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# State-Specific Prevalence of Current Cigarette Smoking and Smokeless Tobacco Use Among Adults — United States, 2014

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Tobacco use is the leading cause of preventable disease and death in the United States, resulting in approximately 480,000 premature deaths and more than $300 billion in direct health care expenditures and productivity losses each year (*1*). In recent years, cigarette smoking prevalence has declined in many states; however, there has been relatively little change in the prevalence of current smokeless tobacco use or concurrent use of cigarettes and smokeless tobacco in most states, and in some states prevalence has increased (*2*). CDC analyzed data from the 2014 Behavioral Risk Factor Surveillance System (BRFSS) to assess state-specific prevalence estimates of current use of cigarettes, smokeless tobacco, and cigarette and/or smokeless tobacco (any cigarette/smokeless tobacco use) among U.S. adults. Current cigarette smoking ranged from 9.7% (Utah) to 26.7% (West Virginia); current smokeless tobacco use ranged from 1.4% (Hawaii) to 8.8% (Wyoming); current use of any cigarette and/or smokeless tobacco product ranged from 11.3% (Utah) to 32.2% (West Virginia). Disparities in tobacco use by sex and race/ethnicity were observed; any cigarette and/or smokeless tobacco use was higher among males than females in all 50 states. By race/ethnicity, non-Hispanic whites had the highest prevalence of any cigarette and/or smokeless tobacco use in eight states, followed by non-Hispanic other races in six states, non-Hispanic blacks in five states, and Hispanics in two states ($p<0.05$); the remaining states did not differ significantly by race/ethnicity. Evidence-based interventions, such as increasing tobacco prices, implementing comprehensive smoke-free policies, conducting mass media anti-tobacco use campaigns, and promoting accessible smoking cessation assistance, are important to reduce tobacco use and tobacco-related disease and death among U.S. adults, particularly among subpopulations with the highest use prevalence (*3*).

The BRFSS is an annual state-based telephone (landline and cell phone) survey of noninstitutionalized U.S. adults aged ≥18 years.* During 2014, the median survey response rate for all states, territories, and the District of Columbia (DC) was 47.0% (range = 25.1%–60.1%) (*4*). Current cigarette smokers were persons who reported smoking at least 100 cigarettes in their lifetime and smoked "every day" or "some days" at the time of the survey. Current smokeless tobacco users are persons who reported using chewing tobacco or snus "every day" or "some days" at the time of the survey. Current any cigarette

* Additional information available at http://www.cdc.gov/brfss/.

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and/or smokeless tobacco users were persons who reported current use of cigarettes and/or smokeless tobacco products.

Prevalence estimates with 95% confidence intervals for cigarette smoking, smokeless tobacco use, and any cigarette and/or smokeless tobacco use were calculated overall and by state and sex. Because of limited sample size, data were stratified by race/ethnicity for current any cigarette and/or smokeless tobacco use, but not for current cigarette use or smokeless tobacco use. Race/ethnicity groups were categorized as non-Hispanic white (white), non-Hispanic black (black), Hispanic, and non-Hispanic other (Asian, Native Hawaiian or other Pacific Islander, American Indian or Alaska Native, or some other group). Data were weighted to adjust for nonresponse and to yield state representative estimates. Chi-square tests were conducted to assess differences among groups, with $p<0.05$ considered to be statistically significant.

By state, overall cigarette smoking prevalence ranged from 9.7% (Utah) to 26.7% (West Virginia) (Table 1) (Figure). Prevalence of smokeless tobacco use ranged from 1.4% (Hawaii) to 8.8% (Wyoming). Prevalence of any cigarette and/or smokeless tobacco use ranged from 11.3% (Utah) to 32.2% (West Virginia).

Cigarette smoking was significantly higher among males than females in 34 states (Table 2). Among males, cigarette smoking ranged from 11.2% (Utah) to 27.8% (West Virginia), and among females, from 8.2% (Utah) to 25.6% (West Virginia). Smokeless tobacco use was significantly higher among males than females in 44 states for which statistically stable estimates could be computed, and among males, ranged from 2.3% (Hawaii) to 16.5% (West Virginia). Use among females ranged from 0.40% (Maryland) to 3.4% (Mississippi). Any cigarette and/or smokeless tobacco use was significantly higher among males than among females in all 50 states, and ranged from 14.1% (Utah) to 39.2% (West Virginia) among males, and 8.5% (Utah) to 25.5% (West Virginia) among females.

Any cigarette and/or smokeless tobacco use ranged from 7.5% (DC) to 32.4% (West Virginia) among whites; 14.6% (Texas) to 36.1% (Vermont) among blacks; 8.0% (Maryland) to 45.5% (North Dakota) among Hispanics; and 9.6% (Maryland) to 45.5% (North Dakota) among adults of non-Hispanic other races (Table 3). The prevalence of any cigarette and/or smokeless tobacco use differed significantly by race/ethnicity in 21 states. Prevalence was highest among whites in eight states (Arizona, Delaware, Georgia, Maryland, New York, North Carolina, Texas, and Virginia), followed by adults of non-Hispanic other races in six states (Arkansas, Florida, Kansas, Nebraska, Oklahoma, and South Carolina), blacks in five states (California, Illinois, Indiana, New Jersey, and Wisconsin), and Hispanics in two states (Connecticut and Michigan).

## DISCUSSION

The overall prevalence of current cigarette smoking declined significantly in approximately half of U.S. states during 2011–2013 (*1*); however, differences in any cigarette and/or smokeless tobacco use exist between sexes and among racial/ethnic groups and states. The highest prevalence of cigarette and/or smokeless tobacco use

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**TABLE 1. State-specific prevalence of cigarette smoking,* smokeless tobacco use,† and any cigarette/smokeless tobacco use§ among adults aged ≥18 years — Behavioral Risk Factor Surveillance System, United States, 2014**

| State | Cigarette smoking % (95% CI)¶ | Smokeless tobacco % (95% CI) | Any cigarette and/or smokeless tobacco % (95% CI) |
|---|---|---|---|
| Alabama | 21.1 (19.8–22.5) | 5.8 (5.0–6.7) | 24.3 (23.0–25.7) |
| Alaska | 19.9 (18.2–21.6) | 5.3 (4.4–6.3) | 22.7 (21.0–24.5) |
| Arizona | 16.5 (15.4–17.6) | 3.1(2.6–3.7) | 17.3 (16.2–18.4) |
| Arkansas | 24.7 (22.8–26.8) | 6.5 (5.3–7.8) | 27.6 (25.6–29.7) |
| California | 12.9 (11.9–13.8) | 1.6 (1.3–2.0) | 12.8 (11.9–13.7) |
| Colorado | 15.7 (14.8–16.6) | 4.0 (3.5–4.6) | 16.9 (16.0–17.8) |
| Connecticut | 15.4 (14.2–16.7) | 1.8 (1.4–2.3) | 15.3 (14.2–16.5) |
| Delaware | 19.9 (18.0–21.9) | 1.6 (1.1–2.2) | 20.2 (18.3–22.1) |
| District of Columbia | 16.4 (14.3–18.7) | 1.8 (1.1–2.9) | 15.6 (13.7–17.8) |
| Florida | 17.6 (16.5–18.8) | 2.7 (2.2–3.3) | 17.9 (16.8–19.1) |
| Georgia | 17.4 (16.0–18.8) | 4.7 (4.0–5.7) | 19.3 (17.9–20.7) |
| Hawaii | 14.1 (13.0–15.3) | 1.4 (1.1–1.9) | 14.1 (13.0–15.3) |
| Idaho | 15.9 (14.5–17.5) | 5.0 (4.2–5.9) | 18.8 (17.3–20.4) |
| Illinois | 16.5 (15.1–18.0) | 3.2 (2.5–4.0) | 17.5 (16.1–19.0) |
| Indiana | 22.9 (21.8–24.1) | 4.2 (3.6–4.8) | 24.1 (23.0–25.2) |
| Iowa | 18.5 (17.3–19.7) | 5.1 (4.4–5.9) | 21.4 (20.2–22.7) |
| Kansas | 18.1 (17.3–18.9) | 5.7 (5.2–6.3) | 21.0 (20.1–21.9) |
| Kentucky | 26.2 (24.7–27.7) | 6.8 (6.0–7.8) | 29.6 (28.1–31.1) |
| Louisiana | 24.0 (22.6–25.4) | 5.3 (4.6–6.1) | 26.3 (24.9–27.7) |
| Maine | 19.3 (18.1–20.6) | 2.1 (1.7–2.6) | 19.6 (18.4–20.8) |
| Maryland | 14.6 (13.4–15.9) | 1.7 (1.3–2.2) | 15.3 (14.1–16.6) |
| Massachusetts | 14.7 (13.8–15.7) | 1.5 (1.2–1.9) | 14.6 (13.7–15.6) |
| Michigan | 21.2 (20.0–22.5) | 4.2 (3.6–4.9) | 22.6 (21.4–23.9) |
| Minnesota | 16.3 (15.6–17.0) | 4.0 (3.6–4.4) | 18.4 (17.7–19.2) |
| Mississippi | 23.0 (21.1–25.0) | 7.5 (6.4–8.9) | 26.5 (24.6–28.5) |
| Missouri | 20.6 (19.2–21.1) | 4.8 (4.1–5.7) | 23.2 (21.7–24.7) |
| Montana | 19.9 (18.5–21.4) | 7.6 (6.7–8.7) | 24.7 (23.2–26.2) |
| Nebraska | 17.3 (16.5–18.2) | 4.7 (4.2–5.1) | 20.0 (19.2–20.9) |
| Nevada | 17.0 (15.1–19.1) | 3.2 (2.4–4.2) | 18.4 (16.5–20.5) |
| New Hampshire | 17.5 (16.1–19.1) | 2.3 (1.8–3.1) | 17.8 (16.4–19.3) |
| New Jersey | 15.1 (14.2–16.1) | 2.0 (1.6–2.5) | 15.4 (14.4–16.4) |
| New Mexico | 19.1 (17.8–20.6) | 4.9 (4.3–5.7) | 20.6 (19.2–22.0) |
| New York | 14.4 (13.3–15.6) | 2.4 (1.9–3.1) | 15.0 (13.9–16.1) |
| North Carolina | 19.1 (17.9–20.3) | 4.5 (3.9– 5.2) | 20.9 (19.8–22.2) |
| North Dakota | 19.9 (18.4–21.5) | 6.3 (5.4–7.4) | 23.2 (21.7–24.9) |
| Ohio | 21.0 (19.7–22.4) | 4.6 (3.9–5.3) | 23.5 (22.2–24.9) |
| Oklahoma | 21.1 (19.9–22.3) | 6.5 (5.7–7.3) | 24.7 (23.5–26.0) |
| Oregon | 17.0 (15.6–18.5) | 3.6 (2.9–4.4) | 18.1 (16.7–19.6) |
| Pennsylvania | 19.9 (18.8–21.1) | 4.3 (3.8–4.9) | 21.9 (20.8–23.1) |
| Rhode Island | 16.3 (14.8–17.8) | 2.0 (1.5–2.7) | 16.4 (15.0–17.9) |
| South Carolina | 21.5 (20.4–22.7) | 3.7 (3.2–4.3) | 23.1 (21.9–24.2) |
| South Dakota | 18.6 (17.0–20.3) | 5.4 (4.5–6.4) | 21.6 (20.0–23.3) |
| Tennessee | 24.2 (22.4–26.2) | 7.3 (6.1–8.7) | 27.8 (25.9–29.7) |
| Texas | 14.5 (13.6–15.6) | 4.2 (3.7–4.8) | 16.4 (15.4–17.4) |
| Utah | 9.7 (9.1–10.3) | 3.0 (2.7–3.4) | 11.3 (10.7–12.0) |
| Vermont | 16.4 (15.3–17.6) | 3.4 (2.8–4.1) | 17.9 (16.7–19.1) |
| Virginia | 19.5 (18.4–20.7) | 3.9 (3.4–4.4) | 21.1 (20.0–22.3) |
| Washington | 15.3 (14.3–16.4) | 3.5 (2.9–4.1) | 16.8 (15.7–17.9) |
| West Virginia | 26.7 (25.3–28.1) | 8.5 (7.6–9.5) | 32.2 (30.8–33.7) |
| Wisconsin | 17.4 (16.0–18.8) | 3.5 (3.0–4.2) | 18.8 (17.5–20.2) |
| Wyoming | 19.5 (17.7–21.4) | 8.8 (7.5–10.4) | 24.8 (22.8–26.8) |

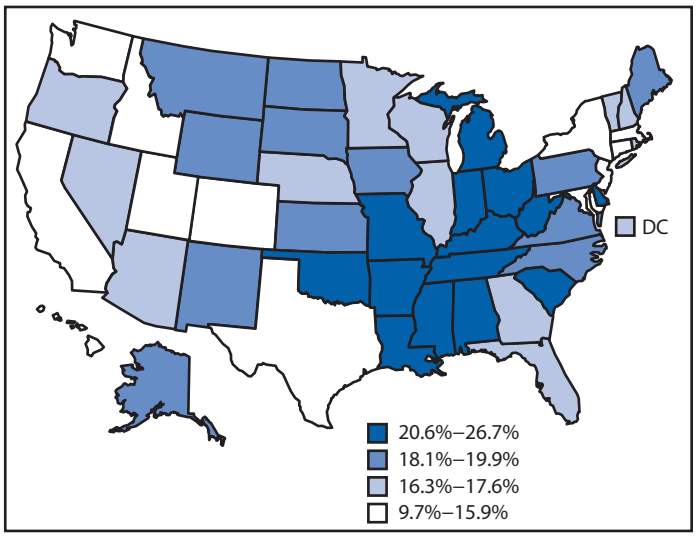
**Abbreviations:** CI = confidence interval.

* Persons aged ≥18 years who reported having smoked ≥100 cigarettes during their lifetime and smoked every day or some days at the time of survey.

† Persons aged ≥18 years who reported currently using chewing tobacco, snuff, or snus every day or some days at the time of survey.

§ Persons aged ≥18 years who reported having smoked ≥100 cigarettes during their lifetime and smoke every day or some days or reported currently using chewing tobacco, snuff, or snus every day or some days at the time of survey.

**FIGURE. State-specific prevalence of cigarette smoking* among adults aged ≥18 years — Behavioral Risk Factor Surveillance System, United States, 2014**




* Persons aged ≥18 years who reported having smoked ≥100 cigarettes during their lifetime and smoked every day or some days at the time of survey.

in the United States was seen in West Virginia. Furthermore, males and whites had higher prevalences of any cigarette and/or smokeless tobacco use than females and other race/ethnicities. The difference in prevalence of any cigarette and/or smokeless tobacco use across states spanned almost 21 percentage points, ranging from 11.3% in Utah to 32.2% in West Virginia. The use of any cigarette and/or smokeless tobacco was particularly high among men compared with women. These disparities might be partly explained by sociocultural influences and norms related to the acceptability of tobacco use (*4*,*5*), as well as variations in the implementation of evidence-based tobacco prevention and control measures (*6*). Continued implementation of proven population-based interventions, including increasing tobacco product prices, implementing and enforcing comprehensive smoke-free laws, warning about the dangers of tobacco use through mass media campaigns, and increasing access to evidence-based clinical interventions (including behavioral counseling and FDA-approved medication), can help reduce tobacco use, particularly in populations with the highest use prevalence (*3*).

These findings highlight the importance of enhanced implementation of evidence-based strategies to help smokers and other tobacco users quit completely. Public Health Service guidelines recommend using both medication and counseling to help cigarette smokers quit.† In addition, state tobacco control programs are critical to promoting health system changes that can facilitate the screening and treatment of tobacco use within clinical settings; expanding insurance coverage and

† Additional information available at http://www.surgeongeneral.gov/tobacco/treating_tobacco_use08.pdf.

**TABLE 2. State-specific prevalence of cigarette smoking,* smokeless tobacco use,† and any cigarette and/or smokeless tobacco use§ among adults aged ≥18 years, by sex — Behavioral Risk Factor Surveillance System, United States, 2014**

| State | Cigarette smoking % (95% CI)¶ | | Smokeless tobacco use % (95% CI) | | Any cigarette and/or smokeless tobacco use % (95% CI) | |
|---|---|---|---|---|---|---|
| | Male | Female | Male | Female | Male | Female |
| Alabama | 23.5 (21.3–25.7)¶ | 19.0 (17.4–20.6) | 11.1 (9.6–12.8)¶ | 1.0 (0.7–1.5) | 30.1 (27.9–32.5)¶ | 19.0 (17.4–20.6) |
| Alaska | 21.3 (18.8–23.9) | 18.4 (16.2–20.7) | 8.3 (6.9–10.1)¶ | 1.9 (1.2–2.9) | 26.0 (23.4–28.7)¶ | 19.1 (17.0–21.5) |
| Arizona | 19.2 (17.4–21.0)¶ | 13.9 (12.6–15.2) | 5.2 (4.3–6.3)¶ | 1.1 (0.7–1.6) | 21.2 (19.5–23.0)¶ | 13.5 (12.3–14.8) |
| Arkansas | 26.2 (23.1–29.4) | 23.4 (21.0–26.0) | 12.2 (10.0–14.8)¶ | 1.1 (0.7–1.8) | 32.9 (29.7–36.2)¶ | 22.6 (20.3–25.1) |
| California | 16.3 (14.9–17.9)¶ | 9.5 (8.4–10.6) | 2.8 (2.2–3.5)¶ | 0.5 (0.3–0.9) | 16.9 (15.4–18.4)¶ | 8.8 (7.8–9.9) |
| Colorado | 16.9 (15.6–18.2)¶ | 14.6 (13.4–15.8) | 7.3 (6.4–8.3)¶ | 0.8 (0.5–1.2) | 20.2 (18.9–21.6)¶ | 13.6 (12.5–14.7) |
| Connecticut | 17.5 (15.6–19.5)¶ | 13.5 (12.0–15.1) | 2.9 (2.2–3.9)¶ | 0.7 (0.4–1.1) | 17.8 (16.0–19.8)¶ | 13.0 (11.6–14.5) |
| Delaware | 23.5 (20.4–26.9)¶ | 16.6 (14.6–18.8) | 3.1 (2.2–4.3) | —** | 24.5 (21.4–27.8)¶ | 16.2 (14.3–18.4) |
| District of Columbia | 18.4 (15.3–21.9) | 14.6 (11.9–17.7) | 2.6 (1.6–4.3) | —** | 17.7 (14.9–21.1) | 13.8 (11.3–16.7) |
| Florida | 20.0 (18.1–21.9)¶ | 15.5 (14.1–16.9) | 4.4 (3.5–5.6)¶ | 1.1 (0.7–1.7) | 21.1 (19.3–23.0)¶ | 14.9 (13.6–16.3) |
| Georgia | 21.4 (19.1–23.9)¶ | 13.6 (12.1–15.3) | 8.3 (6.8–10.1)¶ | 1.5 (1.1–2.0) | 25.1 (22.8–27.6)¶ | 13.8 (12.3–15.4) |
| Hawaii | 16.2 (14.5–18.0)¶ | 12.1 (10.6–13.7) | 2.3 (1.7–3.1)¶ | 0.6 (0.3–1.2) | 16.5 (14.8–18.3)¶ | 11.7 (10.2–13.3) |
| Idaho | 16.4 (14.3–18.7) | 15.5 (13.5–17.6) | 9.1 (7.6–10.8) | —** | 22.5 (20.2–25.0)¶ | 15.2 (13.3–17.3) |
| Illinois | 18.7 (16.5–21.2)¶ | 14.5 (12.7–16.4) | 5.8 (4.5–7.4)¶ | 0.8 (0.4–1.3) | 21.2 (18.9–23.6)¶ | 14.0 (12.4–15.9) |
| Indiana | 24.5 (22.7–26.3)¶ | 21.5 (20.0–23.0) | 7.4 (6.4–8.6)¶ | 1.1 (0.7–1.6) | 27.9 (26.1–29.7)¶ | 20.5 (19.1–21.9) |
| Iowa | 19.9 (18.1–21.7)¶ | 17.2 (15.6–18.8) | 9.9 (8.6–11.5)¶ | 0.5 (0.3–0.9) | 26.3 (24.4–28.3)¶ | 16.7 (15.2–18.3) |
| Kansas | 19.5 (18.3–20.9)¶ | 16.7 (15.6–17.8) | 10.7 (9.7–11.7)¶ | 0.9 (0.7–1.3) | 25.9 (24.5–27.3)¶ | 16.2 (15.2–17.3) |
| Kentucky | 27.2 (24.8–29.6) | 25.2 (23.5–27.1) | 12.2 (10.6–14.0)¶ | 1.8(1.2–2.5) | 34.5 (32.2–37.0)¶ | 24.9 (23.2–26.7) |
| Louisiana | 27.6 (25.4–29.9)¶ | 20.7 (19.1–22.3) | 9.4 (8.1–10.9)¶ | 1.4 (1.0–2.0) | 32.5 (30.3–34.8)¶ | 20.4 (18.9–22.1) |
| Maine | 21.0 (19.1–23.0)¶ | 17.8 (16.3–19.4) | 3.8 (3.0–4.8)¶ | 0.5 (0.3–0.9) | 22.1 (20.2–24.1)¶ | 17.2 (15.8–18.8) |
| Maryland | 16.8 (14.8–19.0)¶ | 12.6 (11.3–14.2) | 3.1 (2.3–4.2)¶ | 0.4 (0.3–0.6) | 18.5 (16.5–20.7)¶ | 12.5 (11.1–13.9) |
| Massachusetts | 16.7 (15.2–18.3)¶ | 12.9 (11.7–14.1) | 2.5 (1.9–3.2)¶ | 0.6 (0.4–0.9) | 17.0 (15.6–18.6)¶ | 12.4 (11.3–13.6) |
| Michigan | 23.7 (21.8–25.7)¶ | 18.9 (17.3–20.5) | 7.4 (6.2–8.7)¶ | 1.3 (0.9–1.8) | 27.0 (25.1–29.0)¶ | 18.5 (16.9–20.1) |
| Minnesota | 17.9 (16.8–19.0)¶ | 14.8 (13.8–15.7) | 7.2 (6.5–7.9)¶ | 0.9 (0.7–1.3) | 22.1 (20.9–23.3)¶ | 14.8 (13.9–15.8) |
| Mississippi | 23.2 (20.4–26.4) | 22.7 (20.3–25.3) | 12.0 (9.9–14.5)¶ | 3.4 (2.4–4.8) | 29.9 (26.9–33.1)¶ | 23.4 (21.1–26.0) |
| Missouri | 21.9 (19.7–24.3) | 19.4 (17.6–21.4) | 9.2 (7.7–11.0)¶ | 0.7 (0.4–1.3) | 27.3 (25.0–29.8)¶ | 19.2 (17.4–21.2) |
| Montana | 20.0 (18.0–22.2) | 19.9 (17.9–22.0) | 13.7 (12.0–15.5)¶ | 1.6 (1.0–2.5) | 29.4 (27.2–31.7)¶ | 19.9 (18.0–22.1) |
| Nebraska | 18.5 (17.3–19.9)¶ | 16.2 (15.1–17.3) | 8.5 (7.7–9.3)¶ | 1.0 (0.7–1.3) | 24.2 (22.9–25.6)¶ | 16.0 (14.9–17.1) |
| Nevada | 20.2 (17.3–23.5)¶ | 13.7 (11.4–16.4) | 5.1 (3.7–6.9) | —** | 22.8 (19.8–26.1)¶ | 14.0 (11.7–16.6) |
| New Hampshire | 18.4 (16.2–20.9) | 16.7 (14.8–18.7) | 4.4 (3.3–5.8) | —** | 19.7 (17.5–22.1)¶ | 16.0 (14.2–17.9) |
| New Jersey | 17.8 (16.2–19.5)¶ | 12.6 (11.5–13.8) | 3.0 (2.3–3.8)¶ | 1.1 (0.8–1.5) | 18.4 (16.9–20.1)¶ | 12.5 (11.5–13.6) |
| New Mexico | 22.0 (19.8–24.3)¶ | 16.5 (14.8–18.3) | 8.6 (7.3–10.0)¶ | 1.5 (1.1–2.1) | 25.1 (23.0–27.4)¶ | 16.2 (14.6–18.0) |
| New York | 17.0 (15.2–19.0)¶ | 12.0 (10.7–13.4) | 3.8 (3.0–5.0)¶ | 1.2 (0.7–1.9) | 18.5 (16.6–20.4)¶ | 11.8 (10.6–13.1) |
| North Carolina | 21.9 (20.1–23.8)¶ | 16.5 (15.1–18.0) | 7.6 (6.4–9.0)¶ | 1.6 (1.2–2.1) | 25.4 (23.5–27.3)¶ | 16.9 (15.5–18.3) |
| North Dakota | 23.4 (21.0–25.9)¶ | 16.3 (14.5–18.3) | 11.8 (10.1–13.7) | —** | 30.6 (28.1–33.3)¶ | 15.6 (13.9–17.5) |
| Ohio | 21.7 (19.7–23.8) | 20.4 (18.7–22.1) | 8.6 (7.4–10.1)¶ | 0.8 (0.5–1.3) | 27.3 (25.2–29.5)¶ | 19.9 (18.3–21.6) |
| Oklahoma | 23.1 (21.2–25.1)¶ | 19.1 (17.6–20.7) | 12.6 (11.2–14.3)¶ | 0.5 (0.3–0.9) | 30.8 (28.8–32.9)¶ | 18.8 (17.4–20.4) |
| Oregon | 18.2 (16.1–20.4) | 15.8 (13.9–17.9) | 6.2 (5.0–7.6)¶ | 1.1 (0.6–2.0) | 21.1 (19.0–23.3)¶ | 15.3 (13.5–17.3) |
| Pennsylvania | 21.0 (19.3–22.9) | 18.9 (17.5–20.4) | 8.3 (7.2–9.5)¶ | 0.6 (0.4–0.9) | 25.7 (24.0–27.6)¶ | 18.3 (17.0–19.8) |
| Rhode Island | 18.8 (16.5–21.3)¶ | 13.9 (12.3–15.7) | 3.5 (2.4–5.0)¶ | 0.7 (0.4–1.2) | 19.7 (17.4–22.2)¶ | 13.5 (11.9–15.2) |
| South Carolina | 24.1 (22.4–26.0)¶ | 19.1 (17.7–20.7) | 6.6 (5.6–7.7)¶ | 1.0 (0.8–1.4) | 27.3 (25.5–29.1)¶ | 19.2 (17.7–20.7) |
| South Dakota | 18.7 (16.5–21.3) | 18.4 (16.3–20.7) | 10.1 (8.4–12.1)¶ | 0.7 (0.4–1.3) | 25.2 (22.6–27.8)¶ | 18.1 (16.0–20.3) |
| Tennessee | 26.0 (23.0–29.2) | 22.6 (20.4–24.9) | 13.3 (11.0–16.0)¶ | 1.7 (1.2–2.4) | 33.4 (30.4–36.6)¶ | 22.6 (20.4–24.8) |
| Texas | 16.7 (15.2–18.3)¶ | 12.5 (11.3–13.7) | 6.7 (5.8–7.7)¶ | 1.8 (1.4–2.5) | 20.5 (18.9–22.1)¶ | 12.4 (11.3–13.6) |
| Utah | 11.2 (10.2–12.2)¶ | 8.2 (7.4–9.0) | 5.1 (4.5–5.8)¶ | 1.0 (0.7–1.3) | 14.1 (13.1–15.2)¶ | 8.5 (7.7–9.3) |
| Vermont | 17.8 (16.1–19.7)¶ | 15.0 (13.6–16.6) | 5.6 (4.6–6.8)¶ | 1.3 (0.8–2.1) | 20.9 (19.1–22.9)¶ | 15.0 (13.6–16.5) |
| Virginia | 22.6 (20.8–24.5)¶ | 16.6 (15.2–18.1) | 7.1 (6.1–8.2)¶ | 0.8 (0.6–1.2) | 25.9 (24.1–27.8)¶ | 16.6 (15.2–18.1) |
| Washington | 16.9 (15.3–18.7)¶ | 13.8 (12.5–15.2) | 6.2 (5.2–7.4)¶ | 0.8 (0.5–1.3) | 20.2 (18.5–22.0)¶ | 13.4 (12.1–14.8) |
| West Virginia | 27.8 (25.6–30.1) | 25.6 (23.8–27.4) | 16.5 (14.7–18.4)¶ | 0.8 (0.5–1.2) | 39.2 (36.9–41.5)¶ | 25.5 (23.8–27.4) |
| Wisconsin | 18.7 (16.7–21.0) | 16.1 (14.4–17.9) | 6.6 (5.6–7.9) | —** | 22.5 (20.4–24.7)¶ | 15.2 (13.6–17.0) |
| Wyoming | 20.7 (18.0–23.7) | 18.2 (15.9–20.8) | 16.3 (13.8–19.1)¶ | 1.1 (0.6–1.9) | 31.6 (28.6–34.8)¶ | 17.7 (15.5–20.2) |

**Abbreviations**: CI = confidence interval.

* Persons aged ≥18 years who reported having smoked ≥100 cigarettes during their lifetime and smoked every day or some days at the time of survey.

