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# Trends in Reported Babesiosis Cases — United States, 2011–2019

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Babesiosis is a tickborne disease caused by intraerythrocytic *Babesia* parasites. In the United States, most babesiosis cases are caused by *Babesia microti*, transmitted from bites of black-legged ticks, *Ixodes scapularis,* in northeastern and midwestern states. Transmission can also occur through blood transfusions, transplantation of organs from infected donors, or congenital (mother-to-child) transmission (*1*). *Babesia* infection can be asymptomatic or cause mild to severe illness that can be fatal. Overall, U.S. tickborne disease cases have increased 25%, from 40,795 reported in 2011 to 50,856 in 2019 (*2*). Babesiosis trends were assessed in 10 states* where babesiosis was reportable during 2011–2019. Incidence increased significantly in Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont ($p<0.001$), with the largest increases reported in Vermont (1,602%, from two to 34 cases), Maine (1,422%, from nine to 138), New Hampshire (372%, from 13 to 78), and Connecticut (338%, from 74 to 328). Unlike the other seven states, Maine, New Hampshire, and Vermont, were not included as states with endemic disease in previous CDC babesiosis surveillance summaries. These three states should now be considered to have endemic transmission comparable to that in other high-incidence states; they have consistently identified newly acquired cases every year during 2011–2019 and documented presence of *Babesia microti* in the associated tick vector (*3*). Because incidence in Northeastern states, including Maine, New Hampshire, and Vermont, is increasing, tick prevention messaging, provider education, and awareness of infection risk among travelers to these states should be emphasized.

Babesiosis can cause illness ranging from asymptomatic or mild to severe; the disease can be fatal, particularly among persons who are immunocompromised or asplenic. Common symptoms include fever, muscle and joint pain, and headache. In certain patients, severe complications can occur, including thrombocytopenia, renal failure, and acute respiratory distress syndrome (*1*). Babesiosis can be treated using a combination of antimicrobial medications, such as azithromycin and atovaquone (*2*).

The first case of human babesiosis acquired in the United States was identified in 1969 on Nantucket Island, Massachusetts (*4*). In 2011, babesiosis became a nationally notifiable condition. Where babesiosis is reportable, cases are reported to CDC by state health departments. Until now, CDC considered babesiosis to be endemic in seven states: Connecticut, Massachusetts, Minnesota, New Jersey, New York, Rhode Island, and Wisconsin (*5*). In 2019, the U.S. Food and Drug Administration (FDA) recommended screening blood donations for *Babesia* in states where residents were

* Connecticut, Maine, Massachusetts, Minnesota, New Hampshire, New Jersey, New York, Rhode Island, Vermont, and Wisconsin.

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considered to be at high risk for *Babesia* infection. As a result, FDA recommended blood donation screening in the following 15 states or jurisdictions: Connecticut, Delaware, Maine, Maryland, Massachusetts, Minnesota, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virginia, Wisconsin, and the District of Columbia (*6*).

Previous studies have examined babesiosis transmission and found increasing case counts or rates in particular geographic areas, such as New York (*7*) in previous years (2011–2015) (*4*) and among specific populations, such as those enrolled in Medicare (*8*). The current study identifies trends in babesiosis in the United States during 2011–2019 and highlights establishment of endemic transmission in new geographic areas. Tracking babesiosis transmission over time provides important data to monitor the transmission risk in areas with and without endemic disease.

This analysis used data from the previously described national babesiosis surveillance system (*4*). These data included reported cases from the 41 states where babesiosis was reportable during 2011–2019 (*5*); data reported by the state of New York and New York City were merged and are referred to as New York. Trends were tracked over time by including in the analysis all states that met the following criteria: 1) data were submitted for the entire analytic time span (2011–2019), and 2) 10 or more babesiosis cases were reported for ≥2 consecutive years. Using these criteria, case data reported by Connecticut, Maine, Massachusetts, Minnesota, New Hampshire, New Jersey, New York, Rhode Island, Vermont, and Wisconsin were included. Yearly incidence and overall percent rate change from 2011 to 2019 were calculated for each state. State babesiosis rates were modeled with Poisson regression. An overall model was fit, controlling for state, with year of diagnosis as a continuous variable. State-level models were also fit, controlling for event year (symptom onset or laboratory diagnosis date) as a continuous variable. The natural logarithm of the state's census population for each year was used in the offset (a variable used when data are recorded over an observed period) to control for state population. All analyses were conducted using SAS (version 9.4, SAS Institute). This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[†]

During 2011–2019, a total of 16,456 cases of babesiosis were reported to CDC by 37 states, including 16,174 (98.2%) reported from the 10 states included in this analysis (Figure). New York reported the largest number of cases (4,738 total; average = 526.4 per year), followed by Massachusetts (4,136; 459.6), and Connecticut (2,200; 244.4). The lowest numbers of cases were reported in Vermont (114; 12.7) and New Hampshire (340; 37.8). Incidences ranged from 0.32 per 100,000 population in Vermont in 2011 to 18.0 in Rhode Island in 2015 (Table). The three states with the highest

