning from India, a country with endemic rubella transmission. The brother had a rash on his lower extremities that was diagnosed as poison ivy. Specimens from the patient and brother were collected and submitted to CDC; results were rubella IgG-positive with low avidity, indicating recent infection.

Among approximately 120 contacts of the patient, three were not vaccinated, including the patient's daughter, aged 11 years, one hospital staff member, and the patient's female coworker at a call center. All three were advised to avoid contact with pregnant women for 23 days; the patient's daughter and the hospital staff member were excluded from school and work, respectively, for 21 days.

Rubella infection in pregnancy can result in miscarriage, stillbirth, or congenital rubella syndrome (CRS), which is characterized by low birthweight and birth defects including deafness, cataracts, heart defects, and intellectual disabilities (*1*). The severity and nature of defects depend upon the gestational age of the fetus at the time of infection. The risk for CRS ranges from 10%–90% and is highest when infection occurs during the first trimester (*2*). Endemic transmission of rubella was eliminated in the United States in 2004 as a result of high levels of coverage with measles-mumps-rubella vaccine (MMR) (*1*).

An obstetrician specializing in high-risk pregnancies followed the patient for the remainder of her pregnancy. All follow-up testing was negative, and the patient delivered a full-term, apparently normal, infant in May. Echocardiogram, skeletal survey, head ultrasound, hearing, and eye exams were normal. The infant's initial rubella IgM was positive, and two sets of nasopharyngeal and urine specimens, obtained 30 days apart, were negative for rubella RNA by reverse transcription–polymerase chain reaction. Until negative results for rubella virus were received, the infant was considered infectious. Based on test results and the absence of congenital defects, indications are that this infant meets the criteria for congenital rubella infection and not CRS (*3*). The infant will continue to be followed by an infectious disease specialist.

This case highlights several important points. Per the Advisory Committee on Immunization Practices recommendations, health care institutions should ensure that all persons working in health care facilities have documentation of adequate vaccination against measles, mumps, and rubella or evidence of immunity (*4*); the hospital staff member who was excluded received the MMR vaccine before returning to work. Health care providers should routinely assess women of childbearing age for evidence of rubella immunity (IgG antibodies) and recommend vaccination when appropriate. Pregnant women testing negative for rubella immunity should be vaccinated immediately after delivery (*4*); this case represents a missed opportunity for rubella vaccination after the birth of the patient's first child. When a pregnant woman develops a rash illness, providers should ask about international travel for both the patient and her contacts. Finally, more emphasis and education are required for health care providers on the importance of timely reporting of suspected vaccine-preventable diseases.

Corresponding author: Tiffany Wallin, tiffany.wallin@jocogov.org, 913-826-1252.

[1]Disease Containment Division, Johnson County Department of Health and Environment, Olathe, Kansas; [2]Strategic Planning Division, Johnson County Department of Health and Environment, Olathe, Kansas.

All authors have completed and submitted the ICMJE form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

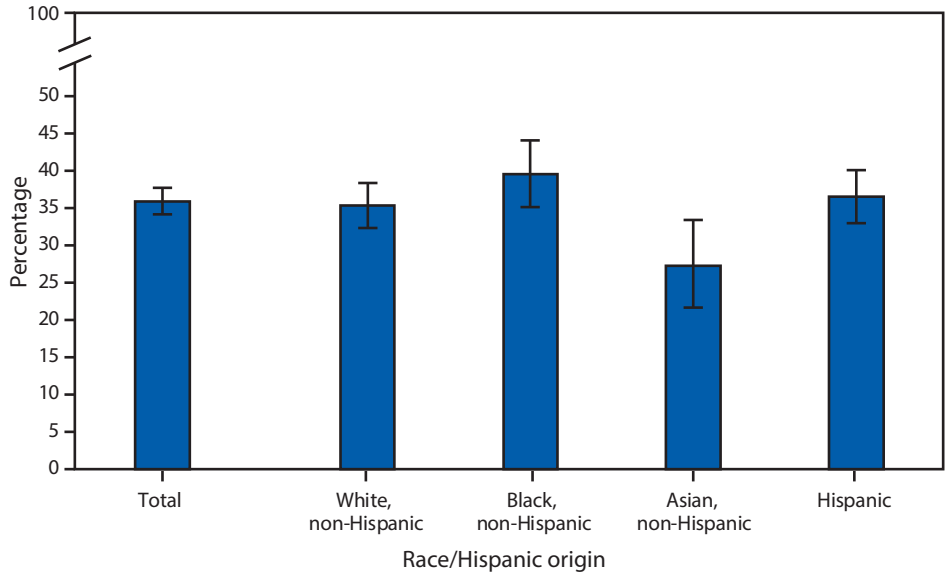
References

1. CDC. Rubella (German measles, three-day measles). Atlanta, GA: US Department of Health and Human Services, CDC; 2017. https://www.cdc.gov/rubella/hcp.html
2. Canadian Paediatric Society. Rubella (German measles) in pregnancy. Paediatr Child Health 2007;12:798–802. https://doi.org/10.1093/pch/12.9.798
3. CDC. Manual for the surveillance of vaccine-preventable diseases. Chapter 15: congenital rubella syndrome. Atlanta, GA: US Department of Health and Human Services, CDC; 2008. https://www.cdc.gov/vaccines/pubs/surv-manual/chpt15-crs.html
4. McLean HQ, Fiebelkorn AP, Temte JL, Wallace GS. Prevention of measles, rubella, congenital rubella syndrome, and mumps, 2013: summary recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Recomm Rep 2013;62(No. RR-4).

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage* of Youths Aged 2–19 Years Consuming Any Fast Food† on a Given Day, by Race and Hispanic Origin§ — National Health and Nutrition Examination Survey, 2013–2016



* 95% confidence intervals indicated with error bars.
† Fast food was defined as any food item reported during a 24-hour dietary recall that was reported as "restaurant fast food/pizza."
§ Estimates for non-Hispanic persons reporting more than one race are not shown separately, but are included in the total.

During 2013–2016, 36.0% of youths aged 2–19 consumed fast food on a given day. Non-Hispanic Asian youths (27.3%) had a lower percentage of fast food consumption on a given day, compared with non-Hispanic black (39.6%), Hispanic (36.6%), and non-Hispanic white (35.4%) youths. There were no significant differences in fast food consumption on a given day among non-Hispanic white, non-Hispanic black, and Hispanic youths.

Sources: National Center for Health Statistics Data Brief No. 322. https://www.cdc.gov/nchs/products/databriefs/db322.htm; National Center for Health Statistics, National Health and Nutrition Examination Survey Data, 2013–2016. https://www.cdc.gov/nchs/nhanes.htm.

Reported by: Kirsten Herrick, PhD, kherrick1@cdc.gov, 301-458-4383; Cheryl Fryar, MSPH; Namanjeet Ahluwalia, PhD; Craig Hales, MD.

The *Morbidity and Mortality Weekly Report (MMWR)* Series is prepared by the Centers for Disease Control and Prevention (CDC) and is available free of charge in electronic format. To receive an electronic copy each week, visit *MMWR* at *https://www.cdc.gov/mmwr/index.html*.

Readers who have difficulty accessing this PDF file may access the HTML file at *https://www.cdc.gov/mmwr/index2018.html*. Address all inquiries about the *MMWR* Series, including material to be considered for publication, to Executive Editor, *MMWR* Series, Mailstop E-90, CDC, 1600 Clifton Rd., N.E., Atlanta, GA 30329-4027 or to mmwrq@cdc.gov.

ISSN: 0149-2195 (Print)