† Persons aged ≥18 years who reported currently using chewing tobacco, snuff, or snus every day or some days at the time of survey.

§ Persons aged ≥18 years who reported having smoked ≥100 cigarettes during their lifetime and smoke every day or some days or reported currently using chewing tobacco, snuff, or snus every day or some days at the time of survey.

¶ Chi-square test assessed for differences between males and females; significant level $p<0.05$.

** Estimates not presented because of relative standard error (RSE) >30%.

**TABLE 3. State-specific prevalence of any tobacco use,* by race/ethnicity among adults aged ≥18 Years — Behavioral Risk Factor Surveillance System, United States, 2014**

| | Any cigarette and/or smokeless tobacco use % (95% CI) | | | |
|---|---|---|---|---|
| State | White (non-Hispanic) | Black (non-Hispanic) | Hispanic | non-Hispanic Other† |
| Alabama | 26.2 (24.6–27.9) | 20.8 (18.3–23.6) | —¶ | 19.5 (13.9–26.6) |
| Alaska | 20.2 (18.3–22.2) | —¶ | 15.4 (9.6–23.7) | 33.8 (29.6–38.4) |
| Arizona | 18.7 (17.5–20.1)§ | 17.3 (12.6–23.2) | 14.1 (11.9–16.7) | 17.9 (14.2–22.3) |
| Arkansas | 28.3 (26.1–30.7)§ | 27.5 (22.4–33.2) | 15.1 (8.1–26.2) | 30.4 (21.8–40.6) |
| California | 14.7 (13.4–16.0)§ | 21.6 (17.3–26.7) | 10.6 (9.1–12.2) | 10.0 (8.0–12.6) |
| Colorado | 16.6 (15.6–17.7) | 21.7 (16.7–27.7) | 17.1 (14.9–19.5) | 16.4 (12.9–20.6) |
| Connecticut | 14.3 (13.0–15.7)§ | 17.9 (14.1–22.5) | 19.0 (15.4–23.1) | 16.1 (11.4–2.1) |
| Delaware | 22.4 (20.1–24.8)§ | 17.0 (13.1–21.7) | 11.8 (7.9–17.3) | 19.1 (11.5–30.0) |
| District of Columbia | 7.5 (5.5–10.2) | 24.2 (20.8–27.9) | —¶ | 15.6 (9.1–25.5) |
| Florida | 19.8 (18.4–21.2)§ | 15.8 (12.8–19.4) | 14.3 (11.9–17.1) | 19.8 (14.8–26.0) |
| Georgia | 22.1 (20.3–24.0)§ | 16.0 (13.6–18.8) | 15.2 (10.3–22.0) | 15.5 (10.4–22.5) |
| Hawaii | 10.3 (8.5–12.4) | —¶ | 22.9 (18.4–28.1) | 14.2 (12.9–15.7) |
| Idaho | 19.5 (17.9–21.3) | —¶ | 9.8 (6.6–14.4) | 30.8 (22.1–41.3) |
| Illinois | 18.1 (16.4–19.9)§ | 24.4 (19.6–30.0) | 12.8 (9.7–16.7) | 11.2 (7.1–17.4) |
| Indiana | 24.5 (23.3–25.8)§ | 26.6 (22.3–31.4) | 14.4 (10.4–19.6) | 23.2 (17.7–29.7) |
| Iowa | 21.3 (20.1–22.6) | 24.3 (15.9–35.1) | 17.6 (11.9–25.3) | 26.1 (18.5–35.4) |
| Kansas | 21.1 (20.1–22.0)§ | 24.8 (20.5–29.7) | 14.2 (11.7–17.2) | 28.8 (24.5–33.6) |
| Kentucky | 29.3 (27.8–30.9) | 30.2 (23.8–37.6) | 28.2 (17.5–42.1) | 41.5 (32.2–51.4) |
| Louisiana | 27.2 (25.6–29.0) | 25.2 (22.7–27.9) | 18.5 (12.3–27.0) | 27.5 (20.8–35.5) |
| Maine | 18.9 (17.7–20.1) | —¶ | 32.8 (19.1–50.4) | 31.2 (24.0–39.5) |
| Maryland | 16.9 (15.3–18.5)§ | 16.7 (14.2–19.5) | 8.0 (4.9–2.8) | 9.6 (6.6–13.7) |
| Massachusetts | 14.6 (13.6–15.7) | 15.3 (11.6–19.8) | 16.6 (13.3–20.6) | 12.7 (9.9–16.3) |
| Michigan | 22.0 (20.7–23.4)§ | 22.5 (18.8–26.6) | 33.1 (24.3–43.3) | 25.6 (20.2–31.7) |
| Minnesota | 18.4 (17.6–19.2) | 21.1 (16.8–26.1) | 14.9 (11.4–19.4) | 17.7 (14.6–21.4) |
| Mississippi | 29.7 (27.1–32.4) | 23.6 (20.6–26.8) | —¶ | —¶ |
| Missouri | 23.7 (22.1–25.5) | 21.1 (16.9–26.1) | 23.2 (13.7–36.4) | 16.0 (11.2–22.4) |
| Montana | 22.5 (21.0–24.2) | —¶ | 35.3 (24.1–48.3) | 42.7 (36.9–48.8) |
| Nebraska | 20.2 (19.3–21.2)§ | 20.0 (15.0–26.1) | 14.3 (11.3–17.9) | 28.4 (22.9–34.6) |
| Nevada | 19.8 (17.5–22.3) | 23.2 (15.8–32.6) | 16.3 (12.3–21.4) | 15.0 (9.5–22.9) |
| New Hampshire | 17.8 (16.3–19.3) | —¶ | —¶ | 23.7 (15.6–34.4) |
| New Jersey | 16.1 (14.9–17.4)§ | 17.8 (15.1–20.8) | 14.3 (12.0–16.9) | 11.9 (9.3–15.1) |
| New Mexico | 21.6 (19.7–23.7) | 29.4 (16.0–47.5) | 20.2 (18.0–22.5) | 17.6 (14.1–21.7) |
| New York | 16.2 (14.7–17.7)§ | 15.6 (12.6–19.2) | 13.7 (11.0–16.8) | 10.1 (7.4–13.5) |
| North Carolina | 22.1 (20.6–23.6)§ | 21.0 (18.5–23.8) | 11.0 (8.4–14.2) | 20.2 (15.2–26.3) |
| North Dakota | 20.9 (19.4–22.5) | —¶ | 45.5 (29.8–62.2) | 45.5 (37.1–54.1) |
| Ohio | 23.8 (22.3–25.3) | 21.9 (17.7–26.9) | 21.5 (14.2–31.1) | 22.3 (15.9–303.) |
| Oklahoma | 24.4 (22.9–25.9)§ | 26.4 (21.6–31.9) | 14.2 (10.5–19.0) | 32.1 (28.3–36.1) |
| Oregon | 18.4 (16.9–20.0) | —¶ | 13.8 (9.6–19.6) | 20.6 (15.4–27.1) |
| Pennsylvania | 21.9 (20.7–23.2) | 23.5 (19.7–27.8) | 24.8 (18.4–32.7) | 13.6 (9.5–19.2) |
| Rhode Island | 16.6 (15.0–18.2) | 19.8 (13.4 –28.2) | 13.9 (9.9–19.1) | 17.1 (10.6–26.3) |
| South Carolina | 23.1 (21.7–24.5)§ | 22.4 (20.1–24.8) | 19.3 (13.7–26.5) | 32.3 (26.3–38.8) |
| South Dakota | 20.0 (18.2–21.8) | —¶ | —¶ | 36.7 (30.6–43.2) |
| Tennessee | 29.1 (27.0–31.3) | 22.5 (17.8–27.9) | —¶ | 29.7 (20.5–41.0) |
| Texas | 19.2 (17.8–20.7)§ | 14.6 (11.6–18.1) | 13.7 (12.2–15.4) | 13.4 (9.6–18.3) |
| Utah | 11.2 (10.5–11.9) | —¶ | 10.8 (8.9–13.1) | 13.2 (10.1–17.0) |
| Vermont | 17.4 (16.2–18.6) | 36.1 (19.1–57.6) | —¶ | 31.6 (24.1–40.1) |
| Virginia | 22.9 (21.5–24.3)§ | 19.6 (16.9–22.6) | 14.5 (10.6–19.5) | 19.4 (15.3–24.3) |
| Washington | 17.2 (16.0–18.5) | 16.7 (10.5–25.6) | 13.1 (9.9–17.2) | 17.7 (14.2–21.9) |
| West Virginia | 32.4 (30.9–33.9) | 29.8 (21.3–40.0) | 31.4 (17.7–49.3) | 31.1 (22.2–41.7) |
| Wisconsin | 18.3 (17.0–19.7)§ | 30.5 (21.4–41.4) | 13.3 (8.4–20.6) | 21.9 (15.9–29.5) |
| Wyoming | 24.5 (22.4–26.6) | —¶ | 19.6 (12.7–8.9) | 37.2 (26.7–48.9) |

**Abbreviations**: CI = confidence interval.
* Persons aged ≥18 years who reported having smoked ≥100 cigarettes during their lifetime and smoked every day or some days at the time of survey.
† Persons who are self-identified as Asian, Native Hawaiian or other Pacific Islander, American Indian or Alaska Native, or some other group.
§ Chi-square test assessed for differences within the four race/ethnicity categories; significant level p<0.05.
¶ Estimates not presented because relative standard error >30%.

**Summary**

What is already known about this topic?

Tobacco use is the leading cause of preventable disease and death in the United States. In recent years, cigarette smoking prevalence has declined in many states; however, there has been little change in the prevalence of current smokeless tobacco use or concurrent use of cigarettes and smokeless tobacco in most states, with prevalence increasing in some states.

What is added by this report?

State-specific differences and disparities in any cigarette/smokeless tobacco use exist between sexes and among racial/ethnic groups. The highest prevalence of any cigarette and/or smokeless tobacco use in the United States was seen in West Virginia. The difference in prevalence of any cigarette and/or smokeless tobacco use across states spanned almost 21 percentage points, ranging from 11.3% in Utah to 32.2% in West Virginia. Any cigarette and/or smokeless tobacco use was higher among males than females in all 50 states. Non-Hispanic whites had the highest prevalence of cigarette smoking and/or smokeless tobacco use in eight states, followed by non-Hispanic persons of other races in six states, non-Hispanic blacks in five states, and Hispanics in two states.

What are the implications for public health practice?

The significantly higher prevalence of tobacco use among males and some racial/ethnic groups in several states underscores the importance of implementing comprehensive tobacco control and prevention interventions to reduce tobacco use and tobacco-related disparities across states, including increasing tobacco product prices, implementing and enforcing comprehensive smoke-free laws, warning about the dangers of tobacco use through mass media campaigns. Increasing access to evidence-based behavioral counseling and FDA-approved medication, can also help reduce tobacco use, particularly in populations with high use prevalence.

use of proven cessation treatments, and increasing use of state quit lines (telephone-based tobacco cessation services) also help tobacco users quit (*3*). Cessation programs involving both medication and counseling, in combination with comprehensive tobacco control measures, as recommended by the World Health Organization[§] and CDC's best practices for comprehensive tobacco control programs (*3*), can help to reduce tobacco-related morbidity and mortality.

The findings in this report are subject to at least three limitations. First, BRFSS does not include adults without either wireless or landline telephone service; however, their exclusion would not be expected to introduce any major bias because only 3.1% of U.S. adults reported having no telephone service in 2015.[¶] Second, these data are self-reported and might be subject to reporting bias. Although self-reported smoking yields lower prevalence estimates than assessment with serum cotinine, a metabolite of nicotine, it is unlikely that underreporting will have a large effect on the findings of this report because of the overall high concordance between self-reported smoking and biochemical assessment with cotinine (*7*). Finally, the median state response rates ranged from 25.1% to 60.1%. Even after adjusting for nonresponse, low response rates can increase the potential for bias if there are systematic differences between respondents and nonrespondents; however, BRFSS has been shown to be valid and reliable (*8*).

There remains considerable variability in current use of cigarettes, smokeless tobacco, and any cigarette and/or smokeless tobacco use across states and by sex and race/ethnicity. The significantly higher prevalence among males and certain racial/ethnic groups in several states underscores the importance of implementing comprehensive tobacco control and prevention interventions to reduce tobacco use and tobacco-related health disparities (*9*). However, during fiscal year 2016, despite combined revenue of $25.8 billion from settlement payments and tobacco taxes for all states, states will spend only $468 million (1.8%) on comprehensive tobacco control programs, representing <15% of the CDC-recommended level of funding for all states combined (*10*). Comprehensive tobacco control programs funded at CDC-recommended levels have been shown to effectively reduce tobacco use; thus, enhanced and equitable adoption of evidence-based measures across all states could be beneficial to decrease the prevalence of tobacco use across all population groups in the United States (*3*).

[§] Additional information available at http://whqlibdoc.who.int/publications/2009/9789241563918_eng_full.pdf.

[¶] Additional information available at http://www.cdc.gov/nchs/data/nhis/earlyrelease/wireless201605.pdf.

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# Prevalence of Severe Joint Pain Among Adults with Doctor-Diagnosed Arthritis — United States, 2002–2014

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In the United States, arthritis is a leading cause of disability (*1*,*2*); arthritis affected an estimated 52.5 million (22.7%) adults in 2010–2012 and has been projected to affect 78.4 million adults by 2040 (*3*). Severe joint pain (SJP) can limit function and seriously compromise quality of life (*4*,*5*). To determine the prevalence of SJP among adults with doctor-diagnosed arthritis, and the trend in SJP from 2002 to 2014, CDC analyzed data from the National Health Interview Survey. In 2014, approximately one fourth of adults with arthritis had SJP (27.2%). Within selected groups, the age-standardized prevalence of SJP was higher among women (29.2%), non-Hispanic blacks (42.3%), Hispanics (35.8%), and persons with a disability (45.6%), and those who were unable to work (51.9%); prevalence also was higher among those who had fair or poor health (49.1%), obesity (31.7%), heart disease (34.1%), diabetes (40.9%), or serious psychological distress (56.3%). From 2002 to 2014, the age-standardized prevalence of SJP among adults with arthritis did not change ($p = 0.14$); however, the number of adults with SJP was significantly higher in 2014 (14.6 million) than in 2002 (10.5 million). A strategy to improve pain management (e.g., the 2016 National Pain Strategy*) has been developed, and more widespread dissemination of evidence-based interventions that reduce joint pain in adults with arthritis might reduce the prevalence of SJP.

CDC used data from the National Health Interview Survey, an annual, nationally representative, in-person survey of health status and behaviors of the noninstitutionalized civilian U.S. adult population. Sampling weights were applied so that estimates were representative of the civilian noninstitutionalized U.S. population. These weights adjusted for household nonresponse and oversampling of blacks, Hispanics, and Asians. Poststratification adjustments were based on 1990 U.S. Census estimates for 2002 data, 2000 U.S. Census estimates for 2003, 2006, and 2009 data, and 2010 U.S. Census estimates for 2014 data. Analyses were conducted using statistical software to account for the complex sampling design. Total unweighted sample sizes and final response rates were 31,044 and 74.3% in 2002; 30,852 and 74.2% in 2003; 24,275 and 70.8% in 2006; 27,731 and 65.4% in 2009; and 36,697 and 58.9% in 2014.†

Respondents were classified as having doctor-diagnosed arthritis if they answered "yes" to the question, "Have you ever been told by a doctor or other health professional that you have some form of arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia?" Among adults reporting joint pain, respondents were asked to "please think about the past 30 days, keeping in mind all of your joint pain or aching and whether or not you have taken medication. During the past 30 days, how bad was your joint pain on average? Please answer on a scale of 0 to 10, where 0 is no pain or aching and 10 is pain and aching as bad as it can be." SJP was defined as a response ≥7.

For 2014, unadjusted and age-standardized SJP prevalence were estimated for adults with arthritis, both overall and by selected demographic (sex, age group, race/ethnicity [non-Hispanic whites, non-Hispanic blacks, and Hispanics], disability status,§ education level, and employment status) and health (smoking status, body mass index,¶ leisure-time physical activity level,** overall health status, heart disease and diabetes,†† and serious psychological distress status§§) characteristics. Estimates were age-standardized to the 2000 U.S. standard population using three age groups (18–44, 45–64, and ≥65 years) (*6*). Unadjusted prevalence estimates

* https://iprcc.nih.gov/docs/DraftHHSNationalPainStrategy.pdf.

† http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm.

§ Adults were considered to have a disability if they answered "yes" to any of the following six questions: "Are you deaf or have serious difficulty hearing? Are you blind or have serious difficulty seeing even when wearing glasses? Because of a physical, mental, or emotional condition, do you have serious difficulty concentrating, remembering, or making decisions? Do you have serious difficulty walking or climbing stairs? Do you have difficulty dressing or bathing? Because of a physical, mental, or emotional condition, do you have difficulty doing errands alone such as visiting a doctor's office or shopping?"

¶ Body mass index = weight (kg) / (height [m])2. Categorized as follows: underweight/normal weight (<25.0), overweight (25.0 to <30.0), obese (≥30.0).

** Determined from responses to six questions regarding frequency and duration of participation in leisure-time activities of moderate or vigorous intensity and categorized according to the U.S. Department of Health and Human Services *2008 Physical Activity Guidelines for Americans*. Participants were considered active if they reported ≥150 minutes of moderate equivalent minutes per week. Those with some aerobic activity, but not enough to meet the active definition were classified as insufficiently active. Inactive adults were those with no moderate or vigorous intensity aerobic activity lasting at least 10 minutes.

†† Adults were considered to have doctor-diagnosed heart disease if they answered "yes" to any of the following four questions: "Have you ever been told by a doctor or other health professional that you had coronary heart disease? Angina, also called angina pectoris? A heart attack (also called myocardial infarction)? Any kind of heart condition or heart disease (other than the ones I just asked about)?" Adults were considered to have doctor-diagnosed diabetes if they answered "yes" to the following question: "Have you ever been told by a doctor or other health professional that you had diabetes?"

§§ Adults were considered to have serious psychological distress if they had a score of ≥13 on the Kessler 6 scale (0–24).

for SJP describe the absolute population burden in a specific year, whereas age-standardized prevalence estimates describe the relative population burden adjusting for age-distribution differences across years or population groups. To examine differences for demographic and health characteristics in 2014, nonoverlapping 95% confidence intervals (CIs) (for the age-standardized estimates) were considered statistically significant. To examine trends in the age-standardized prevalence of SJP among adults with arthritis, a linear orthogonal polynomial contrast for the age-standardized estimates was used.

In 2014, the age-standardized prevalence of arthritis was 20.8%. Among adults with arthritis, the unadjusted prevalence of SJP was 27.2% and the age-standardized prevalence of SJP was 26.5%, with the highest prevalence among persons aged 45–64 years (30.7%) (Table). Within selected demographic groups, the age-standardized prevalence of SJP was significantly higher among women (29.2%), non-Hispanic blacks (42.3%), Hispanics (35.8%), those with a disability (45.6%), those with less than a high school education (40.2%), and those unable to work (51.9%). Within selected health characteristics, prevalence of SJP was highest among those with fair/poor health (49.1%), obesity (31.7%), heart disease (34.1%), diabetes (40.9%), and serious psychological distress (56.3%) (Table).

For the 5 years studied, the age-standardized prevalence of SJP among adults with arthritis (range = 24.9%–26.5%) did not significantly change (p = 0.14), but the estimated number of adults with SJP was significantly higher in 2014 (14.6 million, CI = 13.8–15.4 million) compared with 2002 (10.5 million, CI = 9.9–11.1 million) (Figure).

**Summary**

**What is already known about this topic?**

Severe joint pain (SJP) is a common outcome among adults with arthritis that can limit a person's ability to perform basic functions and seriously compromise quality of life (e.g., resulting in more restricted social participation and more depression).

**What is added by this report?**

The unadjusted prevalence of SJP in the preceding 30 days among adults with arthritis was 27.2% in 2014. The age-standardized prevalence of SJP remained high (range = 24.9%–26.5%) and stable during 2002–2014, but the absolute numbers continued to increase and in 2014 reached 14.6 million. Groups disproportionately affected by SJP included women, non-Hispanic blacks, Hispanics, those with a disability, those unable to work, and those with less than a high school education, fair/poor health, obesity, heart disease, diabetes, or serious psychological distress.

**What are the implications for public health practice?**

Two major objectives of the 2016 National Pain Strategy are 1) to take steps to reduce barriers to pain care, and 2) to increase patient knowledge of treatment options and risks. The *CDC Guideline for Prescribing Opioids for Chronic Pain — United States, 2016*, offers additional guidance on managing pain from arthritis. Health care providers and public health practitioners can begin implement the recommendations and improve pain care among adults with arthritis by prioritizing self-management education and appropriate physical activity interventions as effective, nonpharmacologic ways to reduce pain and improve health outcomes.

## Discussion

SJP affected more than one fourth of adults with arthritis in 2014 and was significantly higher among middle-aged adults. The age-adjusted prevalence of SJP was higher among women, non-Hispanic blacks, Hispanics, those with a disability, those with less than a high school education, and those unable to work. SJP also was higher among those with fair/poor health, obesity, diabetes, heart disease, and serious psychological distress. The age-standardized prevalence of SJP remained high (range = 24.9%–26.5%) and stable during 2002–2014, but the absolute numbers continued to grow significantly, and in 2014 reached 14.6 million.

SJP can limit a person's ability to perform basic functions and seriously compromise their quality of life. The *CDC Guideline for Prescribing Opioids for Chronic Pain* recommends use of exercise therapy, cognitive behavioral therapy, certain interventional procedures, acetaminophen, and nonsteroidal anti-inflammatory drugs for the treatment of arthritis (*7*); there is insufficient evidence for and serious risks associated with long-term use of opioid therapy to treat chronic pain. Medications can help, but low-impact physical activity (e.g., walking, biking, and swimming) is a nonpharmacologic and underused way of reducing joint pain (*8*). For those concerned about safely increasing physical activity without worsening their joint pain or their arthritis, community-based programs[¶¶] (e.g., EnhanceFitness and Walk with Ease) are available. In addition, participation in self-management education interventions (e.g., the Chronic Disease Self-Management Program) has been shown to improve health-related quality of life and confidence in managing symptoms of arthritis and other health conditions (*9*). Targeting specific subgroups with a high prevalence of SJP (e.g., non-Hispanic blacks, Hispanics, those unable to work, and those with poor health or chronic conditions) might help reduce the large disparities in SJP burden.