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

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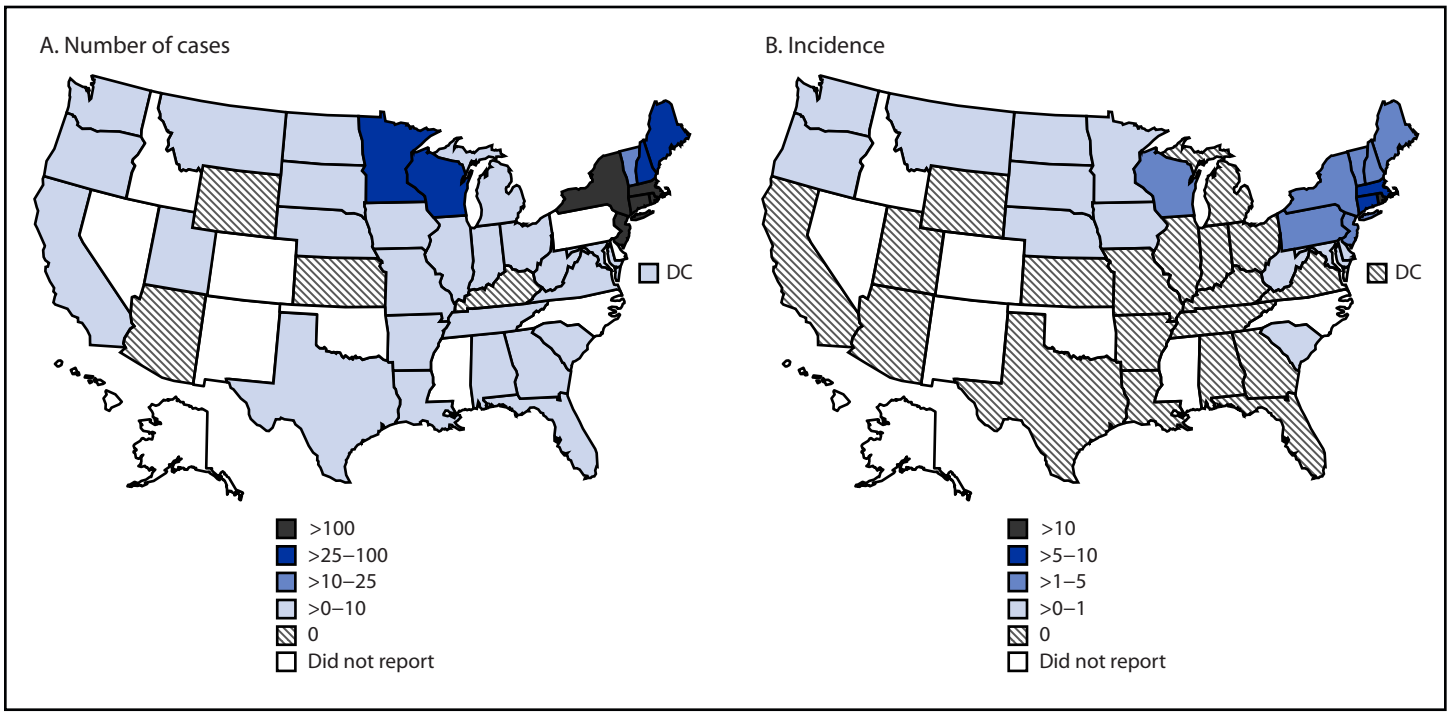
**FIGURE. Average number of reported babesiosis cases (A)* and average babesiosis incidence (B),† by state — United States, 2011–2019**




**Abbreviation:** DC = District of Columbia.
* Cases classified by state of residence (16,456).
† Cases per 100,000 population.

**TABLE. Reported babesiosis cases and incidence, by year — 10 states,* 2011–2019**

| State*,† | Total no. of cases reported | Average annual case count (range) | Incidence§ (no. of cases) 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | Average annual incidence (range) | Total 9-yr incidence change, % | p-value¶ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Connecticut | **2,200** | 244.4 (74–328) | 2.1 (74) | 3.4 (123) | 7.5 (268) | 5.7 (205) | 9.1 (328) | 9.0 (322) | 8.6 (309) | 6.9 (248) | 9.0 (323) | 6.8 (2.1–9.1) | **338.4** | <0.001 |
| Maine | **591** | 65.7 (9–138) | 0.7 (9) | 0.8 (10) | 2.7 (36) | 3.2 (42) | 4.1 (55) | 6.2 (82) | 8.8 (118) | 7.5 (101) | 10.3 (138) | 4.9 (0.7–10.3) | **1,421.6** | <0.001 |
| Massachusetts | **4,136** | 459.6 (208–636) | 3.1 (208) | 3.9 (261) | 6.2 (417) | 7.9 (535) | 6.5 (444) | 7.6 (517) | 8.6 (591) | 7.6 (527) | 9.2 (636) | 6.7 (3.1–9.2) | **193.0** | <0.001 |
| Minnesota | **486** | 54.0 (41–73) | 1.4 (73) | 0.8 (41) | 1.2 (64) | 0.9 (49) | 0.8 (45) | 0.9 (50) | 1.1 (60) | 0.9 (49) | 1.0 (55) | 1.0 (0.8–1.4) | **−28.2** | 0.176 |
| New Hampshire | **340** | 37.8 (13–78) | 1.0 (13) | 1.4 (19) | 1.7 (22) | 3.2 (42) | 4.0 (53) | 1.0 (13) | 5.8 (78) | 2.7 (37) | 4.6 (63) | 2.8 (1.0–5.8) | **371.5** | <0.001 |
| New Jersey | **1,719** | 191.0 (92–247) | 1.9 (166) | 1.0 (92) | 1.9 (171) | 1.8 (159) | 3.1 (281) | 1.9 (174) | 2.1 (193) | 2.8 (247) | 2.6 (236) | 2.1 (1.0–3.1) | **40.9** | <0.001 |
| New York | **4,738** | 526.4 (253–696) | 2.1 (418) | 1.3 (253) | 2.7 (534) | 2.4 (471) | 2.9 (581) | 2.2 (430) | 3.5 (696) | 3.3 (641) | 3.4 (663) | 2.7 (1.3–3.5) | **58.3** | <0.001 |
| Rhode Island | **1,272** | 141.3 (56–190) | 6.9 (73) | 5.3 (56) | 13.5 (142) | 16.3 (172) | 18.0 (190) | 14.7 (155) | 15.2 (161) | 15.6 (165) | 14.9 (158) | 13.4 (5.3–18.0) | **115.7** | <0.001 |
| Vermont | **114** | 12.7 (2–34) | 0.3 (2) | 0.3 (2) | 1.0 (6) | 0.5 (3) | 1.4 (9) | 2.4 (15) | 3.5 (22) | 3.4 (21) | 5.4 (34) | 2.0 (0.3–5.4) | **1,601.8** | <0.001 |
| Wisconsin | **578** | 64.2 (43–88) | 1.4 (80) | 0.8 (45) | 1.3 (76) | 0.7 (43) | 1.0 (56) | 1.2 (68) | 1.5 (88) | 1.1 (64) | 1.0 (58) | 1.1 (0.7–1.5) | **−28.9** | 0.892 |

* Babesiosis is not a reportable condition by law in the following states: Alaska, Colorado, Hawaii, Idaho, Mississippi, Nevada, New Mexico, North Carolina, Oklahoma, and Pennsylvania.
† The following states or jurisdictions did not meet inclusion criteria for the analysis (cases reported all years during 2011–2019 and ≥10 cases per year for ≥2 years): Alabama, Arizona, Arkansas, California, Delaware, District of Columbia, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Michigan, Missouri, Montana, Nebraska, North Dakota, Ohio, Oregon, South Carolina, South Dakota, Tennessee, Texas, Utah, Virginia, Washington, West Virginia, and Wyoming.
§ Cases per 100,000 population.
¶ P-values calculated using Poisson regression for each state, controlling for year and state.

reported incidences were Rhode Island (18.0 per 100,000 population in 2015), Maine (10.3 in 2019), and Massachusetts (9.1 in 2019).

Vermont, Maine, and New Hampshire experienced the largest percent change in incidence between 2011 and 2019. Vermont reported two cases in 2011 (incidence = 0.3 per 100,000 population) and 34 cases in 2019 (5.4), representing a 1,602% increase in incidence. Maine reported nine cases in 2011 (0.7) and 138 cases in 2019 (10.3), a 1,422% rate increase. Reported cases in New Hampshire increased from 13 in 2011 (1.0) to 63 in 2019 (4.6), a 372% rate increase. Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont reported significant changes in annual babesiosis incidence. Annual incidence did not change significantly in Minnesota and Wisconsin. Incidence trended upward in Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont, whereas incidence in Minnesota and Wisconsin remained stable.

**Summary**

What is already known about this topic?

Babesiosis is an emerging zoonotic tickborne parasitic disease in the United States and occurs primarily in the Northeast and Midwest.

What is added by this report?

During 2011–2019, U.S. babesiosis incidence significantly increased in northeastern states. Three states (Maine, New Hampshire, and Vermont) that were not considered to have endemic babesiosis had significantly increasing incidences and reported case counts similar to or higher than those in the seven states with known endemic transmission.

What are the implications for public health practice?

As case rates rise in multiple states, tick prevention messaging, provider education, and traveler risk awareness should be emphasized.