The findings in this report are subject to at least seven limitations. First, all of the data were self-reported. However, the doctor-diagnosed arthritis case definition has been shown to be acceptable for public health surveillance (*10*). Other characteristics are subject to information bias (e.g., recall bias or social desirability bias); for example, it is likely that weight was

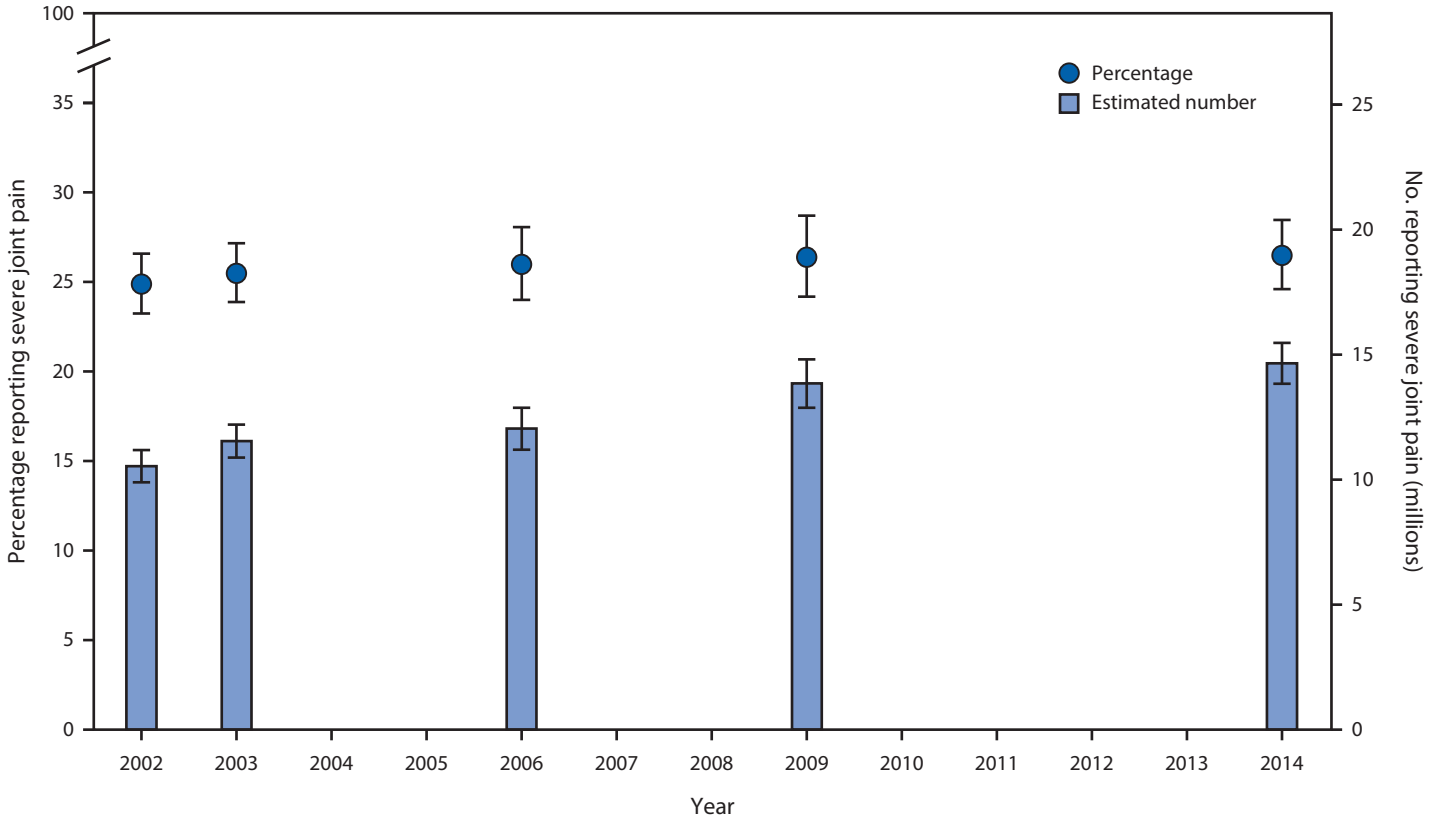
¶¶ http://www.cdc.gov/arthritis/interventions.htm.

**TABLE. Number and percentage of adults with doctor-diagnosed arthritis who reported severe joint pain in the preceding 30 days, by selected characteristics — National Health Interview Survey, United States, 2014**

| Characteristic | No. in sample reporting severe joint pain | Weighted no. (thousands)* | Unadjusted % (95% CI) | Age-standardized %† with SJP (95% CI) |
|---|---|---|---|---|
| **Overall** | **2,548** | **14,622** | **27.2 (26.0–28.6)** | **26.5 (24.6–28.5)** |
| **Demographics** | | | | |
| **Age group (yrs)** | | | | |
| 18–44 | 304 | 1,978 | 24.9 (21.6–28.5) | — |
| 45–64 | 1,199 | 7,361 | 30.7 (28.6–32.9) | — |
| ≥65 | 1,045 | 5,283 | 24.3 (22.6–26.1) | — |
| **Sex** | | | | |
| Men | 783 | 5,198 | 24.1 (22.2–26.2) | 22.7 (20.3–25.2) |
| Women | 1,765 | 9,423 | 29.3 (27.8–30.9) | 29.2 (26.7–31.9) |
| **Race/Ethnicity** | | | | |
| White, non-Hispanic | 1,544 | 9,822 | 23.9 (22.5–25.4) | 23.1 (21.0–25.4) |
| Black, non-Hispanic | 575 | 2,640 | 42.8 (39.5–46.2) | 42.3 (37.6–47.2) |
| Hispanic | 342 | 1,758 | 38.2 (33.9–42.6) | 35.8 (31.1–40.8) |
| **Disability status§** | | | | |
| Disabled | 797 | 4,436 | 39.9 (37.3–42.6) | 45.6 (39.5–51.8) |
| Not disabled | 448 | 2,613 | 17.5 (15.8–19.4) | 23.1 (21.1–25.1) |
| **Education level** | | | | |
| Less than high school diploma | 675 | 3,563 | 42.2 (38.8–45.8) | 40.2 (34.4–46.4) |
| High school diploma or equivalent | 751 | 4,267 | 27.8 (25.5–30.3) | 27.4 (23.9–31.3) |
| Some college | 488 | 2,891 | 28.8 (26.0–31.8) | 29.1 (25.1–33.3) |
| College and above | 623 | 3,816 | 19.5 (17.7–21.3) | 19.3 (16.6–22.2) |
| **Employment status** | | | | |
| Employed/Self-employed | 702 | 4,590 | 20.7 (18.8–22.9) | 20.1 (17.8–22.6) |
| Unemployed | 105 | 694 | 31.6 (25.2–38.9) | 29.8 (22.6–38.2) |
| Unable to work | 834 | 4,367 | 53.1 (49.5–56.7) | 51.9 (46.7–57.1) |
| Other | 905 | 4,967 | 23.5 (21.7–25.5) | 29.2 (22.5–37.0) |
| **Health characteristics** | | | | |
| **Smoking status** | | | | |
| Current smoker | 597 | 3,397 | 35.4 (32.2–38.8) | 32.9 (29.4–36.7) |
| Former smoker | 794 | 4,766 | 27.9 (25.7–30.1) | 26.6 (22.6–31.0) |
| Never smoker | 1,127 | 6,305 | 23.7 (22.1–25.4) | 22.9 (20.4–25.5) |
| **Leisure-time physical activity** | | | | |
| Inactive | 1,309 | 7,426 | 36.7 (34.4–39.1) | 36.5 (32.6–40.5) |
| Insufficiently active | 523 | 3,049 | 25.3 (22.7–28.1) | 27.9 (23.2–33.0) |
| Active | 649 | 3,788 | 18.7 (16.9–20.6) | 18.1 (15.9–20.5) |
| **Overall health status** | | | | |
| Excellent/Very good | 495 | 3,174 | 15.1 (13.5–16.8) | 15.6 (13.1–18.5) |
| Good | 743 | 4,193 | 23.7 (21.7–25.8) | 22.8 (19.8–26.2) |
| Fair/Poor | 1,310 | 7,255 | 48.8 (46.3–51.4) | 49.1 (44.7–53.5) |
| **Body mass index** | | | | |
| Underweight/Normal weight | 512 | 2,912 | 21.4 (19.2–23.7) | 21.2 (18.2–24.6) |
| Overweight | 734 | 4,182 | 23.6 (21.5–25.8) | 23.5 (19.9–27.6) |
| Obese | 1,187 | 6,849 | 34.1 (32.0–36.4) | 31.7 (28.8–34.7) |
| **Heart disease status** | | | | |
| Yes | 794 | 4,440 | 34.3 (31.6–37.1) | 34.1 (28.7–40.0) |
| No | 1,746 | 10,157 | 25.0 (23.5–26.6) | 24.8 (22.7–26.9) |
| **Diabetes status** | | | | |
| Yes | 681 | 3,884 | 37.9 (34.8–41.1) | 40.9 (33.7–48.5) |
| No | 1,867 | 10,737 | 24.7 (23.4–26.1) | 24.5 (22.6–26.5) |
| **Serious psychological distress status** | | | | |
| Yes | 331 | 1,798 | 58.6 (53.5–63.6) | 56.3 (48.9–63.3) |
| No | 2,100 | 12,211 | 25.0 (23.7–26.4) | 23.9 (22.0–26.0) |

* Weighted number of adults with severe joint pain among those with doctor-diagnosed arthritis.
† Percentages were age-standardized to the 2000 U.S. Census population.
§ Estimates were generated from questions in the survey's family disability file.

**FIGURE. Age-standardized percentage and estimated number* of adults with doctor-diagnosed arthritis who reported severe joint pain in the preceding 30 days — National Health Interview Survey, United States, 2002–2014**




* With 95% confidence intervals.

underreported and height and leisure-time physical activity levels were overreported. Second, assessment of joint pain on average over the preceding 30 days might be overly influenced by recent or severe episodes. Third, because the SJP question was asked before the arthritis question in the survey, it cannot be certain that the SJP reported was related to doctor-diagnosed arthritis, although it seems reasonable to assume that it was. Fourth, these data are cross-sectional; therefore, causal inferences cannot be made. This might be especially relevant for characteristics such as serious psychological distress, which can be both a risk factor for and a result of SJP. Fifth, there is no information on individual or clinical treatment for pain to assess the prevalence of SJP among those with and without treatment. Sixth, because final response rates ranged from 74.3% in 2002 to 58.9% in 2014, the findings might reflect some response bias, although the application of sampling weights is expected to considerably reduce nonresponse bias. Finally, it was not possible to show individual estimates for certain racial/ethnic populations (e.g., Asians, American Indian/Alaska Natives, Native Hawaiian/Pacific Islanders, and multiracial) because they did not meet the minimum criterion for precision of relative standard error ≤30.0%.

Strengths of this study include using a large, nationally representative survey with information on arthritis, joint pain, and important demographic and health characteristics over several years, which allowed evaluation of changes over time.

The 2016 National Pain Strategy, the first broad federal effort to develop strategies to reduce pain, has strategies and objectives in six categories (population research, prevention and care, disparities, service delivery and payment, professional education and training, and public education and communication) aimed at reducing the burden of pain for persons and the nation. Two major objectives are to 1) take steps to reduce barriers to pain care, and 2) to increase patient knowledge of treatment options and risks. CDC currently funds arthritis programs in 12 states.*** Health care providers and public health practitioners can begin to implement the recommendations and improve pain care among adults with arthritis and SJP by prioritizing self-management education and appropriate physical activity interventions as effective nonpharmacologic ways to reduce pain and improve health outcomes.

*** http://www.cdc.gov/arthritis/state_programs/programs.

[1]Division of Population Health, National Center for Chronic Disease Prevention and Health Promotion, CDC; [2]Division of Cancer Prevention and Control, National Center for Chronic Disease Prevention and Health Promotion, CDC.

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# Vaccination Coverage Among Children in Kindergarten — United States, 2015–16 School Year

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State-mandated vaccination requirements for school entry protect children and communities against vaccine-preventable diseases (*1*). Each school year, federally funded immunization programs (e.g., states, territories, jurisdictions) collect and report kindergarten vaccination data to CDC. This report describes vaccination coverage estimates in all 50 states and the District of Columbia (DC), and the estimated number of kindergartners with at least one vaccine exemption in 47 states and DC, during the 2015–16 school year. Median vaccination coverage* was 94.6% for 2 doses of measles, mumps and rubella vaccine (MMR); 94.2% for diphtheria, tetanus, and acellular pertussis vaccine (DTaP); and 94.3% for 2 doses of varicella vaccine. MMR coverage increased in 32 states during the last year, and 22 states reported coverage ≥95% (*2*). A total of 45 states and DC had either a grace period allowing students to attend school before providing documentation of vaccination or provisional enrollment that allows undervaccinated students to attend school while completing a catch-up schedule. Among the 23 states that were able to voluntarily report state-level data on grace period or provisional enrollment to CDC, a median of 2.0% of kindergartners were not documented as completely vaccinated and were attending school within a grace period or were provisionally enrolled. The median percentage of kindergartners with an exemption from one or more vaccinations† was 1.9%. State and local immunization programs, in cooperation with schools, can improve vaccination coverage by ensuring that all kindergartners are vaccinated during the grace period or provisional enrollment.

Federally funded immunization programs in 50 states and DC partner 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.§ Eight states reported data for some homeschooled kindergartners.¶ During the 2015–16 school year, for the first time, 23 states reported data on children who were neither fully vaccinated nor exempt, but attending kindergarten under a grace period or provisional enrollment. 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. A provisional enrollment allows a student without complete vaccination or exemption to attend school while completing a catch-up vaccination schedule.

States use a range of data sources to assess vaccination coverage, and during the 2015–16 school year, vaccination assessments varied by immunization program because of differences in state mandates, data reported, and available resources. Among the 51 programs reporting data, 32 used a census to collect kindergarten vaccination data; 10 used a sample; three used a voluntary school response; and six used a mix of sampling methods.** Programs used the same methods to collect both vaccination coverage and exemption data, except for programs in Alaska, Kansas, New Mexico, and Virginia, which used a sample to collect vaccination coverage data and a census

* Median vaccination coverage was determined using estimates from the 50 states and DC.

† Median exemption rate was determined using estimates from 47 states and DC; states excluded were Illinois, Minnesota, and Missouri. Data from Wyoming were included in the median for any exemption, but not for medical or nonmedical exemptions.

§ Assessment date varied by state/area.

¶ California included data for independent study students in public school data and data for homeschools with six or more students in private school data. Minnesota requires vaccination and exemption reporting for homeschooled students beginning at age 7 years and reports these data separately from public and private school data, although the actual number of homeschooled students included in the data was not known. North Carolina included students enrolled in virtual academies in public school data. North Dakota reported that some public school jurisdictions included homeschooled students in their data. Oregon reported some homeschool data separately and 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 students enrolled in public and private online schools. Vermont included homeschooled students in their public and private school data if they were enrolled in one or more classes in those schools; homeschooled children who were exclusively homeschooled were not subject to vaccination requirements and were not included in these estimates.

** States using a census attempted to collect data from all kindergartners at all schools and succeeded with collecting data for ≥90% of students. The type of sample employed by the 10 states using a sample for determining coverage rates varied, and included a stratified two-stage cluster sample (eight states), a stratified one-stage cluster sample (one), and a simple random sample (one). A voluntary response of schools was defined as census survey with a response rate <90% of the known population of kindergartners. A mix of methods included two or more described methods, usually a census for one school type and voluntary response for the other.

for exemption data. Six states (Colorado, Delaware, Hawaii, Nevada, South Carolina, and Wisconsin) used a sample for both vaccination coverage and exemption data. Kindergartners were considered up-to-date for a vaccine if they received all doses required for school entry,[††] except in seven states[§§] that considered kindergartners up-to-date only if they had received all doses of all vaccines required for school entry.

Kindergartners with a history of varicella disease were reported as either vaccinated against varicella or medically exempt, varying by program. Medical exemptions were those that were issued by a health care provider; all other exemptions (i.e., religious and philosophic) were nonmedical. Vaccination coverage and exemption estimates were adjusted based on survey type and response rates.[¶¶]

During the 2015–16 school year, vaccination coverage data were reported for 4,087,187 kindergartners, exemption data for 3,791,755 kindergartners, and grace period/provisional enrollment data for 2,173,042 kindergartners.[***] Among the 50 states and DC, median MMR coverage was 94.6% (range = 87.1% [Colorado] to 99.4% [Maryland and Mississippi]); 22 states reported coverage ≥95%, and three states and DC reported coverage <90% (Table 1). Among 49 states and DC that require DTaP vaccination, median coverage was 94.2% (range = 86.6% [Colorado] to 99.6% [Maryland]); 20 states reported coverage ≥95%, and four states and DC reported coverage <90%. Among 42 states and DC that required 2-dose varicella vaccination, median coverage was 94.3% (range = 85.7% [Colorado] to 99.4% [Mississippi]); 18 states reported coverage ≥95%, and five states and DC reported coverage <90%. The number of states requiring 2 doses of varicella vaccine for school entry increased from 39 in 2014–15 to 42 in 2015–16. Median 2-dose varicella coverage increased from 93.6% to 94.3%, in part because of high coverage in three states that added a requirement for 2 doses of varicella vaccine (Montana [93.6%]; North Carolina [97.0%]; and Utah [94.8%]) (*3*).

Since the 2014–15 school year, MMR coverage increased in 32 states (*2*). Compared with 2014–15, among states that reported coverage for both 2014–15 and 2015–16, four fewer states reported <90% MMR coverage, and five more states reported ≥95% MMR coverage in 2015–16 (Figure). The median increase was 0.7 percentage points (range = 0.1 [Wyoming] to 4.1 [Oklahoma]) (*2*).

Twenty-three[†††] states voluntarily reported data on grace period or provisional enrollment for the 2015–16 school year. The median reported percentage of kindergartners attending school during a grace period or provisional enrollment was 2.0% (range = 0.0% [Wyoming] to 5.4% [New Hampshire]) (Table 2). In 12 of these 23 states, the percentage of children who were provisionally enrolled or within a grace period at the time of the assessment exceeded the percentage of children with exemptions from one or more vaccines.

Among the 47 states and DC reporting kindergartners with at least one exemption, the median was 1.9% (range = <0.1% [Mississippi] to 6.3% [Oregon]), an increase of 0.2 percentage points from the previous year (Table 2). The percentage of kindergartners with any exemption was <1% in six states, and ≥4% in nine states. From the 2014–15 to the 2015–16 school year, the exemption rate decreased by >1.0 percentage points in three states (Colorado, Michigan, and Wisconsin), and increased by >0.5 percentage points in two states (Nevada and North Dakota). The number of states with exemption rates ≥4.0% decreased from 11 in 2014–15 to nine in 2015–16. Michigan reported a 1.7 percentage point decrease in exemptions. Among states that reported exemptions by type, the median percentage of medical exemptions was 0.2% (range = <0.1% in four states [Colorado, Delaware, Mississippi, South Carolina] to 1.2% [Alaska]), and the median percentage of nonmedical exemptions was 1.6% (range = 0.4% [DC] to 6.2% [Oregon]). During 2015–16, a total of 25 states[§§§] share or plan to share

[††] All the 50 states and DC required 2 doses of a measles-containing vaccine, with MMR as the only measles-containing vaccine available in the United States. For local DTaP vaccine requirements, Nebraska required 3 doses, four states (Illinois, Pennsylvania, Virginia, and Wisconsin) required 4 doses, Pennsylvania did not require pertussis, and all other states required 5 doses unless the fourth dose was administered on or after the fourth birthday. Kentucky required 5 doses of DTaP by age 5, but reported 4-dose coverage for kindergartners. For varicella vaccine, eight states required 1 dose and 42 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.

[¶¶] Most of the programs using a census or voluntary response provided CDC with data aggregated at the state level. Coverage and exemption data based on a census were adjusted for nonresponse using the inverse of the response rate, stratified by school type. Programs using complex sample surveys provided CDC with de-identified 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 by complex sample design wherever possible.

[***] Immunization programs in U.S. territories reported vaccination coverage and exemptions to CDC. Their data were not included in median coverage and exemption calculations. Select U.S. cities also reported data to CDC, which were included in state-reported data to calculate medians.

[†††] California, Colorado, Florida, Georgia, Hawaii, Idaho, Iowa, Maine, Mississippi, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, Pennsylvania, Tennessee, Texas, Utah, Vermont, Washington, West Virginia, and Wyoming reported data on kindergartners attending school under a grace period or provisional enrollment.

[§§§] http://www.cdc.gov/vaccines/imz-managers/SchoolVaxView/pubs-resources.html.

**TABLE 1. Estimated vaccination coverage* among children enrolled in kindergarten, by vaccine and state/area — United States, 2015–2016 school year**

| State/Area | Kindergarten population† | Total surveyed | Proportion surveyed (%) | Type of survey conducted§ | MMR¶ 2 doses (%) | DTaP** 5 doses (%) | Varicella 1 dose (%) | Varicella 2 doses (%) |
|---|---|---|---|---|---|---|---|---|
| ***Median††*** | | | | | ***94.6*** | ***94.2*** | ***96.1*** | ***94.3*** |
| Alabama§§ | 60,392 | 60,392 | 100.0 | Census | ≥93.1 | ≥93.1 | ≥93.1 | NReq |
| Alaska¶¶,*** | 9,937 | 772 | 7.8 | Stratified 2-stage cluster sample | 93.5 | 92.8 | NReq | 92.6 |
| Arizona§§ | 83,088 | 83,088 | 100.0 | Census | 94.2 | 94.2 | 96.7 | NReq |
| Arkansas††† | 40,258 | 38,480 | 95.6 | Census (public); voluntary response (private) | 90.8 | 88.2 | NReq | 90.6 |
| California††† | 593,788 | 551,123 | 92.8 | Census | 94.5 | 94.2 | 96.3 | NReq |
| Colorado | 69,137 | 350 | 0.5 | Simple random sample | 87.1 | 86.6 | NReq | 85.7 |
| Connecticut§§ | 39,533 | 39,533 | 100.0 | Census | 97.0 | 97.0 | NReq | 96.6 |
| Delaware | 11,589 | 1,103 | 9.5 | Stratified 2-stage cluster sample | 97.6 | 98.0 | NReq | 97.6 |
| District of Columbia§§ | 8,080 | 8,080 | 100.0 | Census | 88.5 | 88.2 | NReq | 88.1 |
| Florida§§,¶¶ | 224,430 | 224,430 | 100.0 | Census | ≥93.7 | ≥93.7 | NReq | ≥93.7 |
| Georgia§§ | 131,403 | 131,403 | 100.0 | Census | ≥94.6 | ≥94.6 | NReq | ≥94.6 |
| Hawaii | 16,325 | 1,098 | 6.7 | Stratified 2-stage cluster sample | 91.6 | 93.8 | 95.4 | NReq |
| Idaho§§ | 22,686 | 22,686 | 100.0 | Census | 90.2 | 89.8 | NReq | 89.1 |
| Illinois§§ | 151,309 | 151,309 | 100.0 | Census | 94.9 | 95.0 | NReq | 95.5 |
| Indiana | 83,525 | 58,062 | 69.5 | Voluntary response | 89.2 | 92.6 | NReq | 88.0 |
| Iowa§§ | 41,215 | 41,215 | 100.0 | Census | ≥91.8 | ≥91.8 | NReq | ≥91.8 |
| Kansas¶¶,***,††† | 39,555 | 8,304 | 21.0 | Stratified 2-stage cluster sample | 89.4 | 89.4 | NReq | 87.9 |
| Kentucky¶¶,††† | 54,353 | 54,075 | 99.5 | Census | 92.2 | 93.9 | NReq | 91.6 |
| Louisiana§§ | 59,159 | 59,159 | 100.0 | Census | 96.8 | 98.3 | NReq | 96.8 |
| Maine | 13,526 | 12,243 | 90.5 | Census | 95.1 | 96.1 | 96.1 | NReq |
| Maryland††† | 72,012 | 67,903 | 94.3 | Census (public); voluntary response (private) | 99.4 | 99.6 | NReq | 99.2 |
| Massachusetts§§,††† | 72,897 | 72,897 | 100.0 | Census | 96.4 | 94.9 | NReq | 95.8 |
| Michigan§§ | 116,299 | 116,299 | 100.0 | Census | 95.7 | 95.9 | NReq | 95.2 |
| Minnesota¶¶ | 69,710 | 68,143 | 97.8 | Census | 92.8 | 93.0 | NReq | 92.3 |
| Mississippi§§ | 41,042 | 41,042 | 100.0 | Census | ≥99.4 | ≥99.4 | NReq | ≥99.4 |
| Missouri§§,¶¶ | 74,413 | 74,413 | 100.0 | Census | 95.7 | 95.6 | NReq | 95.4 |
| Montana§§ | 11,484 | 11,484 | 100.0 | Census | 94.9 | 94.0 | NReq | 93.6 |
| Nebraska§§,††† | 30,409 | 30,409 | 100.0 | Census | 95.6 | 96.8 | NReq | 97.3 |
| Nevada | 37,118 | 1,222 | 3.3 | Stratified 2-stage cluster sample | 94.7 | 94.2 | NReq | 93.4 |
| New Hampshire | 11,852 | 11,831 | 99.8 | Census | ≥91.9 | ≥91.9 | NReq | ≥91.9 |
| New Jersey§§ | 110,116 | 110,116 | 100.0 | Census | ≥96.3 | ≥96.3 | ≥96.3 | NReq |
| New Mexico*** | 29,049 | 774 | 2.7 | Stratified 2-stage cluster sample | 96.2 | 94.7 | NReq | 95.8 |
| New York (including New York City)§§ | 232,521 | 232,521 | 100.0 | Census | 95.6 | 94.1 | NReq | 94.8 |
| New York City§§ | 104,621 | 104,621 | 100.0 | Census | 94.6 | 91.9 | NReq | 93.5 |
| North Carolina¶¶,††† | 128,290 | 117,971 | 92.0 | Census (public); voluntary response (private) | 97.3 | 97.1 | NReq | 97.0 |
| North Dakota | 9,875 | 9,586 | 97.1 | Census | 90.7 | 90.8 | NReq | 90.4 |
| Ohio | 144,604 | 135,434 | 93.7 | Census (public); voluntary response (private) | 92.1 | 92.1 | NReq | 91.5 |
| Oklahoma††† | 54,335 | 52,215 | 96.1 | Census | 94.4 | 96.1 | NA | NReq |
| Oregon§§,††† | 45,531 | 45,531 | 100.0 | Census | 93.9 | 93.5 | 95.2 | NReq |
| Pennsylvania | 143,298 | 133,604 | 93.2 | Census (public); voluntary response (private) | 95.5 | NReq§§§ | NReq | 96.5 |
| Rhode Island§§,¶¶,††† | 11,165 | 11,163 | 100.0 | Census | 96.4 | 96.8 | NReq | 96.0 |
| South Carolina | 59,240 | 5,251 | 8.9 | Stratified 1-stage cluster sample | 96.5 | 97.0 | NReq | 96.2 |
| South Dakota§§ | 12,181 | 12,181 | 100.0 | Census | 96.5 | 96.4 | NReq | 95.2 |
| Tennessee§§,¶¶ | 79,233 | 79,233 | 100.0 | Census | 93.5 | 93.5 | NReq | 93.5 |
| Texas (including Houston)¶¶,††† | 394,801 | 389,604 | 98.7 | Census (public); voluntary response (private) | 97.6 | 97.4 | NReq | 97.2 |
| Houston, TX¶¶,††† | 42,173 | 41,509 | 98.4 | Census | 96.5 | 96.6 | NReq | 96.0 |
| Utah§§ | 50,114 | 50,114 | 100.0 | Census | 94.2 | 93.7 | NReq | 94.8 |
| Vermont§§ | 6,366 | 6,366 | 100.0 | Census | 93.6 | 93.6 | NReq | 91.9 |
| Virginia¶¶,*** | 100,074 | 4,304 | 4.3 | Stratified 2-stage cluster sample | 95.7 | 98.3 | NReq | 93.7 |
| Washington¶¶ | 86,492 | 84,155 | 97.3 | Census | 91.0 | 91.1 | NReq | 89.4 |
| West Virginia | 21,333 | 18,690 | 87.6 | Voluntary response | 95.2 | 94.8 | NReq | 94.3 |
| Wisconsin¶¶,††† | 70,220 | 1,375 | 2.0 | Stratified 2-stage cluster sample | 93.2 | 96.9 | NReq | 92.5 |
| Wyoming¶¶,¶¶¶ | 7,825 | 5,791 | 74.0 | Voluntary response | 96.9 | 96.6 | NReq | 96.5 |

See table footnotes on the next page.