## Discussion

Monitoring patterns of disease over time is critical to understanding regional changes in infection risk. Clinicians can use knowledge about current infection risk to aid in patient diagnoses, and public health authorities can base prevention activities on risk. Increasing babesiosis case counts and incidences have been documented in other smaller scale studies (*4*,*7*,*8*), but this report is the first comprehensive national surveillance assessment and multistate analysis of babesiosis over time. During 2011–2019, babesiosis incidence significantly increased in states with endemic transmission, as well as in certain neighboring states. Connecticut, Massachusetts, and New York reported the largest numbers of cases as well as significantly increasing incidences. The highest incidences have been reported from Rhode Island (18.0 cases per 100,000 population), Maine (10.3), and Massachusetts (9.2). Reported case counts in Maine, New Hampshire, and Vermont were similar to or higher than those in states previously identified as having endemic babesiosis, and annual incidences in these states have increased significantly.

Because case counts and rates have increased, clinicians need to be aware of the signs and symptoms of and risk factors for babesiosis in their practice areas, particularly as other tickborne conditions can have similar clinical manifestations, risk for disease acquisition, and geographic distribution (*1*). This awareness applies to states bordering those with endemic disease, where increased case counts and infection rates have been documented. Low numbers of cases have been reported from areas where no, or rare, sporadic cases of babesiosis had been reported, including the Canadian provinces of Manitoba and Ontario (*9*) as well as Delaware, Illinois, Iowa, Maryland, North Dakota, Ohio, South Dakota, Virginia, and West Virginia (*5*).

The expansion of babesiosis risk could have implications for the blood supply. *Babesia* is transmissible via blood transfusion, and persons who acquire babesiosis through contaminated blood have been shown to have significantly worse health outcomes and a higher risk for death than do those who acquire the disease from a tick bite (*1*). Currently, the FDA recommends blood donation screening for babesiosis in 14 states and the District of Columbia (*6*). Babesiosis risk in Maine, New Hampshire, and Vermont is comparable to that in the northeastern and midwestern states where babesiosis has been considered endemic, and FDA guidance recommends blood donor screening for *Babesia* infection in those states (*6*). Ongoing evaluation of both tickborne and transfusion transmission risks in states that border those with endemic transmission is important for the evaluation and evolution of babesiosis blood screening policy.

The parasite *B. microti* has been identified in ticks within Maine, New Hampshire, and Vermont (*3*). Based on the increasing numbers of cases, trends in rates, and the parasite's presence in ticks within the states, CDC now considers babesiosis to be endemic in these states.

The findings in this report are subject to at least three limitations. First, babesiosis is not reportable in all states; for example, although transmission of *B. microti* has been documented in Pennsylvania, babesiosis is not a reportable condition in that state (*6*,*10*). Second, these data probably do not represent all incident cases of babesiosis in reporting states. Patients with nonspecific symptoms might not be tested for babesiosis. Finally, cases are reported by the patient's state of residence and might not always reflect the location where transmission occurred.

Members of the public and health care providers in states with endemic babesiosis and bordering states should be aware of the clinical signs of babesiosis and risk factors for *Babesia* infection. Persons spending time outdoors in states with endemic babesiosis should practice tick bite prevention, including wearing long pants, avoiding underbrush and long grass, and using tick repellents.

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# Emergency Department Visits by Incarcerated Adults for Nonfatal Injuries — United States, 2010–2019

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During 2010–2019, U.S. correctional authorities held 1.4–1.6 million persons in state and federal prisons annually, and 10.3–12.9 million persons were admitted to local jails each year (*1*,*2*). Incarcerated persons experience a disproportionate burden of negative health outcomes, including unintentional and violence-related injuries (*3*,*4*). No national studies on injury-related emergency department (ED) visits by incarcerated persons have been conducted, but a previous study demonstrated a high rate of such visits among a Seattle, Washington jail population (*5*). To examine nonfatal injury-related ED visits among incarcerated adults, CDC analyzed 2010–2019 National Electronic Injury Surveillance System–All Injury Program (NEISS-AIP) data. During 2010–2019, an estimated 733,547 ED visits by incarcerated adults occurred in the United States. The proportion of ED visits resulting from assault* and self-harm among incarcerated adults was five times as high as those among nonincarcerated adults. Among incarcerated adults, men and adult persons aged <65 years had the highest proportion of assault-related ED visits. Falls accounted for the most ED visits among incarcerated adults aged ≥65 years. A higher proportion of ED visits by incarcerated women than incarcerated men were for overdose or poisoning. These findings suggest that injuries among incarcerated adults differ from those among nonincarcerated adults and might require development and implementation of age- and sex-specific prevention strategies for this population.

NEISS-AIP collects data on patients treated in EDs for nonfatal injuries from a nationally representative, stratified probability sample of hospitals.† Data are weighted by the inverse probability of selection to provide annual national estimates. A visit by an incarcerated person was defined as an ED visit by a person aged ≥18 years who was transported to an ED from a jail or prison for an injury.§ A visit by a nonincarcerated person was defined as an ED visit by any other persons aged ≥18 years. Data include a narrative summarizing the circumstances of each visit written by a trained data abstractor. Specific terms within narratives were used to identify visits by incarcerated persons.¶ An iterative process was used to improve identification of visits by incarcerated persons through manual review of a sample of narratives by two authors to ensure that selected visits met the case definition and to identify additional terms.

The weighted number of ED visits among incarcerated and nonincarcerated adults were calculated using SAS-callable SUDAAN (version 11.0.1; RTI International). Visits were stratified by patient sex, age group, injury intent, mechanism of injury,** and disposition,†† and the proportion of visits with these characteristics was calculated separately for incarcerated and nonincarcerated adults. Ratio of proportions (RPs) with 95% CIs were calculated to compare ED visits by incarcerated and nonincarcerated adults. Rao-Scott chi-square tests were used to calculate p-values, and p-values <0.05 were considered statistically significant. SUDAAN Rlogist procedure was used to estimate RPs with 95% CIs by sex and age group among incarcerated adults. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.§§

During 2010–2019, an estimated 733,547 ED visits by incarcerated adults and 211,497,918 by nonincarcerated adults occurred in the United States (Table 1). Compared with ED visits among nonincarcerated adults, a higher proportion of ED visits among incarcerated adults were among men (83.7% versus 50.9%) and adults aged <45 years (77.1% versus 51.0%). The proportion of visits due to assault and self-harm was about

* Assault was defined as assault or legal intervention.

† https://www.cpsc.gov/s3fs-public/2001d010-6b6.pdf

§ ED visits among persons brought in by law enforcement before being booked in a jail or prison (e.g., immediately after arrest) or among persons who sustained an injury during detention-associated transportation were excluded from the case definition. Only persons brought directly to the ED from either a prison or a jail were included in this analysis. Injuries could have been sustained before incarceration. Occupational injuries were removed to exclude staff members injured while working in jails or prisons and were removed from nonincarcerated cases for consistency.

¶ "Jail," "prison," "corrections," "correctional," "incarcerate," "incarcerated," "incarceration," "convict," "inmate," "detention," "detain," "detainee," "detained," and "police cell," were used for inclusion, and other relevant search terms such as "custody," "custody dispute," "cell phone," and "cellulitis" were used to help identify cases for exclusion.

** Injuries were categorized by intent (unintentional/undetermined, assault/legal intervention, or self-harm). Injuries were also categorized by mechanism of injury (fall, cut/pierce, struck by/against an object, inhalation/suffocation, overdose/poisoning, fire/burn, or other). Other includes injuries related to motor vehicles (occupant, motorcyclist, pedal cyclist, pedestrian, and other transport, which includes traffic-related, non–traffic-related, and unknown transportation injuries), overexertion, drowning/submersion, machinery, foreign body, dog bite, other bite/sting, firearm gunshot, bb/pellet gunshot, natural/environmental, other specified, and unknown/unspecified.

†† Disposition was categorized as treated and released, transferred to another hospital or hospitalized, or other. Other includes patients who left without being seen, left against medical advice, were held for observation, or had unknown disposition.

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

five times as high among incarcerated adults (34.6% and 9.1%, respectively) than among nonincarcerated adults (6.5% and 1.9%, respectively). The most common mechanism of injury among incarcerated adults with an ED visit was being struck by or against an object (44.0%); among nonincarcerated adults, this mechanism accounted for 14.7% of ED visit injuries. The most common mechanisms of injury among nonincarcerated adults with an ED visit were "other" mechanisms (e.g., transportation-related injuries and drowning) (41.0%). A higher proportion of ED visits by incarcerated adults resulted in hospitalization or transfer to another hospital (17.3%) than did ED visits by nonincarcerated adults (13.2%).

Among incarcerated adults, the mechanism of injury for ED visits differed by age group (Table 2). When compared with ED visits by incarcerated adults aged ≥65 years, a higher proportion of ED visits by those aged 18–24 years resulted from being struck by or against an object or being cut or pierced, and a lower proportion of visits resulted from a fall. A higher proportion of ED visits by incarcerated adults aged 18–24 years was attributable to assault or self-harm compared with those by incarcerated adults aged ≥65 years. A lower proportion of ED visits in this youngest age group resulted in hospitalization or transfer to another hospital.

Reasons for ED visits by incarcerated adults also differed by sex (Table 3). Compared with ED visits by incarcerated men, a lower proportion of visits by incarcerated women resulted from being struck by or against an object, and a higher proportion were for fall-related injuries and overdose or poisoning. The proportion of ED visits attributable to assault by incarcerated women (20.0%) was lower than that by incarcerated men (37.4%).