**TABLE 1. (*Continued*) Estimated vaccination coverage* among children enrolled in kindergarten, by vaccine and state/area — United States, 2015–2016 school year**

| State/Area | Kindergarten population† | Total surveyed | Proportion surveyed (%) | Type of survey conducted§ | MMR¶ 2 doses (%) | DTaP** 5 doses (%) | Varicella 1 dose (%) | Varicella 2 doses (%) |
|---|---|---|---|---|---|---|---|---|
| Guam*** | 2,715 | 780 | 28.7 | Stratified 2-stage cluster sample | 89.8 | 92.6 | NReq | NReq |
| N. Mariana Islands§§ | 900 | 900 | 100.0 | Census | 89.8 | 77.7 | NReq | 89.9 |
| Puerto Rico | 35,573 | 1,489 | 4.2 | Stratified 2-stage cluster sample | 96.5 | 92.9 | NReq | 95.4 |
| U.S. Virgin Islands | 1,418 | 577 | 40.7 | Stratified 2-stage cluster sample | 87.2 | 85.6 | NReq | 86.9 |

**Abbreviations:** DTaP/DT = diphtheria and tetanus toxoids (DT) and acellular pertussis vaccine; MMR = measles, mumps, and rubella vaccine; NA = not available (i.e., not collected or reported to CDC); 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 antigen-specific) are designated by use of the ≥ symbol. Coverage might include history of disease and laboratory evidence of immunity.

† The kindergarten population is an approximation provided by each state/area.

§ Sample designs varied by state/area: census = all schools (public and private),and all children within schools were included in the assessment; simple random = a simple random sample design was used; 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% and does not imply that participation was optional.

¶ Most states required 2 doses of MMR; Alaska, California, New Jersey, and Oregon required 2 doses of measles, 1 dose of mumps, and 1 dose of rubella vaccines. Georgia, New York, New York City, North Carolina, Pennsylvania, and Virginia required 2 doses of measles and mumps, 1 dose of rubella vaccines. Iowa required 2 doses of measles and 2 doses of rubella vaccines.

** Pertussis vaccination coverage might include some DTP (diphtheria and tetanus toxoids and pertussis vaccine) vaccinations if administered in another country or vaccination provider continued to use after 2000. Most states required 5 doses of DTaP vaccine for school entry; Illinois, Virginia, and Wisconsin required 4 doses; Nebraska required 3 doses. Pennsylvania required 4 doses of diphtheria and tetanus vaccine, but pertussis vaccine was not required. Kentucky required ≥5 but reported ≥4 doses of DTaP.

†† Median calculated from data from the 50 states and the District of Columbia (i.e., does not include Houston, New York City, Guam, N. Mariana Islands, Puerto Rico, or U.S. Virgin Islands).

§§ The proportion surveyed was probably <100%, but shown as 100% based on incomplete information about the actual current enrollment.

¶¶ Did not include some special types of schools.

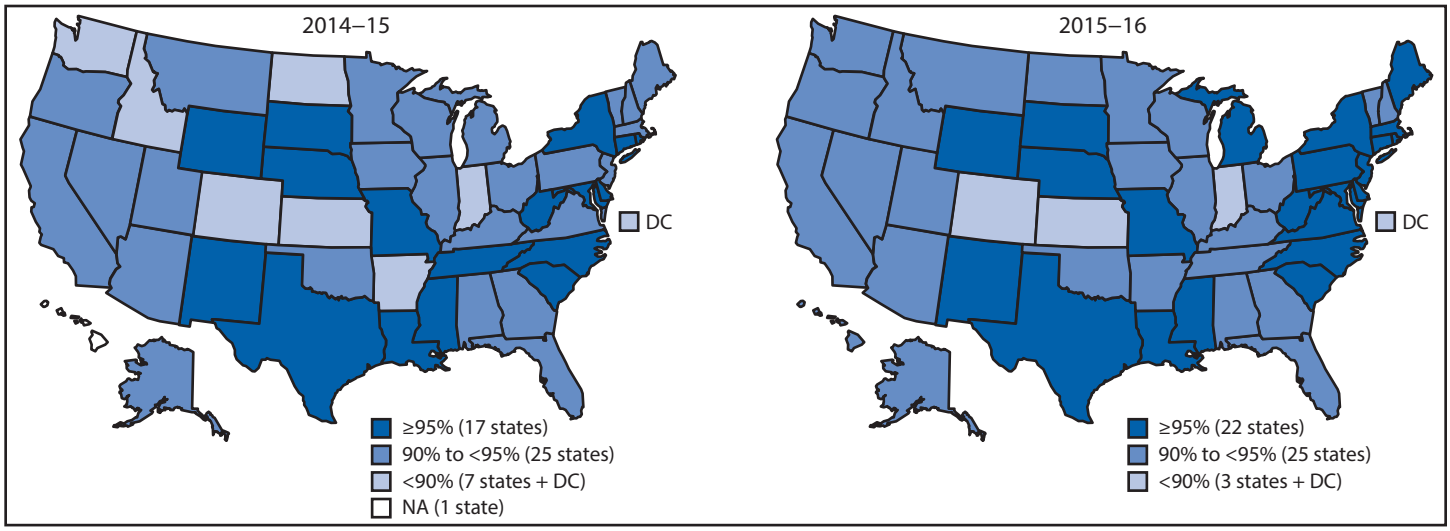
*** Kindergarten coverage data were collected from a sample, and exemption data were collected from a census of kindergartners.

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

§§§ Pertussis vaccine was not required in Pennsylvania. Coverage for diphtheria and tetanus was 96.3%.

¶¶¶ Collected public school data only.

**FIGURE. Estimated measles, mumps, and rubella vaccine (MMR) coverage among kindergartners — United States, 2014–15 and 2015–16 school years*,†,§**




* In 2014–15, most states required 2 doses of MMR. Alaska, California, New Jersey, and Oregon required 2 doses of measles, 1 dose of mumps, and 1 dose of rubella vaccines. Georgia, New York, Pennsylvania, and Virginia required 2 doses of measles and mumps, 1 dose of rubella. Iowa required 2 doses of measles and 2 doses of rubella vaccines. New York required 2 doses of measles and mumps and 1 dose of rubella vaccine by age 7 years, but reported ≥1 doses of MMR.

† For 2014–15, Hawaii is excluded from the map because it reported compliance, rather than coverage.

§ For 2015–16, most states required 2 doses of MMR. Alaska, California, New Jersey, and Oregon required 2 doses of measles, 1 dose of mumps, and 1 dose of rubella vaccines. Georgia, New York, New York City, North Carolina, Pennsylvania, and Virginia required 2 doses of measles and mumps, 1 dose of rubella vaccines. Iowa required 2 doses of measles and 2 doses of rubella vaccines.

local-level data online for vaccination coverage, exemptions, or both, which is an increase from 21 states during 2014–15 (*3*).

## Discussion

During the 2015–16 school year, median kindergarten vaccination coverage was nearly 95% for MMR (94.6%), DTaP (94.2%), and varicella vaccine (94.3%), which was similar to the previous school year. MMR coverage increased for 32 states from the previous school year. The national median exemption rate of 1.9% was a slight increase from the previous school year (1.7%), but only two states had an increase >0.5 percentage points in their state exemption rate and exemptions varied by state. The percentage of kindergartners who did not have complete documentation of vaccination, and who attended school within a grace period or were provisionally enrolled, was as high as 5.4% among the 23 states with data available.

Grace period and provisional enrollment, not collected in previous years, might in part explain results from previous years indicating that some children were enrolled in school but reported neither as vaccinated nor as exempt (*3*). Immunization programs can support and work with schools with high provisional enrollment and help students obtain missing vaccine doses. For example, the California Health Department worked to improve vaccination coverage at schools identified from local-level data as having high levels of provisional enrollment. School staff members were trained on the proper use of provisional enrollment (*4*). As a result, from 2014–15 to 2015–16, the number of provisionally enrolled kindergartners decreased from 36,731 (6.3%) to 24,424 (4.4%), MMR coverage increased from 92.6% to 94.5%, and DTaP coverage increased from 92.4% to 94.2% (*4*). The decrease in the number of provisionally enrolled children in California and the increase in MMR and DTaP coverage demonstrates that state immunization programs and schools can use provisional enrollment data to boost school vaccination coverage.

The increase in MMR coverage observed among 32 states during the 2015–16 school year might be attributable in part to the 2015 measles outbreaks, which included a reported total of 159 persons from 18 states and DC, of whom approximately 80% were unvaccinated or had unknown vaccination status (*5*). Maintaining high vaccination coverage levels is important for measles control and elimination (*6*).

A slight increase (0.2 percentage points) in the median exemption rate from 2014–15 to 2015–16 is accounted for in part by the addition of reports from Texas (1.6%) and Wyoming (2.7%), neither of which reported the number of children with an exemption from one or more vaccines for the 2014–15 school year. The 1.7 percentage point decrease in exemptions reported by Michigan might be because of a new state rule requiring parents who request exemptions to receive health education at a county health department about the risks for vaccine-preventable diseases and the benefits of vaccination (*7*). The greatest fluctuations in exemptions occurred among states that used samples to collect exemption data. Of the five states with an increase of ≥0.5 percentage points or decrease of ≥1 percentage points in exemptions since the previous school year, three (Colorado, Nevada, and Wisconsin) reported data from a sample of students. CDC recommends using a census of schools to collect exemption data because exemptions are rare events that cluster geographically (*8*). Since the 2011–12 school year, five states switched to a census from a sample to collect exemption data, increasing representativeness and reliability.

*Healthy People 2020* sets a vaccination coverage target of 95% among kindergartners for the vaccines reported here, as

**Summary**

**What is already known about this topic?**

Immunization programs conduct annual kindergarten vaccination assessments to monitor vaccination coverage among school children. Although state-level vaccination coverage is high and exemptions are low, some children in kindergarten remain undervaccinated.

**What is added by this report?**

Among the 50 states and the District of Columbia (DC), median vaccination coverage was 94.6% for 2 doses of measles, mumps, and rubella vaccine (MMR) and 94.2% for local requirements for diphtheria, tetanus, and acellular pertussis vaccine among 49 states and DC. Among the 42 states and DC with a 2-dose varicella vaccine requirement, varicella vaccine coverage was 94.3%. Thirty-two states reported an increase in 2-dose MMR coverage. The median exemption level remained low (1.9%) but exemption rates varied by state. In 12 of 23 states that reported data on grace period or provisional enrollment for children who were not fully vaccinated, the proportion of kindergartners under a grace period or provisional enrollment was higher than the proportion that were exempt from one or more vaccines.

**What are the implications for public health practice?**

Routine monitoring of vaccination coverage and exemptions among kindergartners at the state level is important to ensure all children are protected from vaccine-preventable diseases. Local-level data on school vaccination coverage, exemptions, and grace period/provisional enrollment are essential to help immunization programs identify schools with higher numbers of students who are not completely vaccinated and not exempt. Immunization programs and schools can use local level data to work together to improve vaccination coverage and protect all kindergartners from vaccine-preventable diseases.TABLE 1. Estimated vaccination coverage* among children enrolled in kindergarten, by vaccine and state/area — United States, 2015–2016 school year

**TABLE 2. Estimated number and percentage* of children enrolled in kindergarten with reported type of exemption from vaccination, and grace period/provisional enrollment, by state/area† — United States, 2015–16 school year**

| | Medical exemptions | Nonmedical exemptions | | | Any exemption | | | | Grace period/ Provisional enrollment§ |
|---|---|---|---|---|---|---|---|---|---|
| State/Area | No. (%) | No. religious | No. philosophic | Total No. (%) | Total No. | 2015–2016 (%) | 2014–2015 (%) | % point difference | No. (%) |
| ***Median (%)¶*** | ***0.2*** | ***NC*** | ***NC*** | ***1.6*** | ***NC*** | ***1.9*** | ***1.7*** | ***0.2*** | ***2.0*** |
| Alabama | 40 (0.1) | 438 | —** | 438 (0.7) | 478 | 0.8 | 0.8 | 0.0 | NA |
| Alaska | 103 (1.2) | 421 | —** | 421 (4.7) | 524 | 5.9 | 5.8 | 0.1 | NA |
| Arizona | 189 (0.2) | —†† | 3,732 | 3,732 (4.5) | 3,921 | 4.7 | 4.8 | -0.1 | NA |
| Arkansas | 21 (0.1) | 160 | 332 | 491 (1.2) | 512 | 1.3 | 1.3 | 0.0 | NA |
| California | 993 (0.2) | 3,323 | 10,684 | 14,008 (2.4) | 15,000 | 2.5 | 2.7 | -0.2 | 26,232 (4.4) |
| Colorado | 0 (<0.1) | 198 | 2,765 | 2,963 (4.3) | 2,963 | 4.3 | 5.4 | -1.1 | 395 (0.6) |
| Connecticut | 110 (0.3) | 689 | —** | 689 (1.7) | 799 | 2.0 | 1.9 | 0.1 | NA |
| Delaware | 5 (<0.1) | 131 | —** | 131 (1.1) | 136 | 1.2 | 1.3 | -0.1 | NA |
| District of Columbia | 44 (0.5) | 33 | —** | 33 (0.4) | 77 | 1.0 | 1.1 | -0.1 | NA |
| Florida | 699 (0.3) | 4,226 | —** | 4,226 (1.9) | 4,925 | 2.2 | 2.1 | 0.1 | 8,875 (4.0) |
| Georgia | 145 (0.1) | 2,315 | —** | 2,315 (1.8) | 2,460 | 1.9 | 2.1 | -0.2 | 2,672 (2.0) |
| Hawaii | 70 (0.4) | 426 | —** | 426 (2.5) | 496 | 2.9 | 3.3 | -0.4 | 294 (1.7) |
| Idaho | 69 (0.3) | 122 | 1,198 | 1,320 (5.8) | 1,389 | 6.1 | 6.5 | -0.4 | 537 (2.4) |
| Illinois§§ | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Indiana | 395 (0.5) | 912 | —** | 912 (1.1) | 1,035 | 1.2 | 1.1 | 0.1 | NA |
| Iowa | 119 (0.3) | 635 | —** | 635 (1.5) | 754 | 1.8 | 1.8 | 0.0 | 1,730 (4.2) |
| Kansas | 97 (0.2) | 554 | —** | 554 (1.4) | 651 | 1.6 | 1.4 | 0.2 | NA |
| Kentucky | 129 (0.2) | 382 | —** | 382 (0.7) | 510 | 0.9 | 0.9 | 0.0 | NA |
| Louisiana | 75 (0.1) | 28 | 342 | 370 (0.6) | 445 | 0.8 | 0.6 | 0.2 | NA |
| Maine | 69 (0.5) | 28 | 515 | 542 (4.0) | 612 | 4.5 | 4.4 | 0.1 | 169 (1.3) |
| Maryland | 348 (0.5) | 601 | —** | 601 (0.8) | 949 | 1.3 | 1.2 | 0.1 | NA |
| Massachusetts | 216 (0.3) | 760 | —** | 760 (1.0) | 976 | 1.3 | 1.4 | -0.1 | NA |
| Michigan | 246 (0.2) | 749 | 3,208 | 3,957 (3.4) | 4,203 | 3.6 | 5.3 | -1.7 | NA |
| Minnesota§§ | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Mississippi | 18 (<0.1) | —†† | —** | —††,** | 18 | <0.1 | <0.1 | 0.0 | 194 (0.5) |
| Missouri§§ | NA | NA | NA | NA | NA | NA | NA | NA | NA |
| Montana | 49 (0.4) | 390 | —** | 390 (3.4) | 439 | 3.8 | 3.9 | -0.1 | 262 (2.3) |
| Nebraska | 186 (0.6) | 422 | —** | 422 (1.4) | 608 | 2.0 | 1.6 | 0.4 | 564 (1.9) |
| Nevada | 37 (0.1) | 695 | —** | 695 (1.9) | 732 | 2.0 | 1.3 | 0.7 | 1,265 (3.4) |
| New Hampshire | 21 (0.2) | 288 | —** | 288 (2.4) | 309 | 2.6 | 2.9 | -0.3 | 645 (5.4) |
| New Jersey | 211 (0.2) | 1,727 | —** | 1,727 (1.6) | 1,938 | 1.8 | 1.8 | 0.0 | 1,256 (1.1) |
| New Mexico | 19 (0.1) | 346 | —** | 346 (1.2) | 365 | 1.3 | 1.2 | 0.1 | 441 (1.5) |
| New York (including New York City) | 323 (0.1) | 1,729 | —** | 1,729 (0.7) | 2,052 | 0.9 | 0.8 | 0.1 | NA |
| New York City | 44 (<0.1) | 394 | —** | 394 (0.4) | 438 | 0.4 | 0.4 | 0.0 | NA |
| North Carolina | 141 (0.1) | 1,240 | —** | 1,240 (1.0) | 1,382 | 1.1 | 1.0 | 0.1 | NA |
| North Dakota | 30 (0.3) | 59 | 240 | 299 (3.0) | 329 | 3.3 | 2.7 | 0.6 | NA |
| Ohio | 358 (0.2) | —¶¶ | —¶¶ | 2,896 (2.0) | 3,255 | 2.3 | 2.1 | 0.2 | NA |
| Oklahoma | 79 (0.1) | 236 | 580 | 816 (1.5) | 895 | 1.6 | 1.5 | 0.1 | NA |
| Oregon | 61 (0.1) | —¶¶ | —¶¶ | 2,810 (6.2) | 2,871 | 6.3 | 6.0 | 0.3 | NA |
| Pennsylvania | 511 (0.4) | 1,212 | 1,408 | 2,620 (1.8) | 3,132 | 2.2 | 2.1 | 0.1 | 7,365 (5.1) |
| Rhode Island | 21 (0.2) | 105 | —** | 105 (0.9) | 126 | 1.1 | 1.1 | 0.0 | NA |
| South Carolina | 23 (<0.1) | 937 | —** | 937 (1.6) | 960 | 1.6 | 1.2 | 0.4 | NA |
| South Dakota | 22 (0.2) | 175 | —** | 175 (1.4) | 197 | 1.6 | 1.7 | -0.1 | NA |
| Tennessee | 111 (0.1) | 739 | —** | 739 (0.9) | 850 | 1.1 | 1.1 | 0.0 | 1,003 (1.3) |
| Texas (including Houston) | 821 (0.2) | —¶¶ | —¶¶ | 5,350 (1.4) | 6,170 | 1.6 | NA | NA | 11,048 (2.8) |
| Houston, TX | 90 (0.2) | —¶¶ | —¶¶ | 301 (0.7) | 392 | 0.9 | 0.3 | 0.6 | NA |
| Utah | 88 (0.2) | 10 | 2,204 | 2,214 (4.4) | 2,302 | 4.6 | 4.3 | 0.3 | 1,085 (2.2) |
| Vermont | 9 (0.1) | 59 | 293 | 352 (5.5) | 361 | 5.7 | 6.1 | -0.4 | 296 (4.6) |
| Virginia | 254 (0.3) | 901 | —** | 901 (0.9) | 1,155 | 1.2 | 1.1 | 0.1 | NA |
| Washington | 862 (1.0) | 267 | 2,886 | 3,153 (3.6) | 3,878 | 4.5 | 4.6 | -0.1 | 1,730 (2.0) |
| West Virginia | 35 (0.2) | —†† | —** | —††,** | 35 | 0.2 | 0.2 | 0.0 | 414 (1.9) |
| Wisconsin | 244 (0.3) | 190 | 1,861 | 2,051 (2.9) | 2,295 | 3.3 | 5.3 | -2.0 | NA |
| Wyoming§§,*** | NA | NA | NA | NA | 209 | 2.7 | NA | NA | 0.0 (<0.1) |

See table footnotes on the 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 state/area† — United States, 2015–16 school year**

| | Medical exemptions | Nonmedical exemptions | | | Any exemption | | | | Grace period/ Provisional enrollment§ |
|---|---|---|---|---|---|---|---|---|---|
| State/Area | No. (%) | No. religious | No. philosophic | Total No. (%) | Total No. | 2015–2016 (%) | 2014–2015 (%) | % point difference | No. (%) |
| Guam | 0 (0.0) | 1 | —** | 1 (<0.1) | 1 | <0.1 | 0.1 | -0.1 | NA |
| N. Mariana Islands | 0 (0.0) | 0 | 0 | 0 (0.0) | 0 | 0.0 | 0.0 | 0.0 | NA |
| Puerto Rico | 39 (0.1) | 57 | —** | 57 (0.2) | 97 | 0.3 | 0.2 | 0.1 | NA |
| U.S. Virgin Islands | 0 (<0.1) | 9 | —** | 9 (0.6) | 9 | 0.6 | 1.7 | -1.1 | NA |

**Abbreviations:** NA = not available (i.e., not collected or reported to CDC); NC = not calculated.

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

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

§ Grace period/provisional enrollment data were collected for the first time in 2015–16. Data were reported voluntarily. 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 47 states and District of Columbia; states excluded were Illinois, Minnesota, and Missouri. Wyoming was included in only the Any Exemption median. Houston, New York City, Guam, N. Mariana Islands, Puerto Rico, and U.S. Virgin Islands were also excluded.

** Exemptions because of philosophic reasons were not allowed.

†† Exemptions because of religious reasons were not allowed.

§§ State did not report the number of children with exemptions, but instead reported the number of exemptions for each vaccine, which would 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 the following: for Illinois, 0.2% with medical exemptions, 1.1% with religious exemptions, and 1.4% for any exemptions; for Minnesota, 0.2% with medical exemptions, 3.1% with nonmedical exemptions, and 3.4% for any exemptions; for Missouri 0.2% with medical exemptions, 1.7% with religious exemptions, and 1.8% for any exemptions; and for Wyoming, 0.2% with medical exemptions and 2.2% with religious exemptions.

¶¶ Religious and philosophic exemptions were not reported separately.

*** Collected public school data only.

well as for other vaccines.¶¶¶ This report found medians for MMR, DTaP, and varicella vaccine all approach the *Healthy People 2020* target. A total of 22 states met the *Healthy People 2020* target for vaccination with MMR, 20 states met the DTaP vaccination target, and 18 states met the varicella vaccination target.

The findings in this report are subject to at least three limitations, which have been previously reported (*3*). First, comparability is limited because of variations in states' requirements. Second, representativeness might be negatively affected because of data collection methodologies that miss some schools or students or assess vaccination status at different times. Finally, actual vaccination coverage, exemption estimates, or both might be under- or overestimated because of improper or absent documentation. State-level aggregate grace period/provisional enrollment data were reported to CDC by states that could easily access the data from reporting schools, and represent kindergartners who are identified by the schools as having incomplete vaccination records. The definition of kindergartners under a grace period/provisional enrollment varied by state, so those estimates might not be comparable.

Kindergarten vaccination requirements provide an opportunity for children who are behind on early childhood vaccinations to be vaccinated by school entry. Thorough school vaccination assessments at the state and local levels allow immunization programs to identify schools and communities where focused action could improve vaccination coverage to ensure that more children can benefit from the protection offered by vaccines. Local-level data allow programs to identify schools with undervaccinated students, and public dissemination raises awareness of community vaccination coverage. Immunization programs can use the data to monitor grace period/provisional enrollment levels, in addition to coverage and exemptions, and to work with schools with higher grace period or provisional enrollment rates to ensure all kindergartners receive recommended vaccinations and are protected from vaccine-preventable diseases.

¶¶¶ *Healthy People 2020* objective IID-10.1 is 4 doses of DTaP vaccine. This report describes compliance with state requirements of 3, 4, or 5 doses of DTaP vaccine. Among the 50 states and DC, only Nebraska required and reported 3 doses of DTaP vaccine. The IID-10.2 target is ≥95% of kindergartners receiving ≥ 2 doses of MMR vaccine. Four states required 2 doses of measles-containing vaccine but only 1 dose each of mumps and rubella vaccine. Four states required 2 doses measles and mumps but only 1 dose of rubella vaccine. One state required 2 doses of measles and rubella and zero doses of mumps. The IID-10.5 target is ≥95% of kindergartners receiving ≥2 doses of varicella vaccine. State-level data with Healthy People 2020 targets are available on SchoolVaxView (http://www.cdc.gov/vaccines/imz-managers/coverage/schoolvaxview/data-reports/index.html).

[1]National Center for Immunization and Respiratory Disease, Immunization Services Division, CDC; [2]Association of Schools and Programs of Public Health.

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# Vaccination Coverage Among Children Aged 19–35 Months — United States, 2015

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Sustained high coverage with recommended vaccinations among children has kept many vaccine-preventable diseases at low levels in the United States (*1*). To assess coverage with vaccinations recommended for children by age 2 years in the United States (*2*), CDC analyzed data collected by the 2015 National Immunization Survey (NIS) for children aged 19–35 months (born January 2012–May 2014). Overall, coverage did not change during 2014–2015. Coverage in 2015 was highest for ≥3 doses of poliovirus vaccine (93.7%), ≥3 doses of hepatitis B vaccine (HepB) (92.6%), ≥1 dose of measles, mumps, and rubella vaccine (MMR) (91.9%), and ≥1 dose of varicella vaccine (91.8%). The data were also examined for potential vaccination coverage differences by race/ethnicity, poverty status, and urbanicity. Although disparities were noted for each of these factors, the most striking differences were seen for poverty status. Children living below the federal poverty level* had lower coverage with most of the vaccinations assessed compared with children living at or above the poverty level; the largest disparities were for rotavirus vaccine (66.8% versus 76.8%), ≥4 doses of pneumococcal conjugate vaccine (PCV) (78.9% versus 87.2%), the full series of *Haemophilus influenzae* type b vaccine (Hib) (78.1% versus 85.5%), and ≥4 doses of diphtheria, tetanus, and acellular pertussis vaccine (DTaP) (80.2% versus 87.1%). Although coverage was high in some groups, opportunities exist to continue to address disparities. Implementation of evidence-based interventions, including strategies to enhance access to vaccination services and systems strategies that can reduce missed opportunities, has the potential to increase vaccination coverage for children living below the poverty level and in rural areas (*3*).

NIS monitors vaccination coverage among children aged 19–35 months in the 50 states, the District of Columbia, selected local areas, and territories† using a random digit dialing (RDD) sample of landline and cellular telephone numbers. After identifying a household with at least one age-eligible child, a telephone interview is conducted to collect sociodemographic characteristics for all age-eligible children and request permission to contact the child's vaccination providers. If consent is given, a survey is mailed to each provider to request the child's vaccination history, including dates of receipt of vaccine doses. All coverage estimates are based on provider-reported vaccination histories. Details regarding NIS methodology and weighting have been described previously.§ For 2015, national vaccination coverage estimates were based on a sample of 15,167 children with completed household interviews and adequate provider data. The Council of American Survey Research Organizations (CASRO) response rate was 34.9%.¶ Logistic regression was used to assess differences among racial/ethnic groups, controlling for poverty status, and to evaluate the potential interaction between poverty status and Metropolitan Statistical Area** (MSA) status (a measure of urbanicity). Statistical comparisons were made using t-tests on weighted data, taking into account the complex survey design. P-values <0.05 were considered statistically significant.

## National Vaccination Coverage

Nationally, coverage did not change during 2014–2015 for the vaccinations assessed, and the percentage of children who received no vaccinations remained <1% (Table 1). The *Healthy People 2020*†† target of 90% coverage was met for four vaccines: 1) ≥3 doses of poliovirus vaccine (93.7%), 2) ≥3 doses of

* Poverty level uses income and family size to categorize households into those 1) at or above the poverty level, and 2) below the poverty level. Poverty level was based on 2014 U.S. Census poverty thresholds (http://www.census.gov/hhes/www/poverty/data/threshold).

† The local areas sampled separately for the 2015 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 two additional sample areas (El Paso County, Texas and Hidalgo County, Texas). The 2015 NIS was also conducted in Guam, Puerto Rico, and the U.S. Virgin Islands; these three territories were excluded from national coverage estimates.

§ Further details regarding the statistical methodology of NIS are available in the NIS User's Guide 2014, which can be downloaded at http://www.cdc.gov/nchs/nis/data_files.htm.

¶ The CASRO household response rate, 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) (http://www.casro.org). The CASRO response rate is equivalent to the American Association for Public Opinion Research (AAPOR) type 3 response rate (http://www.aapor.org/AAPOR_Main/media/publications/Standard-Definitions20169theditionfinal.pdf). The 15,167 children with adequate provider data in the 2015 NIS represent 56.2% of children with completed household interviews.

** Metropolitan Statistical Areas have at least one urbanized area of 50,000 or more population, plus adjacent territory that has a high degree of social and economic integration with the core as measured by commuting ties. The Office of Management and Budget published the Standards for Delineating Metropolitan Statistical Areas in 2010; current definitions are based on an update published in February of 2013 (https://www.whitehouse.gov/sites/default/files/omb/bulletins/2015/15-01.pdf).

†† https://www.healthypeople.gov/2020/topics-objectives/topic/immunization-and-infectious-diseases.

**TABLE 1. Estimated vaccination coverage among children aged 19–35 months, by selected vaccines and doses —National Immunization Survey, United States, 2011–2015***

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|
| **Vaccine/Dose** | **% (95% CI)** | **% (95% CI)** | **% (95% CI)** | **% (95% CI)** | **% (95% CI)** |
| **DTaP†** | | | | | |
| ≥3 doses | 95.5 (±0.5) | 94.3 (±0.7)** | 94.1 (±0.9) | 94.7 (±0.7) | 95.0 (±0.6) |
| ≥4 doses | 84.6 (±1.0) | 82.5 (±1.2)** | 83.1 (±1.3) | 84.2 (±1.2) | 84.6 (±1.1) |
| **Poliovirus (≥3 doses)** | 93.9 (±0.6) | 92.8 (±0.7)** | 92.7 (±1.0) | 93.3 (±0.8) | 93.7 (±0.6) |
| **MMR (≥1 dose)** | 91.6 (±0.8) | 90.8 (±0.8) | 91.9 (±0.9) | 91.5 (±0.9) | 91.9 (±0.8) |
| **Hib§** | | | | | |
| Primary series | 94.2 (±0.6)** | 93.3 (±0.7) | 93.7 (±0.9) | 93.3 (±0.8) | 94.3 (±0.6) |
| Full series | 80.4 (±1.1)** | 80.9 (±1.2) | 82.0 (±1.3) | 82.0 (±1.3) | 82.7 (±1.1) |
| **HepB** | | | | | |
| ≥3 doses | 91.1 (±0.7) | 89.7 (±0.9)** | 90.8 (±1.0) | 91.6 (±0.9) | 92.6 (±0.7) |
| Birth dose¶ | 68.6 (±1.3)** | 71.6 (±1.4)** | 74.2 (±1.4)** | 72.4 (±1.5) | 72.4 (±1.4) |
| **Varicella (≥1 dose)** | 90.8 (±0.7) | 90.2 (±0.8) | 91.2 (±0.9) | 91.0 (±0.9) | 91.8 (±0.8) |
| **PCV** | | | | | |
| ≥3 doses | 93.6 (±0.6)** | 92.3 (±0.8)** | 92.4 (±1.0) | 92.6 (±0.8) | 93.3 (±0.7) |
| ≥4 doses | 84.4 (±1.0) | 81.9 (±1.1)** | 82.0 (±1.3) | 82.9 (±1.3) | 84.1 (±1.1) |
| **HepA** | | | | | |
| ≥1 dose | 81.2 (±1.0)** | 81.5 (±1.1) | 83.1 (±1.2)** | 85.1 (±1.1)** | 85.8 (±1.1) |
| ≥2 doses | 52.2 (±1.4)** | 53.0 (±1.5) | 54.7 (±1.6) | 57.5 (±1.6)** | 59.6 (±1.5) |
| **Rotavirus††** | 67.3 (±1.3)** | 68.6 (±1.4) | 72.6 (±1.5)** | 71.7 (±1.6) | 73.2 (±1.4) |
| **Combined series§§** | 68.5 (±1.3)** | 68.4 (±1.4) | 70.4 (±1.5) | 71.6 (±1.5) | 72.2 (±1.4) |
| **No vaccinations** | 0.8 (±0.2) | 0.8 (±0.1) | 0.7 (±0.3) | 0.8 (±0.2) | 0.8 (±0.2) |

**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 vaccine; MMR = measles, mumps, and rubella vaccine; PCV = pneumococcal conjugate vaccine.

* For 2011, children born January 2008–May 2010; for 2012, children born January 2009–May 2011; for 2013, children born January 2010-May 2012; for 2014, children born January 2011–May 2013; and for 2015, children born January 2012–May 2014.

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

§ Hib Primary series: receipt of ≥2 or ≥3 doses, depending on product type received. Full series: receipt of ≥3 or ≥4 doses, depending on product type received (primary series and booster dose).

¶ One dose HepB administered between birth and age 3 days.

** Statistically significant (p<0.05) change in coverage compared with previous year.

†† Rotavirus vaccine includes ≥2 or ≥3 doses, depending on the product type received (≥2 doses for Rotarix [RV1] and ≥3 doses for RotaTeq [RV5]).

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

HepB (92.6%), 3) ≥1 dose of MMR (91.9%), and 4) ≥1 dose of varicella vaccine (91.8%). Coverage remained below the target of 90% for ≥4 doses of DTaP (84.6%); the full series of Hib (82.7%), and ≥4 doses of PCV (84.1%); below the 85% target for ≥2 doses of hepatitis A vaccine (HepA) (59.6%) and the HepB birth dose§§ (72.4%); and below the 80% target for rotavirus vaccination (73.2%) and the combined seven-vaccine series¶¶ (72.2%).

§§ The *Healthy People 2020* target for the birth dose (0–3 days) of HepB is 85%, measured by annual birth cohort. For the three most recent completed birth cohorts examined by NIS, coverage with the birth dose of HepB was 71.8% for children born in 2010, 73.2% for children born in 2011, and 73.3% for children born in 2012.

¶¶ The combined seven-vaccine series (4:3:1:3*:3:1:4) includes ≥4 doses of DTaP/diphtheria and tetanus toxoids vaccine/diphtheria, tetanus toxoids, and pertussis vaccine; ≥3 doses of poliovirus vaccine; ≥1 dose of measles-containing vaccine; ≥3 or ≥4 doses of Hib (depending upon product type of vaccine); ≥3 doses of HepB; ≥1 dose of varicella vaccine; and ≥4 doses of PCV.

## Vaccination Coverage by Race/Ethnicity, Poverty Level, and MSA Status

Compared with non-Hispanic white*** (white) children, non-Hispanic black (black) children had lower coverage with the full series of Hib, ≥4 doses of PCV, and the rotavirus series (Table 2). Coverage differences between black and white children were not statistically significant after adjustment for poverty status (data not shown). Black, Hispanic, non-Hispanic Asian, and non-Hispanic American Indian/Alaska Native children had higher coverage with the HepB birth dose than did white children. Among Asian children, coverage with ≥4 doses of DTaP, ≥3 doses of poliovirus vaccine, ≥3 doses of HepB, the HepB birth dose, and ≥2 doses of HepA was higher than that for white children.

*** Child's race/ethnicity was reported by his/her parent or guardian. Children categorized in this report as white, black, American Indian/Alaska native, Asian, native Hawaiian/other Pacific Islander, or multiracial were identified as non-Hispanic by the parent or guardian. Children identified as multiracial had more than one race category identified. Persons identified as Hispanic might be of any race.

**TABLE 2. Estimated vaccination coverage among children aged 19–35 months, by selected vaccines and doses, race/ethnicity,* poverty level,† and Metropolitan Statistical Area (MSA) status§ — National Immunization Survey, United States, 2015¶**

| | Race/ethnicity | | | | | | | Poverty level | | MSA status | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | White, non-Hispanic (Referent) | Black, non-Hispanic | Hispanic | American Indian/ Alaska Native | Asian | Native Hawaiian or other Pacific Islander | Multiracial | At or above poverty (Referent) | Below poverty | MSA, central city (Referent) | MSA, non-central city | Non-MSA |
| Vaccine/Dose | % (95% CI) | % (95% CI) | % (95% CI) | % (95% CI) | % (95% CI) | % (95% CI) | % (95% CI) | % (95% CI) | % (95% CI) | % (95% CI) | % (95% CI) | % (95% CI) |
| **DTaP**** | | | | | | | | | | | | |
| ≥ 3 doses | 94.8 (±0.8) | 94.3 (±1.6) | 95.5 (±1.2) | 92.3 (±4.7) | 97.3 (±1.6)†† | 92.2 (±6.6) | 93.6 (±2.7) | 96.0 (±0.6) | 93.1 (±1.2)†† | 95.3 (±0.8) | 95.0 (±0.9) | 93.5 (±1.5)†† |
| ≥ 4 doses | 85.2 (±1.5) | 82.0 (±2.9) | 84.5 (±2.6) | 79.6 (±7.6) | 90.0 (±3.5)†† | —§§ | 82.5 (±3.8) | 87.1 (±1.3) | 80.2 (±2.2)†† | 85.4 (±1.5) | 84.3 (±1.9) | 82.7 (±2.4) |
| Poliovirus (≥ 3 doses) | 93.1 (±0.9) | 93.3 (±1.7) | 94.5 (±1.3) | 91.8 (±4.7) | 96.9 (±1.7)†† | 92.8 (±6.4) | 92.4 (±2.8) | 94.6 (±0.7) | 91.8 (±1.4)†† | 93.9 (±1.0) | 94.0 (±1.0) | 91.7 (±1.8)†† |
| MMR (≥1 dose) | 91.8 (±1.1) | 90.7 (±2.3) | 92.3 (±1.8) | 88.5 (±6.1) | 92.5 (±3.4) | 92.0 (±6.6) | 93.0 (±2.3) | 92.9 (±0.9) | 90.3 (±1.6)†† | 92.4 (±1.2) | 91.7 (±1.3) | 90.7 (±1.8) |
| **Hib¶¶** | | | | | | | | | | | | |
| ≥3 doses | 93.3 (±0.9) | 92.1 (±2.0) | 94.0 (±1.4) | 88.2 (±5.7) | 93.7 (±2.7) | 91.8 (±6.8) | 92.0 (±2.8) | 94.7 (±0.7) | 90.5 (±1.4)†† | 93.6 (±1.0) | 93.3 (±1.1) | 91.8 (±1.6) |
| Primary series | 94.4 (±0.8) | 93.3 (±1.8) | 95.1 (±1.3) | 89.8 (±5.6) | 94.8 (±2.2) | 92.8 (±6.4) | 93.1 (±2.7) | 95.6 (±0.7) | 91.9 (±1.3)†† | 94.6 (±0.9) | 94.3 (±1.0) | 93.2 (±1.5) |
| Full series | 83.0 (±1.5) | 78.9 (±3.1)†† | 83.0 (±2.6) | 81.4 (±7.3) | 87.0 (±3.9) | —§§ | 82.4 (±3.7) | 85.5 (±1.3) | 78.1 (±2.2)†† | 82.3 (±1.6) | 83.6 (±1.8) | 80.9 (±2.4) |
| **HepB** | | | | | | | | | | | | |
| ≥3 doses | 92.0 (±1.1) | 93.3 (±1.8) | 93.2 (±1.5) | 92.4 (±4.9) | 95.5 (±2.3)†† | 94.1 (±5.5) | 91.4 (±3.6) | 92.7 (±1.0) | 92.5 (±1.3) | 92.9 (±1.1) | 92.5 (±1.2) | 92.1 (±1.6) |
| Birth dose*** | 68.2 (±1.8) | 74.2 (±3.6)†† | 77.8 (±3.2)†† | 80.7 (±8.4)†† | 76.7 (±5.5)†† | —§§ | 72.8 (±4.9) | 70.2 (±1.6) | 76.3 (±2.5)†† | 72.1 (±2.1) | 71.7 ±2.2) | 75.6 (±2.8)†† |
| Varicella (≥1 dose) | 91.2 (±1.1) | 91.8 (±2.1) | 92.7(±1.8) | 87.8 (±6.0) | 93.4 (±2.9) | 91.8 (±6.8) | 92.1 (±2.5) | 92.5 (±0.9) | 90.6(±1.6) | 92.5 (±1.2) | 91.5 (±1.2) | 89.9 (±1.9)†† |
| **PCV** | | | | | | | | | | | | |
| ≥3 doses | 93.2 (±1.0) | 92.5 (±1.9) | 94.4 (±1.6) | 89.7 (±5.4) | 92.4 (±2.9) | 90.6 (±7.5) | 92.5 (±2.8) | 94.6 (±0.8) | 91.2 (±1.4)†† | 93.1 (±1.1) | 93.9 (±1.0) | 91.8 (±1.7) |
| ≥4 doses | 85.0 (±1.5) | 81.4 (±2.9)†† | 84.0 (±2.5) | 77.1 (±7.9) | 85.0 (±4.1) | —§§ | 83.7 (±3.6) | 87.2 (±1.2) | 78.9 (±2.2)†† | 83.9 (±1.6) | 85.5 (±1.7) | 80.4 (±2.5)†† |
| HepA (≥ 2 doses) | 58.7 (±1.9) | 59.3 (±3.9) | 60.9 (±3.5) | 61.3 (±9.5) | 67.8 (±6.2)†† | —§§ | 54.1 (±5.3) | 61.7 (±1.7) | 56.0 (±2.8)†† | 60.5 (±2.2) | 59.6 (±2.4) | 55.7 (±3.2)†† |
| Rotavirus††† | 74.6 (±1.7) | 69.7 (±3.6)†† | 72.9 (±3.2) | —§§ | 75.6 (±5.4) | —§§ | 70.6 (±5.2) | 76.8 (±1.6) | 66.8 (±2.7)†† | 72.7 (±2.1) | 75.1 (±2.1) | 68.6 (±3.0)†† |
| Combined series§§§ | 72.7 (±1.8) | 69.1 (±3.6) | 71.7 (±3.2) | 68.2 (±9.0) | 77.9 (±4.9) | —§§ | 73.7(±4.6) | 74.7(±1.6) | 68.7 (±2.5)†† | 72.5 (±2.0) | 72.5 (±2.3) | 70.2 (±2.9) |

**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 vaccine; MMR = measles, mumps, and rubella vaccine; PCV = pneumococcal conjugate vaccine.

* Children's race/ethnicity was reported by parent or guardian. Children identified in this report as white, black, Asian, American Indian/Alaska Native, Native Hawaiian or other Pacific Islander, or multiracial were reported by the parent or guardian as non-Hispanic. Children identified as multiracial had more than one race category selected. Children identified as Hispanic might be of any race.

† Children were classified as below poverty if their total family income was less than the poverty threshold specified for the applicable family size and number of children aged <18 years. Children with total family income at or above the poverty threshold specified for the applicable family size and number of children aged <18 years were classified as at or above poverty. A total of 492 children with adequate provider data and missing data on income were excluded from the analysis. Poverty thresholds reflect yearly changes in the Consumer Price Index (http://www.census.gov/hhes/www/poverty.html).

§ Metropolitan Statistical Area as defined by the US Office of Management and Budget (https://www.whitehouse.gov/sites/default/files/omb/bulletins/2015/15-01.pdf).

¶ Children in the 2015 National Immunization Survey were born January 2012–May 2014.

** 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 from referent group.

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

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

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

Children living below the federal poverty level had lower coverage with nearly all vaccines compared with children living at or above the poverty level (Table 2). As in 2014, coverage with ≥4 doses of DTaP, ≥3 doses of poliovirus vaccine, ≥1 dose of MMR, the primary and full series of Hib, ≥4 doses of PCV, ≥2 doses of HepA, the rotavirus series and the combined seven-vaccine series was lower among children below the poverty level. The difference in coverage levels ranged from 2.6 to 10.0 percentage points; for five vaccines/doses (≥4 doses of DTaP, the full series of Hib, ≥4 doses of PCV, ≥2 doses of HepA, the rotavirus series) and the combined seven-vaccine series, the disparity exceeded 5.0 percentage points.

Coverage differed by MSA status for several vaccines in 2015 (Table 2). Children living in a non-MSA had lower coverage with ≥3 doses of DTaP, ≥3 doses of poliovirus vaccine, ≥1 dose of varicella vaccine, ≥4 doses of PCV, ≥2 doses of HepA, and rotavirus vaccine than did children in an MSA central city. Logistic regression analyses did not identify any statistically significant interaction between poverty status and MSA status for any of the vaccines monitored by NIS. In all cases, poverty status remained independently associated with vaccination coverage after adjustment for MSA status.

**TABLE 3. Estimated vaccination coverage with selected individual vaccines and a combined vaccine series* among children aged 19–35 months, overall and by U.S. Department of Health and Human Services (HHS) region and state and local area — National Immunization Survey, United States, 2015†**