## Discussion

During the study period, an estimated 750,000 ED visits by incarcerated adults and >200 million by nonincarcerated adults occurred. The proportion of ED visits for assault and self-harm was five times as high among incarcerated adults than among nonincarcerated adults. A higher proportion of ED visits by incarcerated adults resulted from being struck by or against an object, compared with ED visits by nonincarcerated adults. Among incarcerated adults with injury-related ED visits, there were differences in injury mechanisms by age group and by sex. This study is the first to present national

**TABLE 1. Estimated number of nonfatal injury-related emergency department visits among incarcerated and nonincarcerated adults — National Electronic Injury Surveillance System–All Injury Program, United States, 2010–2019**

| | Incarcerated | | Nonincarcerated | | | |
|---|---|---|---|---|---|---|
| Characteristic | No.* | % (95% CI) | No. | % (95% CI) | RP† | p-value |
| **Total** | **733,547** | — | **211,497,918** | — | — | — |
| **Sex** | | | | | | |
| Men | 614,174 | 83.7 (78.9–88.5) | 107,723,904 | 50.9 (48.9–53.0) | 1.64 | <0.001 |
| Women | 119,373 | 16.3 (11.5–21.1) | 103,771,368 | 49.1 (47.0–51.1) | 0.33 | <0.001 |
| **Age group, yrs** | | | | | | |
| 18–24 | 146,858 | 20.0 (17.4–22.7) | 33,850,167 | 16.0 (15.0–17.0) | 1.25 | 0.004 |
| 25–34 | 261,062 | 35.6 (33.7–37.5) | 41,261,154 | 19.5 (18.6–20.4) | 1.82 | <0.001 |
| 35–44 | 158,055 | 21.5 (20.2–22.9) | 32,846,662 | 15.5 (14.9–16.2) | 1.39 | <0.001 |
| 45–54 | 95,325 | 13.0 (11.7–14.3) | 33,670,314 | 15.9 (15.1–16.7) | 0.82 | <0.001 |
| 55–64 | 46,951 | 6.4 (5.1–7.7) | 26,762,203 | 12.7 (12.4–12.9) | 0.51 | <0.001 |
| ≥65 | 25,296 | 3.4 (2.2–4.7) | 43,107,418 | 20.4 (17.8–23.0) | 0.17 | <0.001 |
| **Injury intent** | | | | | | |
| Unintentional or undetermined | 413,518 | 56.4 (51.5–61.3) | 193,843,811 | 91.7 (90.0–93.3) | 0.62 | <0.001 |
| Assault | 253,561 | 34.6 (29.2–39.9) | 13,733,851 | 6.5 (4.9–8.1) | 5.32 | <0.001 |
| Self-harm | 66,468 | 9.1 (7.1–11.0) | 3,920,256 | 1.9 (1.6–2.2) | 4.89 | <0.001 |
| **Mechanism of injury** | | | | | | |
| Struck by or against an object | 323,085 | 44.0 (38.7–49.4) | 31,057,444 | 14.7 (13.6–15.7) | 3.00 | <0.001 |
| Other | 149,666 | 20.4 (17.3–23.5) | 86,763,946 | 41.0 (39.1–42.9) | 0.50 | <0.001 |
| Fall | 145,096 | 19.8 (17.4–22.2) | 62,093,113 | 29.4 (27.1–31.6) | 0.67 | <0.001 |
| Overdose or poisoning | 56,319 | 7.7 (5.7–9.7) | 14,602,531 | 6.9 (5.9–7.9) | 1.11 | 0.388 |
| Cut or pierce | 48,405 | 6.6 (5.2–8.0) | 14,359,137 | 6.8 (6.3–7.3) | 0.97 | 0.814 |
| Inhalation or suffocation | 6,881 | 0.9 (0.5–1.3) | 400,448 | 0.2 (0.1–0.2) | 4.96 | <0.001 |
| Fire or burn | 4,096 | 0.6 (0.4–0.7) | 2,221,300 | 1.1 (1.0–1.1) | 0.53 | <0.001 |
| **Disposition** | | | | | | |
| Treated and released | 585,293 | 79.8 (76.4–83.2) | 176,024,926 | 83.3 (80.0–86.7) | 0.96 | 0.053 |
| Transferred or hospitalized | 126,702 | 17.3 (13.8–20.8) | 27,899,796 | 13.2 (11.4–15.1) | 1.31 | <0.001 |
| Other (AMA/LWBS, Unk, or observation) | 21,552 | 2.9 (1.3–4.6) | 7,308,060 | 3.5 (0.7–6.2) | 0.85 | 0.393 |

**Abbreviations:** AMA = against medical advice; LWBS = left without being seen; RP = ratio of proportions; Unk = unknown.
* Numbers are weighted.
† The nonincarcerated sample was used as the referent group for this analysis.

estimates of nonfatal injury-related ED visits by incarcerated adults in the United States.

A majority of ED visits among incarcerated adults were made by men and persons aged ≤45 years, likely reflecting the makeup of the incarcerated population (*1*,*2*). However, because older adults are the fastest growing segment of prison populations (*6*,*7*), it is notable that a higher proportion of ED visits for unintentional injuries, including falls, and a higher proportion of ED visits resulting in hospitalization occurred among incarcerated adults aged ≥65 years than occurred among younger incarcerated adults. A higher proportion of ED visits among incarcerated women were related to poisoning and falls, and a lower proportion were related to assault than were those by incarcerated men. These findings illustrate the importance of age- and sex-specific injury prevention strategies for incarcerated adults.