| National, HHS region, state, and local area | Vaccine/Vaccine series | | | | | |
|---|---|---|---|---|---|---|
| | MMR (≥1 dose) | DTaP (≥4 doses)§ | Hep B (birth dose)¶ | HepA (≥2 doses) | Rotavirus** | Combined vaccine series |
| | % (95% CI) | % (95% CI) | % (95% CI) | % (95% CI) | % (95% CI) | % (95% CI) |
| **U.S. overall** | **91.9 (±0.8)** | **84.6 (±1.1)** | **72.4 (±1.4)** | **59.6 (±1.5)** | **73.2 (±1.4)** | **72.2 (±1.4)** |
| **HHS Region I** | **94.1 (±2.1)** | **88.9 (±2.7)** | **76.3 (±3.3)** | **65.4 (±3.9)** | **80.7 (±3.2)** | **77.8 (±3.3)** |
| Connecticut | 97.5 (±2.4) | 90.8 (±4.5) | 81.8 (±6.2) | 72.0 (±7.3) | 77.9 (±6.7) | 80.6 (±6.0) |
| Maine | 96.0 (±3.1) | 92.0 (±5.0) | 68.7 (±7.7) | 53.8 (±8.3) | 71.1 (±7.7) | 71.8 (±7.9)†† |
| Massachusetts | 91.8 (±4.0) | 87.2 (±5.1) | 78.4 (±5.8) | 65.7 (±6.9) | 83.5 (±5.4) | 78.5 (±6.0) |
| New Hampshire | 93.4 (±3.9) | 88.4 (±5.4) | 72.0 (±7.0) | 60.2 (±7.7) | 80.9 (±6.2) | 74.1 (±7.1) |
| Rhode Island | 94.5 (±3.2) | 90.5 (±4.1) | 73.2 (±6.4) | 65.1 (±6.9) | 87.6 (±4.9) | 77.2 (±6.0) |
| Vermont | 95.5 (±2.7) | 89.2 (±4.2) | 49.4 (±6.7) | 57.1 (±6.7) | 72.7 (±6.2) | 75.6 (±5.9) |
| HHS Region II | 92.6 (±2.2) | 88.1 (±2.7) | 60.6 (±4.0) | 53.4 (±4.1) | 73.7 (±3.8)§§ | 73.4 (±3.7) |
| New Jersey | 92.8 (±4.4) | 89.8 (±4.8) | 63.9 (±7.2) | 58.3 (±7.4) | 75.2 (±6.8) | 76.5 (±6.5) |
| New York | 92.5 (±2.6) | 87.4 (±3.3) | 59.0 (±4.7) | 51.2 (±5.0) | 73.0 (±4.5) | 71.9 (±4.4) |
| City of New York | 94.1 (±2.9) | 85.5 (±5.0) | 53.4 (±6.8) | 47.8 (±6.9) | 71.1 (±6.4) | 68.2 (±6.5) |
| Rest of state (NY) | 90.9 (±4.3) | 89.2 (±4.3) | 64.6 (±6.6) | 54.6 (±7.2) | 75.0 (±6.4) | 75.7 (±6.1) |
| **HHS Region III** | **89.6 (±2.5)** | **85.5 (±2.7)** | **72.5 (±3.6)††** | **61.5 (±3.8)** | **72.7 (±3.6)** | **71.0 (±3.6)** |
| Delaware | 97.2 (±2.6)§§ | 89.9 (±4.5) | 76.0 (±6.7) | 67.6 (±7.3) | 81.5 (±6.1) | 79.3 (±6.1) |
| District of Columbia | 92.4 (±3.8) | 86.1 (±5.0) | 72.7 (±5.8) | 67.9 (±6.5) | 73.0 (±6.2) | 76.3 (±6.0) |
| Maryland | 95.4 (±2.5) | 87.6 (±4.5) | 79.0 (±6.6) | 63.0 (±7.2) | 76.8 (±6.4) | 76.8 (±5.9) |
| Pennsylvania | 90.9 (±3.7) | 88.7 (±3.8) | 73.2 (±6.0) | 64.6 (±6.3) | 74.3 (±5.9) | 72.8 (±5.8) |
| Philadelphia | 93.2 (±3.5) | 87.2 (±4.5) | 77.3 (±6.1) | 65.4 (±6.9) | 71.5 (±6.4) | 76.1 (±6.0) |
| Rest of state (PA) | 90.5 (±4.4) | 88.9 (±4.4) | 72.5 (±7.0) | 64.4 (±7.4) | 74.9 (±6.9) | 72.2 (±6.8) |
| Virginia | 83.4 (±6.7) | 80.6 (±7.0) | 67.3 (±8.1) | 54.1 (±8.3) | 67.1 (±8.3) | 64.4 (±8.3) |
| West Virginia | 86.7 (±5.7) | 78.6 (±6.8) | 68.3 (±7.4) | 65.7 (±7.7)§§ | 69.6 (±7.5) | 64.9 (±7.8) |
| **HHS Region IV** | **91.3 (±1.9)** | **83.3 (±2.3)** | **70.9 (±2.9)** | **55.8 (±3.1)** | **69.8 (±3.0)** | **71.2 (±2.9)** |
| Alabama | 95.2 (±3.5) | 82.2 (±6.4) | 83.2 (±5.4) | 57.6 (±7.6) | 76.2 (±6.9) | 70.6 (±7.1) |
| Florida | 90.4 (±5.0) | 86.0 (±5.2) | 56.9 (±7.6) | 54.6 (±7.5) | 63.8 (±7.5) | 66.6 (±7.2) |
| Georgia | 90.5 (±4.7) | 82.3 (±6.0) | 80.5 (±5.7) | 62.0 (±7.6) | 73.8 (±7.0) | 75.6 (±6.7) |
| Kentucky | 91.6 (±4.1) | 87.0 (±4.8) | 75.3 (±6.7) | 48.3 (±7.3) | 65.3 (±7.1) | 73.0 (±6.5) |
| Mississippi | 89.8 (±5.3) | 79.6 (±7.0) | 77.0 (±7.3) | 41.2 (±8.1) | 65.9 (±8.0) | 70.6 (±7.5) |
| North Carolina | 94.3 (±3.3) | 83.9 (±5.8) | 81.3 (±6.0) | 56.2 (±7.5) | 75.9 (±6.7)†† | 76.4 (±6.5) |
| South Carolina | 88.5 (±5.1) | 77.5 (±7.0) | 68.9 (±7.0) | 54.5 (±7.6) | 69.8 (±7.1) | 68.2 (±7.3) |
| Tennessee | 90.2 (±4.0)†† | 81.2 (±6.5) | 64.7 (±7.9)†† | 59.5 (±8.0) | 70.9 (±7.6) | 70.1 (±7.5) |
| **HHS Region V** | **90.9 (±1.8)** | **84.2 (±2.3)** | **75.2 (±2.5)** | **59.9 (±3.0)** | **73.2 (±2.8)** | **70.2 (±2.8)** |
| Illinois | 91.6 (±2.8) | 85.0 (±3.8) | 71.2 (±4.6) | 57.9 (±4.9) | 75.4 (±4.5) | 70.8 (±4.7) |
| City of Chicago | 90.5 (±4.7) | 86.2 (±5.9) | 82.9 (±5.9) | 62.7 (±8.0) | 78.3 (±6.8)§§ | 72.8 (±7.3) |
| Rest of state (IL) | 91.9 (±3.4) | 84.6 (±4.6) | 67.2 (±5.8) | 56.3 (±6.0) | 74.4 (±5.5) | 70.1 (±5.8) |
| Indiana | 92.0 (±4.4) | 85.3 (±5.7) | 80.0 (±6.3) | 65.3 (±7.4)§§ | 72.6 (±7.2) | 74.7 (±7.0) |
| Michigan | 90.6 (±4.5) | 84.9 (±5.5) | 80.0 (±5.9) | 64.1 (±7.2)§§ | 65.5 (±7.7) | 67.6 (±7.3) |
| Minnesota | 92.6 (±3.6) | 85.4 (±5.0) | 67.8 (±6.5) | 65.4 (±6.6) | 82.6 (±5.4) | 73.2 (±6.4) |
| Ohio | 88.1 (±5.6)†† | 80.9 (±6.8) | 77.9 (±6.5) | 53.1 (±8.2) | 71.8 (±7.6) | 68.3 (±7.9) |
| Wisconsin | 92.4 (±4.3) | 85.2 (±5.7) | 73.1 (±6.6) | 58.6 (±7.5) | 75.3 (±6.7) | 68.8 (±7.1) |
| **HHS Region VI** | **92.3 (±1.8)** | **82.4 (±2.7)** | **76.5 (±2.9)** | **63.9 (±3.2)§§** | **73.5 (±2.9)** | **71.2 (±3.1)** |
| Arkansas | 90.2 (±5.0) | 76.4 (±6.9) | 80.6 (±6.2) | 54.2 (±8.0) | 68.2 (±7.4) | 66.6 (±7.5) |
| Louisiana | 92.6 (±4.3) | 84.4 (±5.7) | 75.3 (±7.1) | 59.0 (±8.0) | 67.7 (±7.6) | 70.8 (±7.6) |
| New Mexico | 89.7 (±5.3) | 84.8 (±6.0) | 67.8 (±7.5) | 62.7 (±7.9) | 73.8 (±6.9) | 70.1 (±7.9) |
| Oklahoma | 92.6 (±5.1) | 85.7 (±6.3) | 80.4 (±5.9) | 71.6 (±7.4)§§ | 67.2 (±8.3) | 75.4 (±7.3) |
| Texas | 92.5 (±2.4) | 82.1 (±3.6) | 76.4 (±3.9) | 64.6 (±4.3) | 75.7 (±3.9)§§ | 71.2 (±4.2)§§ |
| Bexar County | 89.2 (±5.0) | 80.1 (±6.1) | 72.5 (±6.7) | 64.2 (±7.3) | 70.7 (±7.0) | 67.5 (±7.1) |
| City of Houston | 92.8 (±3.9) | 80.5 (±6.5) | 82.6 (±5.7) | 64.5 (±7.6) | 74.8 (±6.8) | 70.5 (±7.3) |
| El Paso County | 90.6 (±4.5) | 82.8 (±6.1) | 76.5 (±7.0) | 73.5 (±6.7)§§ | 73.4 (±7.1) | 71.6 (±7.1) |
| Hidalgo County¶¶ | 86.9 (±5.2) | 82.4 (±5.8) | 89.5 (±4.8) | 64.1 (±6.7) | 73.1 (±6.4) | 71.6 (±6.5) |
| Rest of state (TX)¶¶ | 93.3 (±3.1) | 82.5 (±4.8) | 74.9 (±5.2) | 64.2 (±5.7) | 76.6 (±5.1) | 71.6 (±5.6) |
| **HHS Region VII** | **93.2 (±2.1)** | **85.5 (±3.0)** | **77.2 (±3.6)** | **63.5 (±4.0)§§** | **75.7 (±3.6)** | **73.8 (±3.7)** |
| Iowa | 95.5 (±2.4) | 88.9 (±4.0) | 78.2 (±5.3) | 64.7 (±6.5) | 75.1 (±5.9) | 77.9 (±5.5) |
| Kansas | 92.3 (±4.1) | 86.8 (±4.7) | 83.3 (±5.4) | 67.9 (±6.8) | 77.0 (±6.3) | 75.2 (±6.3) |
| Missouri | 91.6 (±4.3) | 82.6 (±6.3) | 75.0 (±7.4) | 57.2 (±7.9)§§ | 76.1 (±7.0) | 71.0 (±7.4) |
| Nebraska | 95.6 (±3.0) | 86.9 (±5.0) | 72.5 (±6.8) | 72.8 (±6.5) | 73.0 (±6.4) | 73.8 (±6.3) |

See table footnotes on the next page.

**TABLE 3. (*Continued*) Estimated vaccination coverage with selected individual vaccines and a combined vaccine series* among children aged 19–35 months, overall and by U.S. Department of Health and Human Services (HHS) region and state and local area — National Immunization Survey, United States, 2015†**

| National, HHS region, state, and local area | Vaccine/Vaccine series | | | | | |
|---|---|---|---|---|---|---|
| | MMR (≥1 dose) | DTaP (≥4 doses)§ | Hep B (birth dose)¶ | HepA (≥2 doses) | Rotavirus** | Combined vaccine series |
| | % (95% CI) | % (95% CI) | % (95% CI) | % (95% CI) | % (95% CI) | % (95% CI) |
| **HHS Region VIII** | **91.8 (±2.3)** | **83.8 (±2.9)** | **75.8 (±3.4)** | **57.8 (±4.0)** | **74.9 (±3.6)** | **72.7 (±3.6)** |
| Colorado | 93.6 (±3.6) | 86.1 (±5.0) | 73.1 (±6.4) | 59.7 (±7.3) | 75.9 (±6.5) | 75.4 (±6.2) |
| Montana | 91.7 (±3.7) | 78.6 (±6.5) | 73.8 (±6.5) | 43.9 (±7.3) | 67.3 (±7.0) | 68.1 (±7.1) |
| North Dakota | 92.8 (±3.8) | 85.7 (±5.1) | 87.5 (±4.7) | 66.3 (±6.9) | 79.8 (±6.2) | 80.2 (±5.7) |
| South Dakota | 91.4 (±4.8) | 83.1 (±6.0) | 71.4 (±7.3) | 53.0 (±7.8) | 73.4 (±7.0) | 75.6 (±6.8) |
| Utah | 89.2 (±5.2) | 82.0 (±5.8) | 79.6 (±6.0) | 59.8 (±7.6) | 74.5 (±6.7) | 68.1 (±7.3) |
| Wyoming | 93.5 (±3.5) | 83.2 (±6.1) | 67.2 (±7.3) | 45.8 (±7.8)§§ | 76.4 (±6.6) | 73.3 (±7.1) |
| **HHS Region IX** | **92.6 (±3.1)** | **84.9 (±4.6)** | **70.9 (±5.8)** | **60.3 (±6.2)** | **74.1 (±5.6)** | **74.4 (±5.5)** |
| Arizona | 90.6 (±4.1) | 83.7 (±5.8) | 78.0 (±6.0) | 58.6 (±7.4) | 75.1 ±6.6) | 72.3 (±6.7) |
| California | 92.8 (±3.9) | 85.2 (±5.7) | 69.1 (±7.4) | 60.8 (±7.8) | 74.6 (±7.1) | 75.0 (±6.9) |
| Hawaii | 94.7 (±3.3) | 83.2 (±5.4) | 75.5 (±6.3) | 51.4 (±7.0) | 72.5 (±6.4) | 73.8 (±6.3) |
| Nevada | 93.7 (±3.7) | 84.7 (±5.7) | 77.7 (±6.8) | 61.9 (±7.5) | 65.5 (±7.6) | 71.3 (±7.0) |
| **HHS Region X** | **94.1 (±1.8)§§** | **85.6 (±3.1)** | **71.0 (±3.9)** | **58.8 (±4.4)** | **73.4 (±4.0)** | **73.0 (±3.9)** |
| Alaska | 89.7 (±4.0) | 79.7 (±5.2) | 65.7 (±6.1)§§ | 56.5 (±6.5) | 72.0 (±5.9) | 66.3 (±6.2) |
| Idaho | 91.2 (±4.0) | 81.0 (±5.9) | 69.8 (±6.9) | 58.8 (±7.3) | 74.5 (±6.6) | 71.6 (±6.8) |
| Oregon | 94.1 (±3.7)§§ | 85.8 (±5.7) | 72.5 (±7.0)§§ | 61.8 (±8.0) | 72.9 (±7.3) | 67.4 (±7.8) |
| Washington | 95.3 (±2.6)§§ | 87.3 (±4.7) | 71.2 (±6.2) | 57.5 (±7.0) | 73.6 (±6.3) | 77.1 (±5.7) |
| ***Range*** | ***(83.4–97.5)*** | ***(76.4–92.0)*** | ***(49.4–87.5)*** | ***(41.2–72.8)*** | ***(63.8–87.6)*** | ***(64.4–80.6)*** |
| **Territory** | | | | | | |
| Guam*** | 91.7 (±3.6) | 73.3 (±6.1) | 82.3 (±5.0) | 49.4 (±6.9) | 40.6 (±6.5) | 52.9 (±7.0) |
| Puerto Rico*** | 91.4 (±3.9) | 82.0 (±5.8) | 72.7 (±7.6) | 50.7 (±8.1) | 64.9 (±7.6) | 61.0 (±8.1) |
| U.S. Virgin Islands*** | 77.2 (±5.5) | 65.8 (±6.3) | 79.4 (±5.3) | 36.8 (±6.5) | 43.3 (±6.9) | 50.7 (±6.7) |

**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 vaccine; MMR = measles, mumps, and rubella vaccine; PCV = pneumococcal conjugate vaccine.

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

† Children in the 2015 National Immunization Survey were born January 2012–May 2014.

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

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

** Either ≥2 or ≥3 doses of rotavirus vaccine, depending on product type received (≥2 doses for Rotarix [RV1] or ≥3 doses for RotaTeq [RV5]).

†† Statistically significant decrease in coverage compared to 2014 (p<0.05).

§§ Statistically significant increase in coverage compared to 2014 (p<0.05).

¶¶ No comparison was made to coverage in 2014; Hidalgo County was not sampled in 2014 and "rest of state" is not comparable between the two years.

*** Children from Guam (n=467), Puerto Rico (n=617), and the U.S. Virgin Islands (n=580) were excluded from the national estimates. Guam and U.S. Virgin Islands were not sampled in 2014.

## Vaccination Coverage by Geographic Area

Vaccination coverage in 2015 varied considerably by geographic area (Table 3), differing across states by as much as 38.1 percentage points. Coverage with ≥1 dose of MMR ranged from 83.4% (Virginia) to 97.5% (Connecticut). The lowest estimated coverage with ≥4 doses of DTaP was 76.4% (Arkansas) and the highest was 92.0% (Maine). The largest discrepancy among states was for the HepB birth dose, with a low of 49.4% (Vermont) and a high of 87.5% (North Dakota). Coverage with ≥2 doses of HepA varied widely, ranging from 41.2% (Mississippi) to 72.8% (Nebraska). The lowest state-specific estimate for rotavirus series coverage was 63.8% (Florida) and the highest 87.6% (Rhode Island). Coverage with the combined seven-vaccine series ranged from 64.4% (Virginia) to 80.6% (Connecticut).

## Discussion

Nationally, coverage with vaccines recommended by the Advisory Committee on Immunization Practices (ACIP) for children aged 19–35 months remains high and stable. The burden of most vaccine-preventable diseases is low in this population. Furthermore, *Healthy People 2020* coverage targets continue to be met for poliovirus vaccine, MMR, HepB, and varicella vaccine. For other vaccines, coverage levels remained stable, and increased activities are needed to reach target coverage levels. Nationally, large disparities in coverage exist for children living below the poverty level compared with children living at or above the poverty level, with differences of 7–10 percentage points for ≥4 doses of DTaP, Hib (full series), ≥4 doses of PCV, and rotavirus vaccination. Disparities between racial/ethnic groups were observed, but

these diminished in magnitude when poverty status and MSA were accounted for in the analysis.

The widespread, persistent and often sizeable vaccination coverage disparities between children living below poverty and children living at or above the poverty level have been observed for many vaccines monitored by NIS since at least 2009 and are concerning. Based on 2015 data, an estimated 32.9% (95% CI = 31.4%–34.4%) of U.S. children aged 19–35 months were living below the poverty level. The Vaccines for Children (VFC) program[†††] has provided free vaccine to many uninsured, Medicaid-eligible and other children aged ≤18 years who would otherwise have less access to these important vaccines. The extent to which parents and guardians of children living in poverty are aware of the VFC program or face barriers to participation in it is not known. The Affordable Care Act (ACA) stipulates that ACIP-recommended vaccines be made available to insured children with no copayments or other cost-sharing requirements when administered by an in-network provider. Issues such as proximity to health care providers and clinics, transportation, and convenience of clinic hours also should be investigated and addressed, if needed. Breaks in insurance enrollment (especially Medicaid) are another complication faced by families living below the poverty level that might have a negative effect on their ability to access the medical care system in general (*4*).

Widespread geographic variation in coverage levels was evident in the ranges of coverage estimates by state and local area, as well as differences by MSA status. Children in more rural (non-MSA) areas had lower coverage with DTaP, poliovirus vaccine, varicella vaccine, PCV, HepA, and rotavirus vaccine than did more urban (MSA central city) children. This also could reflect issues of access and proximity to vaccination providers, including those who administer VFC vaccines.

Evidence-based interventions such as those recommended in *The Guide to Community Preventive Services* (*3*) can contribute to addressing the poverty and urbanicity gaps in vaccination coverage. Enhancing access to vaccination services might include conducting home vaccination visits, holding extended office/clinic hours during the week or on weekends, and establishing vaccination programs in organized child care centers and in settings where the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) is administered.

Overall, MMR coverage remained within the 92%–95% range generally considered adequate for herd immunity for all three diseases (*5*); however, coverage levels of <90% were observed in several states and local areas as well as in the U.S. Virgin Islands. In the era of VFC, the number of cases of measles has dropped substantially, to only 49 in the United States in 2016 (through July 30) (*6*). Despite high coverage, outbreaks continue to occur, demonstrating that pockets of susceptibility to this highly contagious disease remain. Reductions in rotavirus-related morbidity have been observed in the United States after vaccine introduction, and indirect (herd) effects of vaccination might have contributed to the decline (*7*). Additional activities are needed to increase rotavirus coverage as demonstrated by the relatively low overall coverage, large disparity by poverty, and state variation in vaccination rates. Increased rotavirus vaccination coverage is needed to decrease further the overall prevalence of rotavirus gastroenteritis.

The findings in this report are subject to at least three limitations, each of which could lead to bias in estimates

[†††] http://www.cdc.gov/vaccines/programs/vfc/index.html.

**Summary**

**What is already known about this topic?**

Vaccination has resulted in substantial reductions in morbidity and mortality from childhood diseases in the United States. As new vaccines, such as varicella, pneumococcal conjugate, and rotavirus have been recommended by the Advisory Committee on Immunization Practices, the National Immunization Survey (NIS) has been able to provide important information on vaccine coverage among U.S. children aged 19–35 months and on progress toward meeting coverage targets.

**What is added by this report?**

The 2015 NIS data reveal no significant changes in overall coverage relative to the previous year. More than 90% of children were up to date on vaccination against polio; hepatitis B; measles, mumps, and rubella; and varicella. However, children living below the poverty level continued to have lower coverage with rotavirus vaccine; pneumococcal conjugate vaccine; *Haemophilus influenzae* type b vaccine; and diphtheria, tetanus, and acellular pertussis vaccine. In addition, children living in more rural areas had lower coverage with diphtheria, tetanus, and acellular pertussis vaccine; poliovirus vaccine; varicella vaccine; pneumococcal conjugate vaccine, hepatitis A vaccine; and rotavirus vaccine.

**What are the implications for public health practice?**

CDC will continue to work with state immunization programs through ongoing site visits, teleconferences, and structured interviews to identify reasons for the observed disparities in vaccination coverage by poverty status and to implement effective strategies to eliminate them. Effort is needed to ensure full participation in the Vaccines for Children (VFC) program for eligible children who could benefit from it. Supporting the continued development of state and local immunization information systems to monitor vaccination coverage can help identify areas of undervaccination that might not be easily detected by the national monitoring program. Identifying areas of need and responding with evidence-based interventions will allow continued progress in protecting young children against vaccine-preventable diseases.

of vaccination coverage (*8*). First, response rates were low. Second, the telephone sample frame did not cover the entire target population. Bias from incomplete sample frame and nonresponse may remain after weighting adjustments. Finally, ascertainment of the vaccination status may be incomplete. A total survey error model, including potential underascertainment of vaccinations reported by providers, indicated that some NIS estimates might be too low by about five percentage points (*9*). However, a recent analysis demonstrated no evidence of substantial change in bias in NIS during the period 1995–2013 (*10*).

NIS continues to provide valuable national and state level data. In addition, it is important that states continue to obtain local level coverage data useful for identifying pockets of under-vaccinated children. This analysis documents high overall coverage and, importantly, lower coverage in rural and poorer populations. Continued surveillance is needed to monitor coverage, locate pockets of susceptibility, and evaluate the impact of interventions designed to ensure that all children remain adequately protected against vaccine-preventable diseases. More widespread implementation of evidence-based interventions is needed to bring about continued improvement in vaccination coverage among infants and young children in the United States. Financial barriers to vaccine purchase itself are addressed for children living below the poverty level by the VFC program and vaccine-related stipulations in the ACA. Improved access might be achieved through establishment of vaccination programs in child care centers and in WIC settings. Systems-based interventions, such as patient reminder and recall systems, provider reminders, establishment of standing orders for vaccination, and further development of immunization information systems might be useful in improving vaccination coverage among all young children in the United States.

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# Real-Time Monitoring of Vaccination Campaign Performance Using Mobile Phones — Nepal, 2016

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In 2012, the Global Vaccine Action Plan* established a goal to achieve measles and rubella elimination in five of the six World Health Organization (WHO) regions (194 countries) by 2020 (*1*). Measles elimination strategies aim to achieve ≥95% coverage with 2 routine doses of measles-containing vaccine (*2*), and implement supplementary immunization activities (SIAs)† in settings where routine coverage is low or where there are subpopulations at high risk. To ensure SIA quality and to achieve ≥95% SIA coverage nationally, rapid convenience monitoring (RCM) is used during or immediately after SIAs (*3*,*4*). The objective of RCM is to find unvaccinated children and to identify reasons for nonvaccination in areas with persons at high risk, to enable immediate implementation of corrective actions (e.g., reassigning teams to poorly vaccinated areas, modifying the timing of vaccination, or conducting mop-up vaccination activities). This report describes pilot testing of RCM using mobile phones (RCM-MP) during the second phase of an SIA in Nepal in 2016. Use of RCM-MP resulted in 87% timeliness and 94% completeness of data reporting and found that, although 95% of children were vaccinated, 42% of areas required corrective vaccination activities. RCM-MP challenges included connecting to mobile networks, small phone screen size, and capturing Global Positioning System (GPS) coordinates. Nonetheless, use of RCM-MP led to faster data transmission, analysis, and decision-making and to increased accountability among levels of the health system.

## Intra-Campaign Monitoring Through RCM

As part of Nepal's continuing progress toward measles elimination (*5*), a nationwide measles-rubella vaccination campaign directed at children aged 9–59 months was implemented in four phases§ during September 2015–March 2016 in all 75 districts of Nepal, which are administratively divided into village development committees (VDCs) and further divided into VDC wards. Intra-campaign monitoring was implemented according to the WHO *Comprehensive Field Guide for Planning and Implementing High Quality Supplementary Immunization Activities for Measles and Rubella and other Injectable Vaccines* (*6*). In each VDC, the SIA was conducted over 10–15 days, and RCM was conducted on the third and seventh days in VDCs identified by the Ministry of Health (MoH) as high risk (i.e., <90% immunization service delivery coverage; location near the India border with population movement; large population; and hard-to-reach).

## RCM Monitoring Using Mobile Phones

All 33 districts included in the second phase of the campaign during February 2016 used paper-based RCM, but the MoH and WHO-Nepal selected 10 districts among them that included a mix of high- and low-performance in immunization service delivery and different geographic topographies (five were in the plains and five were hilly) for pilot testing RCM-MP on a limited scale. Thus, in the 10 pilot districts, there was a mix of VDCs where RCM was conducted using paper forms or mobile phones. For the RCM-MP, data collection forms were programmed into an electronic data collection tool¶ and loaded onto Android phones.** National-level staff members were trained on use of the phones and software 2 weeks before deployment, and the national staff team then provided training for field monitors. Electronic data visualization software†† was used to create two dashboards connected directly to the server, where data were uploaded, enabling real-time data visualization of SIA implementation performance indicators on the dashboards for national and district supervisors (Table 1). The first dashboard was designed to be action-oriented, displaying overall SIA performance, reasons for nonvaccination and refusal, and monitoring results by VDC

* http://www.who.int/immunization/global_vaccine_action_plan/en and http://apps.who.int/gb/ebwha/pdf_files/wha65/a65_22-en.pdf.

† SIAs generally are carried out using two approaches. An initial, nationwide catch-up SIA targets all children aged 9 months to 14 years; it has the goal of eliminating susceptibility to measles in the general population. Periodic follow-up SIAs then target all children born since the last SIA. Follow-up SIAs are generally conducted nationwide every 2–4 years and usually target children aged 9–59 months; their goal is to eliminate any measles susceptibility that has developed in recent birth cohorts and to protect children who did not respond to the first measles vaccination. The exact age range for follow-up SIAs depends on the age-specific incidence of measles, coverage with 1 dose of measles-containing vaccine, and the time since the last SIA.

§ Each phase targeted a different set of districts. RCM-MP was implemented during the second phase, in February 2016.

¶ https://www.zegeba.com/.

** Low-cost Android phones with adequate functionalities for running the software and transmitting data were used. All phones were provided by the national program. Because of logistical constraints, monitors were not encouraged to use personal phones.

†† Tableau software was used to visualize the incoming data in real-time (http://www.tableau.com/).

**TABLE 1. Rapid convenience monitoring (RCM) indicators visualized in real-time on dashboards* used by national and subnational supervisors for monitoring a measles and rubella vaccination campaign in 10 districts — Nepal, 2016**

| Dashboard type | Indicator | Description/Formulae | Use |
|---|---|---|---|
| Action | Percentage of children vaccinated, aggregated | 100 x children vaccinated/children assessed | Checks performance aggregated over the entire district, region, or country to detect widely underperforming areas and assess overall performance |
| | Reasons cited for nonvaccination | Frequency of each nonvaccination reason cited | Allows supervisors to use the most frequently cited reasons for tailoring which type of action to take in each community or throughout the district or region |
| | Reasons cited for refusal | Frequency of each refusal reason cited | Allows supervisors to use the most frequently cited reasons for tailoring how to address refusal in specific communities |
| | Action trigger | "No Action" if all in-house and out-of-house criteria are met<br>"Action" if any of the criteria failed | Automatically calculates and highlights which communities require additional vaccination activities |
| Monitoring | RCM geographic coverage and clusters of missed households | Plots the Global Positioning System coordinates of all households monitored on a map, color-coded by whether or not they are completely or incompletely vaccinated | Shows where monitoring was done, and areas where monitors may have missed, as well as clusters of nonvaccinated households |
| | RCM reporting completeness | Number of communities reporting and number of reports received per community | Checks whether or not communities are reporting, and whether or not they are submitting the expected number of reports |

* Action dashboard, Nepal: http://ais.paho.org/phip/viz/who_im_nepal5.asp. Monitoring dashboard, Nepal: http://ais.paho.org/phip/viz/who_im_nepal6.asp.

and date of visit. The second dashboard was created to track monitors' activities using a map showing GPS coordinates collected at each household and to display the number of reports received and results found by district (Figure).

In each pilot district, 10 monitors using mobile phones were responsible for two VDCs each. In each VDC, one or two visits were made to complete one in-house and one out-of-house RCM form[§§] during each visit. In total, 100 monitors collected RCM-MP data on 11,093 children in 377 visits in 196 VDCs. Among monitored children, 10,583 (95%) were vaccinated; 159 (42%) of 377 visited areas required remedial action (Table 2). Among the 311 incompletely vaccinated households, the primary reasons for nonvaccination were child absence during an SIA (126 of 311 [41%]) or vaccine refusal (68 of 311 [22%]); the primary reason for vaccine refusal was child being sick (53 of 68 [78%]). Six months after completion of the SIA, no RCM reports had been received at the central level from districts using paper-based RCM. In contrast, 94% (377 of 400) of expected reports were received from 98% (196 of 200) of VDCs where RCM-MP was conducted, and 87% (328 of 377) of these reports were received on the same day the data were collected.

[§§] http://www.who.int/immunization/diseases/measles/SIA-Field-Guide_DRAFT.pdf.

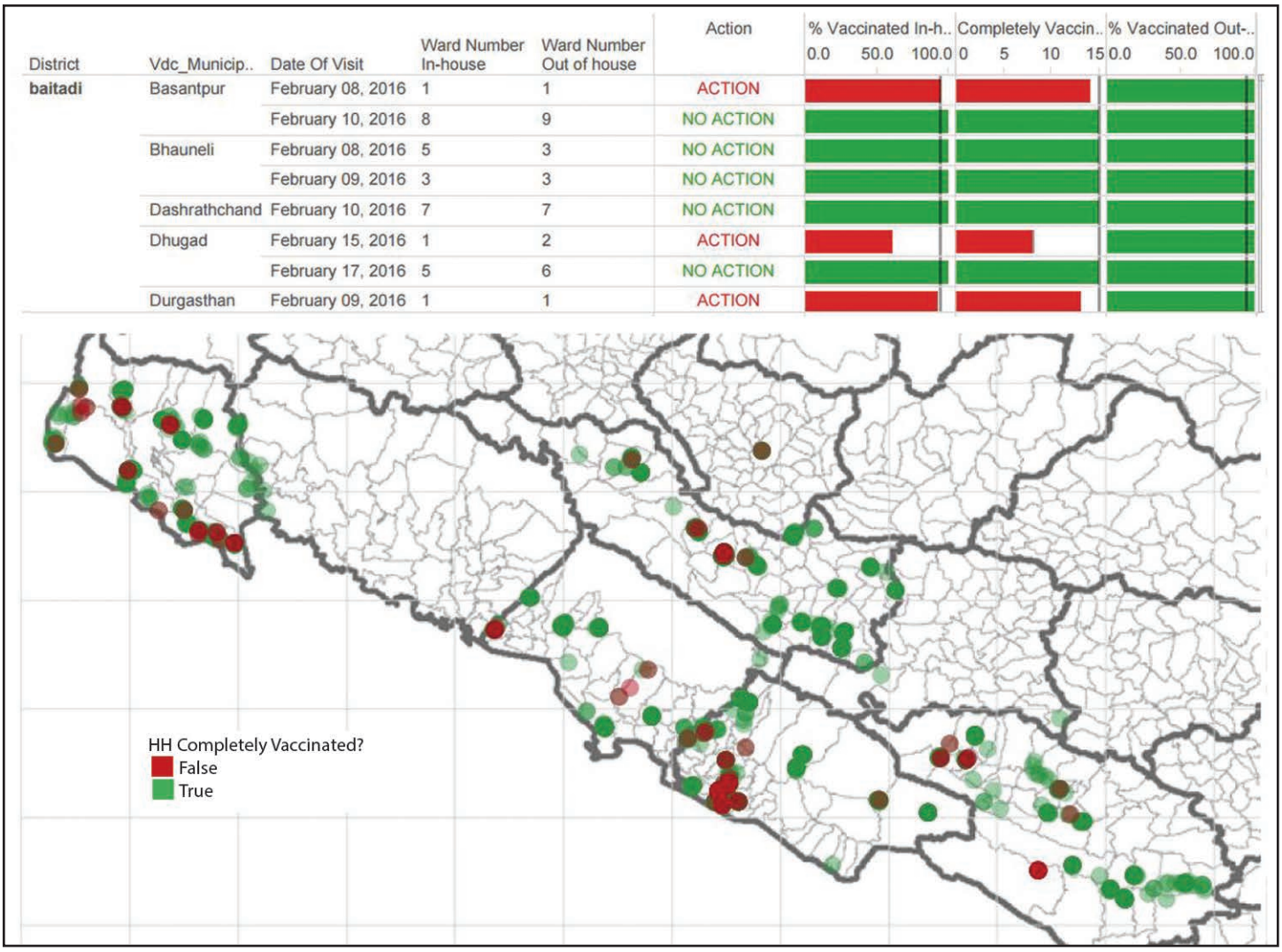
## Assessment of Use of Mobile Phones for RCM

All 100 monitors who used mobile phones, 10 district supervisors, and six national supervisors were asked to respond to a questionnaire about their experience. Completed questionnaires were received from 93 monitors and three district and five national supervisors. Common challenges reported by the monitors were finding and connecting to a third generation (3G) or Wi-Fi network[¶¶] (56 of 93 [60%]) and mistakenly striking incorrect keys (21 of 93 [22%]). Recording GPS location also was a challenge; only 61% (5,730 of 9,425) of expected GPS coordinates were captured. Despite challenges, 64% (54 of 84) of monitors found the mobile technology easy or somewhat easy to use, and 51% (47 of 93) found it easier than paper data collection.[***] Ninety-six percent (78 of 81) of monitors thought that the technology increased data accuracy, and 90% (71 of 79) recommended its future use. Among the three district and five national supervisors, all found the technology helpful or somewhat helpful, and seven

[¶¶] Wi-Fi provides Internet connection for nearby electronic devices, whereas 3G connections can be made anywhere with service coverage for the specific telecommunications network being utilized (https://www.itu.int/osg/spu/ni/3G/technology/index.html).

[***] Denominators varied according to the number of responses. Not all monitors responded to all questions, and monitors also could select more than one response for certain questions.

**FIGURE. Example outputs of real-time online monitoring dashboards used by national and subnational supervisors in 10 districts during a measles-rubella vaccination campaign — Nepal, 2016***




* Top panel shows a portion of the action-oriented dashboard with individual rapid convenience monitoring results. Bottom panel shows Global Positioning System (GPS) coordinates and vaccination status of households monitored. Action dashboard, Nepal: http://ais.paho.org/phip/viz/who_im_nepal5.asp. Monitoring dashboard, Nepal: http://ais.paho.org/phip/viz/who_im_nepal6.asp.

of the eight looked at the dashboard "almost every day" or "every few days." Of the three district supervisors, two reported using the reasons given for nonvaccination to design specific actions, and all three took action in all VDCs requiring remedial action. All five national supervisors reported that the most helpful feature was having data at the central level in a timely manner, and four supervisors reported that tracking monitors' activities through GPS coordinates and automatic analytics in real-time on the dashboard also was useful (Figure). All eight district and national supervisors recommended its future use in campaign settings.

## Discussion

Although the reported SIA administrative coverage was >100%[†††] for the 10 districts included in the pilot study (Table 2), RCM-MP identified a total of 510 (5%) unvaccinated children and 159 (42%) visited areas that needed mop-up vaccination activities. Many unvaccinated children were identified in four districts that reported >100% administrative coverage. The majority of monitors found the mobile

[†††] Administrative coverage is the total number of doses given to the target population, divided by the estimated target population. Values >100% indicate that the intervention reached more persons than the estimated target population.

**TABLE 2. Administrative data* and rapid convenience monitoring (RCM) measles and rubella vaccination campaign data for 10 pilot districts — Nepal, 2016**

| | Administrative data | | RCM data | | |
|---|---|---|---|---|---|
| District | No. in target population | Total vaccinated No. (%) | Total no. of children monitored with mobile phones | Total children vaccinated No. (%) | RCM: action-triggered visited areas No. (%) |
| Baitadi | 27,324 | 27,434 (100.4) | 1,098 | 1,060 (96.5) | 12 (33.3) |
| Banke | 57,244 | 56,008 (97.8) | 1,171 | 1,064 (90.9) | 25 (64.1) |
| Bardiya | 39,487 | 37,388 (94.7) | 882 | 832 (94.3) | 11 (36.7) |
| Dang | 52,505 | 61,669 (117.5) | 1,111 | 1,039 (93.5) | 15 (37.5) |
| Kanchanpur | 57,876 | 55,290 (95.5) | 1,109 | 1,063 (95.9) | 21 (56.8) |
| Kaski | 41,584 | 41,088 (98.8) | 1,079 | 1,005 (93.1) | 21 (53.8) |
| Lamjung | 15,604 | 14,634 (93.8) | 1,161 | 1,126 (97.0) | 17 (40.5) |
| Nawalparasi | 59,745 | 61,670 (103.2) | 1,174 | 1,143 (97.4) | 13 (32.5) |
| Rupandehi | 108,611 | 109,799 (101.1) | 1,140 | 1,108 (97.2) | 13 (38.2) |
| Surkhet | 41,598 | 39,719 (95.5) | 1,168 | 1,143 (97.9) | 11 (27.5) |
| **Total** | **501,578** | **504,699 (100.6)** | **11,093** | **10,583 (95.4)** | **159 (42.2)** |

* Administrative coverage is the total number of doses given to the target population, divided by the estimated target population. Values >100% indicate that the intervention reached more persons than the estimated target population.

technology easy or somewhat easy to use, and about half found it easier to use than paper-based RCM. More than 90% of monitors and all district and national supervisors who completed surveys recommended its future use.

Use of RCM-MP in Nepal resulted in increased reporting timeliness and completeness. The automated calculations and analyses displayed on dashboards eliminated the potential for manual calculation errors, a previous problem with paper-based RCM data (*4*). Mobile data collection provided information more rapidly to higher administrative levels than did paper-based RCM; most RCM results were available on the same day as monitoring. National supervisors cited the rapid availability of data as the most helpful aspect of this technology for ensuring SIA quality.

Timely reporting resulted in better supervision from the national and subnational levels to the VDCs. Aggregated reasons for nonvaccination and refusal were used by supervisors to tailor vaccination strategies and to take immediate actions, which had not been possible with paper-based RCM. However, supervisors pointed out that there was no RCM mechanism for reporting actions taken in the VDCs with unvaccinated children. Therefore, even if supervisors did take action to improve SIA coverage, the status of VDCs initially marked as needing action did not get updated. Future RCM implementation can address this deficiency by including a reporting system for actions taken in poorly performing areas; this change will enable supervisors to monitor follow-up actions routinely and ensure accountability of vaccination teams.

The findings in this report are subject to at least two limitations. First, the selection of VDCs for RCM was purposeful, and convenience sampling was used within VDCs; therefore,


**Summary**

What is already known about this topic?

Rapid convenience monitoring (RCM) has been used for more than 20 years as the primary method for monitoring mass vaccination campaigns. Its effectiveness and contribution to increasing campaign quality has been documented previously. Currently, RCM is implemented using paper reporting systems; however, advancements in information and communications technology make it possible to conduct RCM using mobile phones (RCM-MP).

What is added by this report?

In February 2016, RCM-MP was pilot tested during a measles-rubella vaccination campaign in Nepal. The application of this technology resulted in 87% timeliness and 94% completeness of monitoring data reporting and found that, although 95% of children were vaccinated, 42% of areas required corrective vaccination activities. More than 90% of monitors and all district and national supervisors who responded to the survey recommended its future use. Challenges faced by this method included connecting to mobile networks, small phone screen size, and capturing Global Positioning System coordinates.

What are the implications for public health practice?

Achieving measles and rubella elimination worldwide will be an important milestone in public health, and every effort toward elimination, including vaccination campaigns, should be of high quality and improved with innovations. One way for improving the quality of vaccination campaigns is to optimize the use of mobile phones for monitoring campaign implementation, with faster data transmission, analysis, decision-making, and increased accountability among levels of the health system. While taking into account costs, existing infrastructure, and the availability of resources, the program implemented in Nepal might be used as a model for other countries.

RCM results were not representative of the population and should not be considered as coverage estimates. Second, the impact of RCM-MP on the goal of achieving ≥95% SIA coverage was not quantitatively assessed because of time and resource limitations.

In the RCM-MP pilot, the main challenge to submitting real-time data was difficulty connecting to 3G or Wi-Fi networks. To avoid reliance on 3G coverage, encoding RCM data into text messages is a potential option. However, with expansion of 3G networks of better quality and coverage, it is anticipated that this problem will be overcome. As countries continue to implement campaigns to eliminate measles, rubella, and other vaccine-preventable diseases, the use of mobile phone technology for campaign monitoring might be considered to improve information systems and, ultimately, the quality of campaigns.

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# Update: Interim Guidance for Preconception Counseling and Prevention of Sexual Transmission of Zika Virus for Persons with Possible Zika Virus Exposure — United States, September 2016

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CDC has updated its interim guidance for persons with possible Zika virus exposure who are planning to conceive (*1*) and interim guidance to prevent transmission of Zika virus through sexual contact (*2*), now combined into a single document. Guidance for care for pregnant women with possible Zika virus exposure was previously published (*3*). Possible Zika virus exposure is defined as travel to or residence in an area of active Zika virus transmission (http://www.cdc.gov/zika/geo/index.html), or sex* without a condom† with a partner who traveled to or lived in an area of active transmission. Based on new though limited data, CDC now recommends that all men with possible Zika virus exposure who are considering attempting conception with their partner, regardless of symptom status,§ wait to conceive until at least 6 months after symptom onset (if symptomatic) or last possible Zika virus exposure (if asymptomatic). Recommendations for women planning to conceive remain unchanged: women with possible Zika virus exposure are recommended to wait to conceive until at least 8 weeks after symptom onset (if symptomatic) or last possible Zika virus exposure (if asymptomatic). Couples with possible Zika virus exposure, who are not pregnant and do not plan to become pregnant, who want to minimize their risk for sexual transmission of Zika virus should use a condom or abstain from sex for the same periods for men and women described above. Women of reproductive age who have had or anticipate future Zika virus exposure who do not want to become pregnant should use the most effective contraceptive method that can be used correctly and consistently. These recommendations will be further updated when additional data become available.

* For the purpose of this guidance, sex is specifically defined as vaginal sex (penis-to-vagina sex), anal sex (penis-to-anus sex), oral sex (mouth-to-penis sex or mouth-to-vagina sex), and the sharing of sex toys.

† Condoms include the use of male or female condoms for vaginal or anal sex, male condoms for oral sex (mouth-to-penis), and male condoms cut to create a flat barrier or dental dams for oral sex (mouth-to-vagina).

§ A person is considered symptomatic if one or more signs or symptoms (acute onset of fever, rash, arthralgia, or conjunctivitis) consistent with Zika virus disease is reported. A person is considered asymptomatic if these symptoms are not reported.

## Review of Evidence

Zika virus infection during pregnancy is a cause of congenital microcephaly and serious brain abnormalities (*4*). The risk for adverse pregnancy outcomes associated with maternal Zika virus infection around the time of conception is unknown. To date, there have been no published reports of adverse pregnancy outcomes after periconceptional Zika virus infection. Infections with other viruses (e.g., cytomegalovirus, rubella, parvovirus) around the time of conception have been associated with congenital infection and adverse pregnancy outcomes, although the exact timing of infection relative to conception was sometimes uncertain (*5–9*).

Zika virus is transmitted primarily through the bite of *Aedes aegypti* mosquitoes. Zika virus can also be transmitted through sex without a condom. The risk for sexual transmission of Zika virus from a person infected with Zika virus remains unknown. Most reported sexual transmissions have been from persons with symptomatic Zika virus infections, including from men to female sex partners (*10–12*), from a man to his male sex partner (*13*), and from a woman to her male sex partner (*14*). Two new reports describe one presumed and one more definitive case of sexual transmission from men with asymptomatic Zika virus infection to female sex partners (*15*,*16*). Sexual transmission of Zika virus has been associated with condomless anal sex and vaginal sex and possibly also with fellatio (*17*). Among reported cases of sexually transmitted Zika virus infection, the longest reported period between sexual contact that might have transmitted Zika virus and symptom onset was 32–41 days (based on an incubation period of 3–12 days) (*18*).

Data on the detection of Zika virus RNA in semen can inform estimates of the periods during which sexual transmission might occur. However, detection of Zika virus RNA in semen might not indicate the presence of infectious virus and thus the potential for sexual transmission. Reports indicate that concentrations of detectable Zika virus RNA in semen decrease after infection (*17*,*19–28*). Zika virus RNA was detected in semen of five men more than 90 days after symptom onset,

with the longest period of reported detection 188 days after symptom onset (*20*,*26*,*29*,*30*). Culture is considered the gold standard for demonstrating the presence of replicative and thus infectious virus, and among four published reports of Zika virus cultured from semen, virus was reported in semen up to 69 days after symptom onset (*17*,*19*,*21*,*31*). Culture methods varied in these studies and additional studies are needed to confirm the presence of infectious virus in semen.

New data on the persistence of Zika virus RNA in serum and whole blood might have implications, both for sexual transmission of Zika virus and for fetal exposure to Zika virus. Zika virus RNA has been detected in the serum of nonpregnant persons up to 11–13 days after symptom onset (*32*); in the serum of pregnant women, Zika virus RNA has been detected up to 10 weeks after symptom onset (*33*,*34*). Zika virus RNA was detected in whole blood of a nonpregnant person up to 58 days after symptom onset followed by a negative result at 79 days; however, Zika virus could not be cultured at 58 days (*35*). Experience with other flaviviruses suggests that if a person's immune system has activated an antibody response, viral transmission (i.e., through blood transfusion) is unlikely (*36*). Detection of Zika virus RNA in blood might not indicate the presence of infectious virus, and thus the potential risk for maternal-fetal Zika virus transmission periconceptionally is unknown.

## Guidance for Preconception Counseling and Prevention of Sexual Transmission

CDC is updating its guidance on timing of conception after possible Zika virus exposure and prevention of sexual transmission of Zika virus. CDC continues to evaluate all available evidence and update recommendations as new data become available. Most of the recommendations for preconception counseling and prevention of sexual transmission are dependent on whether persons live in or travel to areas of active Zika virus transmission.[¶] As of September 26, 2016, 59 countries and U.S. territories reported active Zika virus transmission. The Florida Department of Health identified two areas of Miami-Dade County with active local mosquito-borne Zika virus transmission; as of September 20, 2016, only one remains an area of active transmission (*37*). Updates on areas with active Zika virus transmission are available online at http://www.cdc.gov/zika/geo/index.html.

**For Couples Planning to Conceive Who Do Not Live in Areas with Active Zika Virus Transmission.** Health care providers should discuss couples' travel plans in preconception counseling. Women and men who are planning to conceive in the near future should consider avoiding nonessential travel to areas with active Zika virus transmission.

Women who have had possible Zika virus exposure through travel or sexual contact and do not have ongoing risks for exposure should wait at least 8 weeks from symptom onset (if symptomatic) or last possible exposure (if asymptomatic) to attempt conception. Women who wait at least 8 weeks to conceive might have an increased likelihood that Zika virus no longer presents a risk for maternal-fetal transmission.

CDC now recommends that men with possible Zika virus exposure, regardless of symptom status, wait at least 6 months from symptom onset (if symptomatic) or last possible exposure (if asymptomatic) before attempting conception with their partner. CDC previously recommended that men with possible Zika virus exposure who were asymptomatic wait at least 8 weeks from last possible exposure. The updated recommendation minimizes the likelihood that periconceptional sexual transmission will result in fetal exposure to Zika virus. The recommendation to wait at least 6 months for asymptomatic men is based on the range of time after symptom onset that Zika virus RNA has been detected in semen of symptomatic men and the absence of definitive data that the risk for sexual transmission differs between symptomatic and asymptomatic men. Zika virus has not been definitively cultured from semen more than 3 months after symptom onset. It is unknown whether detection of Zika virus RNA in semen indicates presence of infectious virus and the potential for transmission. Current recommendations provide couples planning to conceive with periods that, based on existing data, are expected to minimize risk for Zika virus transmission to an uninfected partner. Studies are underway to better understand the persistence of infectious Zika virus in semen and the associated risk for sexual transmission of the virus. Given that limited data are available, some couples in whom a partner had possible Zika virus exposure might choose to wait longer or shorter than the recommended period to conceive, depending on individual circumstances (e.g., age, fertility, details of possible exposure) and risk tolerance. For example, after consultation with their health care provider, symptomatic persons with negative test results who received testing in the appropriate time window and in accordance with the testing algorithm (*38*) might choose not to wait to conceive.

**For Couples Who Want to Conceive, in Which One or Both Partners Live in Areas with Active Zika Virus Transmission.** Women and men who reside in areas with active Zika virus transmission and who experience symptoms of Zika virus disease should be tested for Zika virus infection (*38*). Men with results that indicate recent Zika virus or unspecified flavivirus infection should wait at least 6 months from symptom

[¶] http://www.cdc.gov/zika/geo/index.html.

onset to attempt conception with their partner; women with results that indicate recent Zika virus or unspecified flavivirus infection should wait at least 8 weeks from symptom onset to attempt conception. Persons who have had symptoms of Zika virus disease with negative Zika virus test results should talk with their health care provider about timing of conception in the setting of ongoing risk for possible exposure.

Persons living in an area with active Zika virus transmission should be counseled on the possible risk for Zika virus infection during the periconception period. CDC has developed tools to assist health care providers with preconception counseling (*39*). Health care providers should provide counseling about the potential consequences to the fetus associated with Zika virus infection during pregnancy, such as microcephaly and other serious brain abnormalities. Women and men should discuss their reproductive life plans** with their health care provider, in the context of potential and ongoing Zika virus exposure. Health care providers should review factors that might influence pregnancy timing (e.g., unknown duration of Zika virus outbreak, fertility, age, reproductive history, medical history, personal values and preferences). For couples who choose to conceive, health care providers should stress use of mosquito bite prevention strategies†† while attempting pregnancy and during pregnancy. Health care providers should counsel couples who decide to wait to attempt conception about strategies to prevent unintended pregnancy, including the most effective contraceptive methods (i.e., long-acting reversible contraception) and provide contraception or referral to appropriate providers for contraception care (*40*).

**Special Considerations for Women Undergoing Fertility Treatment.** Zika virus transmission through assisted reproductive technology has not been reported. However, transmission through gametes or embryos is theoretically possible. Recommendations for sexually intimate couples with Zika virus infection or possible Zika virus exposure undergoing fertility treatment with their own gametes and embryos should follow the testing and timing recommendations as described above; recommendations might need to be adjusted depending on individual circumstances and risk tolerance. The Food and Drug Administration has issued guidance to reduce the risk for Zika virus transmission by donated human cells, tissues, and cellular and tissue-based products, including reproductive tissues (*41*).

**For Couples Who Are Not Pregnant and Are Not Planning to Become Pregnant in the Near Future**. Couples in whom the man or woman has had possible Zika virus exposure who want to maximally reduce their risk for sexually transmitting Zika virus to the uninfected partner should use condoms consistently and correctly or abstain from sex for at least 6 months for men or 8 weeks for women after symptom onset (if symptomatic) or last possible Zika virus exposure (if asymptomatic). Some couples might choose to use condoms or abstain from sex for a shorter or longer period than recommended depending on individual circumstances. Couples should be advised that correct and consistent use of condoms reduces the risk for other sexually transmitted infections.

Health care providers should discuss strategies to prevent unintended pregnancy with couples who do not want to become pregnant. Safety, effectiveness, availability, and acceptability should be considered when choosing a contraceptive method (*42*). Patients should be counseled to use the most effective contraceptive method that can be used correctly and consistently. Long-acting reversible contraception, including contraceptive implants and intrauterine devices, provide highly effective reversible options.

**For Pregnant Women and Their Partners.** Pregnant women living in areas without active Zika virus transmission should be advised to avoid nonessential travel to areas with active transmission. Persons who have traveled to or live in an area with active Zika virus transmission and whose partner is pregnant should be advised to consistently and correctly use condoms during sex or abstain from sex for the duration of the pregnancy. These actions reduce the risk for sexual transmission of Zika virus during pregnancy. Health care providers should ask pregnant women about their own and their sex partner's history of travel to areas with active Zika virus transmission. Pregnant women with possible Zika virus exposure, either through sex or through traveling to or living in an area with active Zika virus transmission, should be tested for Zika virus infection in accordance with CDC's "Updated Interim Pregnancy Guidance: Testing and Interpretation Recommendations for a Pregnant Women with Possible Exposure to Zika Virus" (http://www.cdc.gov/zika/pdfs/testing_algorithm.pdf), including pregnant women with possible sexual exposure whose sex partner has had no symptoms of Zika virus disease. Further guidance for care of pregnant women with possible Zika virus exposure has been published (*3*).