Approximately 50,000 assaults occurring within public correctional facilities are reported annually (*7*). Persons aged ≥18 years detained in jails were twice as likely to die by suicide in 2019 compared with persons in the overall U.S. adult population (*8*). The higher proportion of assault- and self-harm–related ED visits among incarcerated persons, particularly among younger adults and men, points to the need for the development and implementation of violence and suicide prevention strategies that consider the intersectional factors related to incarceration.

The findings in this report are subject to at least five limitations. First, there are differences in health care access for incarcerated persons, which might partially explain the observed differences. For example, some correctional facilities have the capacity to provide health care on-site, and therefore, a subset of injuries among incarcerated adults might not be represented in these findings. The decision to seek ED care is made by authorities rather than patients, which could affect the types of ED visits made by incarcerated persons and be biased toward more serious injuries. Second, it is unclear how the proximity of NEISS-AIP–participating hospitals to correctional facilities affects national estimates presented in this study.

**TABLE 2. Characteristics of nonfatal injury-related emergency department visits among incarcerated adults, by age group — National Electronic Injury Surveillance System–All Injury Program, United States, 2010–2019**

| | Age group, yrs | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 18–24 | | 25–34 | | 35–44 | | 45–54 | | 55–64 | | ≥65 | |
| Characteristic | % (95% CI) | RP (95% CI) | % (95% CI) | RP (95% CI) | % (95% CI) | RP (95% CI) | % (95% CI) | RP (95% CI) | % (95% CI) | RP (95% CI) | % (95% CI) | RP (95% CI) |
| **Injury intent** | | | | | | | | | | | | |
| Unintentional or undetermined | 51.6 (46.6–56.6) | 0.6* (0.6–0.6) | 52.6 (47.3–57.9) | 0.6* (0.6–0.7) | 54.8 (50.8–58.9) | 0.6* (0.6–0.7) | 63.7 (57.6–69.8) | 0.8* (0.7–0.8) | 66.2 (58.6–73.8) | 0.8* (0.7–0.8) | 86.6 80.0–93.2) | Ref |
| Assault | 39.1 (33.1–45.1) | 3.1* (2.2–4.4) | 36.3 (29.9–42.6) | 2.9* (2.1–4.1) | 35.3 (30.9–39.7) | 2.8* (2.0–4.0) | 30.3 (24.8–35.7) | 2.4* (1.7–3.4) | 29.0 (21.4–36.7) | 2.3* (1.6–3.3) | 12.6 (5.8–19.4) | Ref |
| Self-harm | 9.3 (6.8–11.9) | 11.5* (3.3–40.3) | 11.1 (7.9–14.3) | 13.7* (4.0–47.6) | 9.9 (7.2–12.5) | 12.2* (3.5–42.4) | 6.0 (4.7–7.4) | 7.5* (2.1–26.4) | 4.8 (2.9–6.7) | 5.9* (1.6–21.7) | —† | Ref |
| **Mechanism of injury** | | | | | | | | | | | | |
| Struck by or against an object | 51.8 (45.5–58.1) | 2.7* (2.0–3.5) | 45.8 (39.7–52.0) | 2.4* (1.8–3.5) | 43.4 (38.5–48.4) | 2.2* (1.7–2.9) | 37.7 (32.6–42.8) | 1.9* (1.5–2.5) | 38.0 (31.3–44.7) | 2.0* (1.5–2.6) | 19.5 (12.2–26.8) | Ref |
| Other | 18.3 (14.9–21.7) | 1.0 (0.8–1.3) | 21.0 (17.4–24.7) | 1.2 (0.9–1.5) | 21.6 (18.3–25.0) | 1.2 (0.9–1.6) | 21.6 (17.3–25.9) | 1.2 (0.9–1.6) | 18.0 (12.5–23.4) | 1.0 (0.7–1.4) | 18.4 (13.4–23.3) | Ref |
| Fall | 14.2 (12.2–16.2) | 0.3* (0.2–0.3) | 16.3 (13.4–19.3) | 0.3* (0.3–0.4) | 18.8 (16.5–21.0) | 0.4* (0.3–0.4) | 23.9 (19.9–27.8) | 0.5* (0.4–0.5) | 33.5 (27.2–39.7) | 0.6* (0.5–0.7) | 53.6 (43.5–63.7) | Ref |
| Overdose or poisoning | 7.8 (4.6–11.0) | 1.4 (0.8–2.5) | 7.3 (5.0–9.6) | 1.4 (0.8–2.3) | 7.8 (5.6–10.1) | 1.5 (0.8–2.5) | 9.7 (7.0–12.5) | 1.8* (1.0–3.2) | 5.9 (3.1–8.7) | 1.1 (0.6–2.0) | — | Ref |
| Cut or pierce | 6.7 (5.0–8.4) | 3.5* (1.5–8.1) | 7.9 (5.7–10.2) | 4.2* (1.8–9.5) | 6.8 (5.1–8.6) | 3.6* (1.6–8.3) | 5.1 (3.6–6.7) | 2.7* (1.2–6.4) | 3.5 (1.8–5.2) | 1.9 (0.7–4.7) | — | Ref |
| Inhalation or suffocation | — | — | — | — | 1.1 (0.5–1.7) | 3.3 (0.4–24.3) | — | — | — | — | — | Ref |
| Fire or burn | — | — | 0.6 (0.3–1.0) | 0.7 (0.2–2.9) | — | — | — | — | — | — | — | Ref |
| **Disposition** | | | | | | | | | | | | |
| Treated and released | 86.7 (83.8–89.5) | 1.2* (1.1–1.3) | 80.3 (76.6–84.0) | 1.1* (1.0–1.2) | 79.3 (75.0–83.7) | 1.1 (1.0–1.2) | 74.5 (69.3–79.8) | 1.0 (0.9–1.1) | 70.3 (65.4–75.2) | 0.9 (0.9–1.0) | 74.7 (68.1–81.3) | Ref |
| Transferred or hospitalized | 10.5 (8.3–12.7) | 0.5* (0.3–0.6) | 16.5 (12.8–20.2) | 0.7* (0.6–0.9) | 18.3 (13.7–22.9) | 0.8* (0.6–1.0) | 21.6 (16.6–26.6) | 0.9 (0.7–1.2) | 27.2 (22.3–32.0) | 1.2 (0.9–1.5) | 23.7 (16.8–30.5) | Ref |
| Other (AMA/LWBS, Unk, or observation) | — | — | — | — | — | — | 3.9 (1.8–5.9) | 2.4 (1.0–6.0) | — | — | — | Ref |