## Zika Virus Testing

Persons with possible Zika virus exposure who have symptoms of Zika virus disease should receive testing in accordance with CDC interim guidance: "Algorithm for U.S. Testing of Symptomatic Individuals" (*38*). CDC does not recommend Zika virus testing of nonpregnant persons with possible Zika virus exposure who do not have symptoms of Zika virus disease, including persons who are planning to attempt conception, or to assess the risk for sexual transmission of Zika virus. Zika virus testing for this purpose remains of uncertain value, because

** http://www.cdc.gov/preconception/reproductiveplan.html.
†† https://www.cdc.gov/zika/prevention/prevent-mosquito-bites.html.

current understanding of the duration and pattern of shedding of Zika virus in reproductive tissues is limited. Information on the performance of serologic Zika virus testing remains limited, with falsely positive tests resulting in avoidable stress and expense and falsely negative tests providing false reassurance and possibly leading to inadvertent fetal exposure to Zika virus.

[1]Zika Response, CDC.

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# Characteristics of Children Aged <18 Years with Zika Virus Disease Acquired Postnatally — U.S. States, January 2015–July 2016

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Zika virus is an emerging mosquito-borne flavivirus that typically causes an asymptomatic infection or mild illness, although infection during pregnancy is a cause of microcephaly and other serious brain abnormalities. Guillain-Barré syndrome and other neurologic complications can occur in adults after Zika virus infection. However, there are few published reports describing postnatally acquired Zika virus disease among children. During January 2015–July 2016, a total of 158 cases of confirmed or probable postnatally acquired Zika virus disease among children aged <18 years were reported to CDC from U.S. states. The median age was 14 years (range = 1 month–17 years), and 88 (56%) were female. Two (1%) patients were hospitalized; none developed Guillain-Barré syndrome, and none died. All reported cases were travel-associated. Overall, 129 (82%) children had rash, 87 (55%) had fever, 45 (29%) had conjunctivitis, and 44 (28%) had arthralgia. Health care providers should consider a diagnosis of Zika virus disease in children who have an epidemiologic risk factor and clinically compatible illness, and should report cases to their state or local health department.

Zika virus is a flavivirus that is primarily transmitted by *Aedes aegypti* mosquitoes (*1*). Most infections are asymptomatic or cause mild illness characterized by signs and symptoms that can include acute fever, maculopapular rash, arthralgia, or nonpurulent conjunctivitis (*2*). Zika virus infection during pregnancy has been associated with fetal loss and is a cause of microcephaly or other brain abnormalities (*3*,*4*). Guillain-Barré syndrome (an autoimmune disorder of the peripheral nervous system), other neurologic manifestations, and thrombocytopenia have been reported following Zika virus infections in adults (*5*,*6*). However, there are few published data on the clinical findings and outcomes of postnatally acquired Zika virus disease among children (*7*). This case series describes the epidemiology, clinical findings, and outcomes in 158 U.S. children with confirmed or probable postnatally acquired Zika virus disease.

For this analysis, Zika virus disease was defined according to the Council of State and Territorial Epidemiologists' (CSTE) interim national surveillance case definitions.* The analysis includes confirmed or probable Zika virus disease cases among children aged <18 years with onset during January 1, 2015–July 31, 2016 and reported from U.S. states and the District of Columbia to ArboNET, CDC's national arboviral disease surveillance system,† as of September 9, 2016. Children living in Puerto Rico and other U.S. territories were not included in this report. Infants with congenital Zika virus infection were excluded.

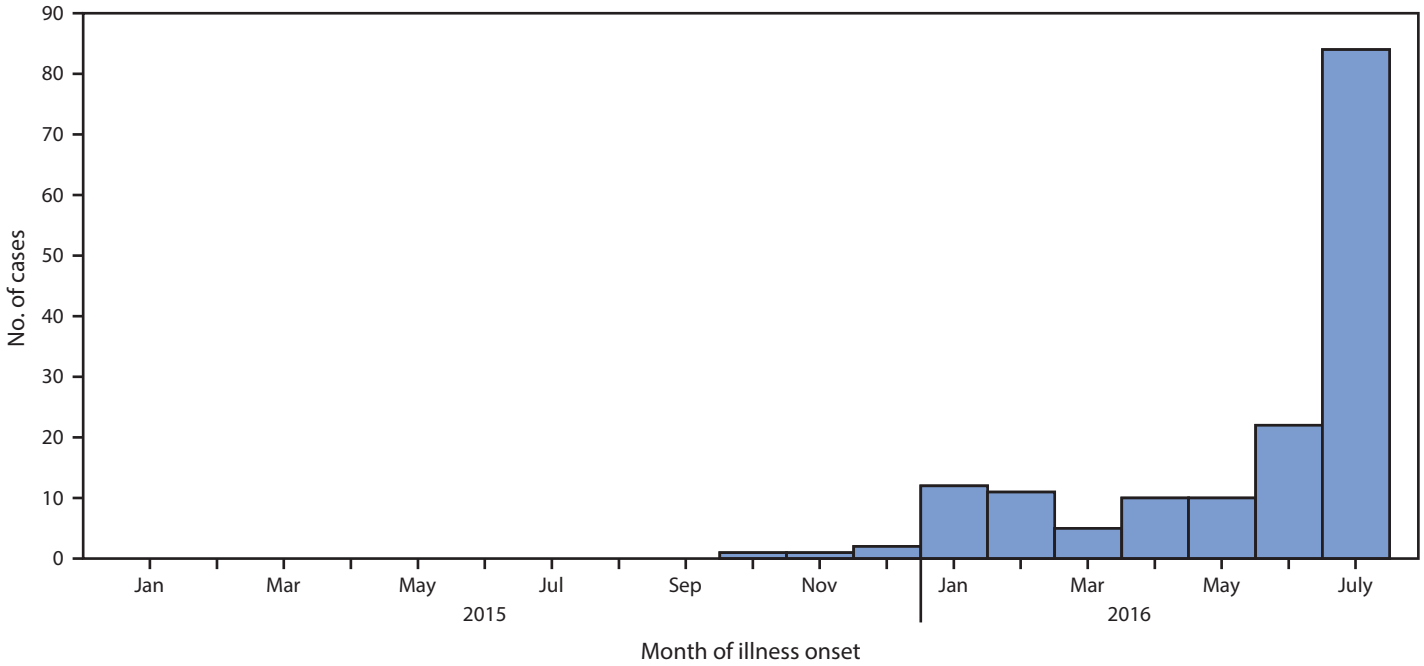
During the study period, 158 confirmed or probable pediatric cases of Zika virus disease were reported from 30 U.S. states. States with the highest numbers of reported cases were Florida (36 [23%]), New York (17 [11%]), and California (15 [9%]); 20 states and the District of Columbia reported no pediatric cases. The first patient reported in this series had onset of symptoms in October 2015; however, 103 (65%) cases occurred during June–July 2016 (Figure). The median patient age was 14 years (range = 1 month–17 years), and 88 (56%) patients were female (Table 1). Forty-two (49%) patients aged 0–14 years and 46 (63%) patients aged 15–17 years were female. Five (3%) patients were pregnant, all of whom were aged 16–17 years. No children were reported to have meningitis, encephalitis, or Guillain-Barré syndrome. Two (1%) children were hospitalized: one child, aged 4 years, was hospitalized for 3 days because of fever, cough, and poor oral intake, and a second child, aged 1 year, was hospitalized overnight for cough and rash. No children with Zika virus disease died. All pediatric patients acquired Zika virus infection during travel to a country or territory with documented local mosquito-borne transmission. The places most frequently visited were the Dominican Republic (39 patients [25%]), Puerto Rico (26 [16%]), Honduras (17 [11%]), Nicaragua (17 [11%]), and Jamaica (14 [9%]).

Of the four primary clinical signs and symptoms included in the case definition, 129 (82%) children had rash, 87 (55%) fever, 45 (29%) conjunctivitis, and 44 (28%) arthralgia (Table 2). Overall, 111 (70%) children had two or more of these four signs and symptoms, including 86 (54%) with both fever and rash; 53 (33%) had three or more of the primary signs or symptoms. There were no significant differences among age groups in the proportion of these four main clinical features reported. Other reported symptoms included headache,

* http://c.ymcdn.com/sites/www.cste.org/resource/resmgr/2016PS/16_ID_01_edited7.29.pdf.

† http://www.cdc.gov/westnile/resources/pdfs/wnvguidelines.pdf.

**FIGURE. Number of cases of confirmed or probable postnatally acquired Zika virus disease (N = 158) in children aged <18 years, by month of illness onset — U.S. states, January 2015–July 2016**




myalgia, vomiting, diarrhea, retro-orbital pain, chills, and sore throat; however, information on each of these symptoms was missing for a large proportion of children.

## Discussion

This series of 158 children with postnatally acquired Zika virus disease corroborates previously published reports suggesting that the clinical course of Zika virus disease is typically mild in children, as it is in adults (*2,7*). In this case series, only two children were hospitalized, and no deaths occurred. Serious complications of Zika virus disease, such as Guillain-Barré syndrome, were not reported for any children in this analysis. However, health care providers should be aware of potential serious consequences of Zika virus disease, including neurologic manifestations, and should notify state health departments of all Zika virus disease cases.

Severe disease following Zika virus infection in children has rarely been reported. Two deaths possibly associated with postnatally acquired Zika virus disease have been reported among children, including a Brazilian girl aged 16 years with possible hemorrhage and a Colombian girl aged 15 years with sickle cell disease who developed severe acute respiratory distress syndrome, hemothorax, and splenic sequestration.[§,¶] Guillain-Barré syndrome and meningoencephalitis also have been reported rarely among children during the recent outbreak in Brazil.[**] No deaths or neurologic complications following Zika virus infection in children were reported after outbreaks in Yap State, Micronesia, or French Polynesia (*2,5*). Further evaluation is needed to determine the incidence of severe disease manifestations, risk factors for more severe illness, and long-term outcomes of postnatally acquired Zika virus infection in children.

Almost half of the pediatric patients with Zika virus disease in this series were aged 15–17 years, with a slight female preponderance. The relatively higher proportion of cases in females and older children might be related to health care–seeking or testing bias (e.g., girls who are or might become pregnant might be more likely to seek care or to be tested) or older children being more likely to travel and thus to be exposed to Zika virus. In addition, clinicians might be less likely to suspect Zika virus infection in younger children, because the signs and symptoms (rash and fever) are nonspecific and similar to those associated with other childhood rash illnesses (e.g., roseola or scarlet fever) or drug reactions.

Compared with symptoms reported for 10 children in previously published case reports or series of Zika virus disease (*7*), the proportion of children in this report with rash was higher and the proportion with fever and gastrointestinal

[§] http://www.paho.org/hq/index.php?option=com_docman&task=doc_download&Itemid=&gid=32405%E2%9F%A8=en.

[¶] http://portalsaude.saude.gov.br/images/pdf/2015/novembro/30/COES-Microcefalias---Informe-Epidemiol--gico---SE-47---30nov2015.pdf.

[**] http://portalsaude.saude.gov.br/images/pdf/2015/dezembro/09/Microcefalia---Protocolo-de-vigil--ncia-e-resposta---vers--o-1----09dez2015-8h.pdf.

**TABLE 1. Characteristics of children aged <18 years with confirmed or probable postnatally acquired Zika virus disease (N = 158) — U.S. states, January 2015–July 2016**

| Characteristic | No. | (%) |
|---|---|---|
| **Age group (yrs)** | | |
| 0–4 | 16 | (10) |
| 5–9 | 29 | (19) |
| 10–14 | 40 | (25) |
| 15–17 | 73 | (46) |
| **Sex** | | |
| Male | 70 | (44) |
| Female | 88 | (56) |
| **Pregnant females** | 5 | (3) |
| **Clinical outcome** | | |
| Hospitalized | 2 | (1) |
| Guillain-Barré syndrome | 0 | — |
| Died | 0 | — |

**TABLE 2. Clinical signs and symptoms in children aged <18 years with confirmed or probable postnatally acquired Zika virus disease (N = 158) — U.S. states, January 2015–July 2016**

| | Yes | | No | | Unknown | |
|---|---|---|---|---|---|---|
| **Sign/Symptom*** | **No.** | **(%)** | **No.** | **(%)** | **No.** | **(%)** |
| Rash | 129 | (82) | 2 | (1) | 27 | (17) |
| Fever | 87 | (55) | 35 | (22) | 36 | (23) |
| Conjunctivitis | 45 | (29) | 35 | (22) | 78 | (49) |
| Arthralgia | 44 | (28) | 33 | (21) | 81 | (51) |

* Some patients had multiple signs, multiple symptoms, or both signs and symptoms.

**Summary**

What is already known about this topic?

Zika virus disease, a mosquito-borne infection, usually causes asymptomatic or mild illness, although congenital infection can result in brain abnormalities, and neurologic manifestations have occurred rarely following infection in adults. However, there are few published reports of postnatally acquired Zika virus disease among children.

What is added by this report?

During January 2015–July 2016, a total of 158 travel-associated confirmed or probable cases of postnatally acquired Zika virus disease among children aged <18 years were reported to CDC from U.S. states. The median age of the patients was 14 years, 88 (56%) were female, and five (3%) were pregnant. Most children with Zika virus disease had rash, and more than half had fever and rash. Two (1%) patients were hospitalized; none had Guillain-Barré syndrome, and none died.

What are the implications for public health practice?

Health care providers should consider a diagnosis of Zika virus disease in children who have an epidemiologic risk factor and clinically compatible illness and should counsel sexually active adolescents regarding the risk for congenital Zika virus infection and prevention of unintended pregnancies. Although Zika virus disease in children is typically mild, health care providers should be aware of the possibility of serious complications, such as neurologic manifestations, and should report all cases of Zika virus disease to their state or local health department.

symptoms was lower. However, this report is population-based and patients met a standard case definition, including clinical, epidemiologic, and laboratory criteria. In contrast, previous reports often identified cases among hospitalized children with febrile illness, the laboratory evidence of Zika virus infection was not always definitive, and some children had evidence of other infections (e.g., malaria and dengue) (*7*). Published reports with aggregate information on symptoms among adults and children with laboratory-confirmed Zika virus disease during a 2007 outbreak in Yap and among adults and children with suspected Zika virus disease during a 2015–2016 outbreak in Colombia found similar overall frequencies of fever and rash as those described in this report (*2,8*). However, higher frequencies of conjunctivitis and arthralgia were described in those reports than in this series, possibly because such symptoms are more commonly identified in adults than children with Zika virus disease, or as a result of the inclusion of patients without laboratory-confirmed Zika virus disease in the Colombia report.

No antiviral medications are available to treat Zika virus infection, but symptomatic treatment with antipyretics and supportive care are appropriate and usually sufficient. Aspirin should never be used to treat symptoms of acute viral illnesses in children because of the risk for Reye syndrome. All nonsteroidal anti-inflammatory drugs (NSAIDs) should be avoided in children aged <6 months. NSAIDs also should be avoided in all other age groups until infection with dengue virus is ruled out, to avoid the potential for hemorrhagic complications of dengue fever (*7*).

Protecting children from mosquito bites is the best way to prevent Zika virus infection in children. However, among sexually active adolescents, there also is a risk for sexual transmission of Zika virus; either mosquito-borne transmission or sexual transmission during pregnancy could result in congenital infection. Five of the travel-associated Zika virus disease cases in this report occurred in adolescents aged 16–17 years who were pregnant, underscoring the importance of ensuring that sexually active adolescents receive guidance for preventing sexual transmission of Zika virus and have access to and counseling on contraception. Pregnant adolescents with possible Zika virus infection should be properly evaluated according to published guidance (*9,10*).

The findings in this report are subject to at least three limitations. First, this series represents only symptomatic cases reported to CDC that met the national confirmed or probable case definition; there likely are other cases of pediatric Zika virus disease that are not reported because the patients did not seek care or were not tested for evidence of recent Zika

virus disease and did not receive a diagnosis. Second, there is potential for testing bias; testing of pregnant women and women of childbearing age has been prioritized (*10*), likely resulting in a disproportionate number of pediatric cases being identified among pregnant adolescents. Third, signs and symptoms of Zika virus infection are optionally reported to ArboNET, often with missing data, which might affect their representativeness; additionally, potential findings such as longer-term neurologic complications are not systematically reported to ArboNET. Nonetheless, this analysis includes the largest series of laboratory-confirmed cases of Zika virus disease among children reported to date.

The symptoms most frequently reported among children with Zika virus disease are common to many childhood illnesses. Health care providers should consider Zika virus disease in the differential diagnosis for children with the acute onset of fever, rash, arthralgia, or conjunctivitis, who reside in or have a history of travel to an area where active Zika virus transmission is occurring, or who have another epidemiologic risk factor for Zika virus disease. Children with suspected Zika virus disease should have blood and urine specimens collected and tested per current guidelines.†† Although Zika virus disease appears to be a mild illness in children, health care providers should report suspected cases to their state or local health department to facilitate diagnosis and mitigate the risk for local transmission. Providers should counsel sexually active adolescents who might be exposed to Zika virus regarding the risk for congenital Zika virus infection and prevention of unintended pregnancies. Guidance for health care providers caring for infants and children with possible postnatally acquired Zika virus disease is available online (http://www.cdc.gov/zika/hc-providers/infants-children.html).

†† http://www.cdc.gov/zika/laboratories/lab-guidance.html.

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# Announcement

## National Bullying Prevention Awareness Month — October 2016

Bullying among youths is defined as any unwanted aggressive behavior by another youth or group of youths who are not siblings or current dating partners and involves an observed or perceived power imbalance, and is repeated multiple times or is highly likely to be repeated (*1*). As a form of youth violence, bullying can include aggression that is physical (hitting or tripping), verbal (name calling or teasing), or relational/social (rumor spreading or leaving out of a group). Electronic aggression, or cyber-bullying, is bullying that occurs through the Internet, cellphone technology, and social media (e.g., e-mail, website, text messaging, posting videos, or pictures) (*2*).

Bullying is widespread in the United States. In 2015, 20% of U.S. high school students reported being bullied on school property, and 16% reported that they had been victims of electronic bullying within the past 12 months (*3*). Youths who are bullied are at increased risk for depression, anxiety, sleep difficulties, and poor school adjustment. Youths who bully others are at increased risk for substance use, academic problems, and violence later in life (*4*).

October is National Bullying Prevention Awareness Month. It is a time when partners collaborate to raise awareness about preventing bullying and identify ways to stop bullying year-round through events, activities, outreach, and education. The ultimate goal of bullying prevention awareness is to prevent bullying before it starts. Some promising school-based bullying prevention program elements include, improving supervision of students, using school rules and behavior management techniques to detect and address bullying, consistently enforcing school-wide anti-bullying policies, and promoting cooperation among different professionals and between school staff and parents (*5*). Additional information is available at http://www.cdc.gov/violenceprevention/youthviolence/bullyingresearch/index.html and http://StopBullying.gov.

### References


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# Announcement

## National Protect Your Hearing Month — October 2016

October is National Protect Your Hearing Month, a time to raise awareness about the causes and prevention of noise-induced hearing loss. Noise-induced hearing loss results from sounds in the environment that are too loud and can damage sensitive structures in the inner ear, even with a brief exposure. This type of hearing loss can result from occupational noise exposures, leisure activities such as sporting events or concerts, or use of personal listening devices. Noise-induced hearing loss is permanent and cannot be reversed (*1*).

Noise-induced hearing loss affects persons of all ages. During 2001–2008, one in five Americans aged ≥12 years, an estimated 48 million persons, had hearing loss in at least one ear, and approximately one in eight (almost 30 million persons) had hearing loss in both ears (*2*). Nearly half of all persons aged 12–35 years in middle- and high-income countries are exposed to unsafe levels of sound from personal listening devices; approximately 40% are exposed to potentially damaging sound levels at clubs, discotheques, and bars (*3*).

The prevalence of hearing loss in the United States is expected to increase as the population ages (*2*), and the cumulative impact of hearing impairment becomes more pronounced among older adults (*2*,*4*). Untreated hearing loss is associated with higher risks for social isolation, depression, dementia, falls with injury, and inability to work, travel, or be physically active (*4*). CDC and other agencies and organizations are focused on the prevention of noise-induced hearing loss, both within the work setting and other environments.

Additional Information to increase awareness about noise-induced hearing loss and promote hearing loss prevention is available at http://www.cdc.gov/nceh/hearing_loss/default.html; http://www.cdc.gov/niosh/topics/noise/; and http://www.cdc.gov/ncbddd/hearingloss/index.html.

### References


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# Notice to Readers

## Update to Reporting of Pneumonia and Influenza Mortality

The current issue of MMWR (week 39) will be the last to include data from the 122 Cities Mortality Reporting System (122 CMRS) in Notifiable Disease and Mortality Tables, Table III ("Deaths in 122 cities" [http://www.cdc.gov/mmwr/volumes/65/wr/mm6539md.htm?s_cid=mm6539md_w#table-17]). Beginning in the publication for the week ending October 8, 2016 (week 40), data from the National Center for Health Statistics (NCHS) Mortality Surveillance System will replace the information reported in Table III, and the 122 Cities Mortality Reporting System (122 CMRS) will be retired. The NCHS Mortality Surveillance System provides improvements in the data, including reports by the week of death and a consistent pneumonia and influenza (P&I) case definition across all sites. These improvements, along with recent and continuing increases in the timeliness of death certificate data, have led CDC to update the P&I mortality surveillance platform from the 122 CMRS to the NCHS Mortality Surveillance System.

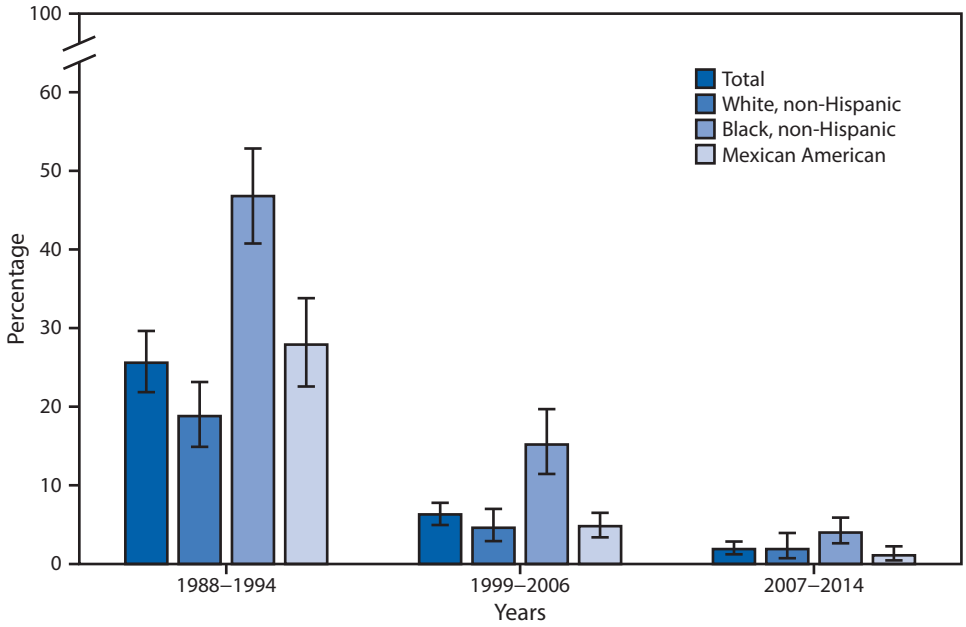
NCHS collects death certificate data from state vital statistics offices for virtually all deaths occurring in the United States. P&I deaths are identified based on *International Classification of Disease, Tenth Revision* multiple cause of death codes. The NCHS Mortality Surveillance System data will be presented by the week the death occurred. The percentage of deaths attributed to P&I on a national level will be released 2 weeks after the week of death to allow for collection of enough data to produce a stable percentage. Table III will present NCHS Mortality Surveillance System data by state and region with the 2-week lag, and areas with less than 20% of the expected total deaths will be marked as insufficient data. However, collection of complete data is not expected at the time of initial report, and the level of completeness will not likely be sufficient to calculate a reliable percentage of deaths attributed to P&I at the U.S. Department of Health and Human Services region* or state level within this 2-week period. The data for earlier weeks are continually revised, and the proportion of deaths attributed to P&I might increase or decrease as new and updated death certificate data are received by NCHS. The most recent data can be found online (https://data.cdc.gov), and historical data from both NCHS and 122 CMRS also will be available at that site.

* The 10 U.S. Department of Health and Human Services regions consist of the following jurisdictions. *Region 1:* Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont; *Region 2:* New Jersey, New York, and New York City; *Region 3*: Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, and West Virginia; *Region 4:* Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee; *Region 5:* Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin; *Region 6:* Arkansas, Louisiana, New Mexico, Oklahoma, and Texas; *Region 7:* Iowa, Kansas, Missouri, and Nebraska; *Region 8:* Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming; *Region 9:* Arizona, California, Hawaii, and Nevada; *Region 10:* Alaska, Idaho, Oregon, and Washington.

# QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

## Percentage* of Children Aged 1–5 Years with Elevated Blood Lead Levels,† by Race/Ethnicity§ — National Health and Nutrition Examination Survey, United States, 1988–1994, 1999–2006, and 2007–2014




* With 95% confidence intervals represented by error bars.
† CDC currently uses ≥5 μg/dL as a reference level to identify children with elevated blood lead levels (http://www.cdc.gov/nceh/lead/ACCLPP/Final_Document_030712.pdf).
§ Totals include data for racial/ethnic groups not shown separately.

From 1988–1994 to 2007–2014, the percentage of children aged 1–5 years with blood lead levels ≥5 μg/dL declined from 25.6% to 1.9%. Blood lead levels fell dramatically for all racial and ethnic groups. Despite the decline, in 2007–2014, non-Hispanic black children (4.0%) aged 1–5 years were twice as likely as non-Hispanic white children (1.9%) and more than three times as likely as Mexican American children (1.1%) to have elevated blood lead levels.

**Source:** The National Health and Nutrition Examination Survey; http://www.cdc.gov/nchs/nhanes/index.htm.

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