**Abbreviations:** AMA = against medical advice; LWBS = left without being seen; Ref = referent group; RP = ratio of proportions; Unk = unknown.

* Statistically significant at p<0.05.

† Dashes indicate that values were suppressed because of one of the following criteria: small sample size (<20 cases), a weighted estimate <1,200, or a coefficient of variation >30%.

Third, classification of incarcerated status was based on text narratives written by NEISS-AIP data abstractors, which might have led to misclassification of incarceration status. Fourth, it was not possible to determine when the injury occurred for incarcerated cases; therefore, data include injuries that could have occurred before incarceration. Finally, data on race and ethnicity were not presented because these data in NEISS-AIP are incomplete; however, U.S. Department of Justice statistics consistently demonstrate that Black or African American men are disproportionately overrepresented in the correctional system *(1,2)* stemming from upstream factors, particularly structural racism (*9*), and are therefore likely overrepresented in these data.

Nearly one in every 100 persons in the United States is in a prison or jail (*10*), and this study found that characteristics of ED visits by incarcerated adults differ from those by nonincarcerated adults. These differences suggest that setting-appropriate risk-prevention strategies that account for the conditions experienced while incarcerated could help prevent injuries among incarcerated persons. Increased availability of community- and facility-level resources for comprehensive mental health services and creating protective environments could help mitigate the risk for self-harm and violence associated with incarceration. CDC has created technical packages and resources that outline evidence-based strategies for communities for preventing suicide,[¶¶] interpersonal and community violence,[***] overdose,[†††] and falls[§§§]; tailoring these strategies and developing interventions for the jail and prison setting with age-appropriate and sex-specific recommendations might reduce injuries and ED visits in this population.


**Summary**

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

Incarcerated adults experience disproportionate negative health outcomes compared with the general adult population, including unintentional and violence-related injuries.

**What is added by this report?**

The proportion of nonfatal injury-related emergency department (ED) visits by incarcerated adults resulting from assault or self-harm was five times as high as those among nonincarcerated adults. Among incarcerated adults, men and persons aged <65 years had the highest proportions of assault-related ED visits. Falls accounted for the most ED visits among incarcerated adults aged ≥65 years. A higher proportion of ED visits by incarcerated women than incarcerated men was for overdose or poisoning.

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

Tailoring injury prevention efforts for incarcerated adults with age- and sex-specific strategies might reduce injuries and ED visits in this population.


**TABLE 3. Characteristics of nonfatal injury-related emergency department visits among incarcerated adults, by sex — National Electronic Injury Surveillance System–All Injury Program, United States, 2010–2019**

| | Men | | Women | |
|---|---|---|---|---|
| **Characteristic** | **% (95% CI)** | **RP** | **% (95% CI)** | **RP** |
| **Injury intent** | | | | |
| Unintentional or undetermined | 53.5 (48.8–58.1) | Ref | 71.3 (68.0–74.7) | 1.3* (1.3–1.4) |
| Assault | 37.4 (32.0–42.8) | Ref | 20.0 (17.4–22.6) | 0.5* (0.5–0.6) |
| Self–harm | 9.1 (6.8–11.4) | Ref | 8.7 (6.4–11.0) | 1.0 (0.8–1.2) |
| **Mechanism of injury** | | | | |
| Struck by or against an object | 46.6 (40.9–52.2) | Ref | 31.1 (27.8–34.5) | 0.7* (0.6–0.7) |
| Other | 19.1 (16.0–22.1) | Ref | 27.2 (23.8–30.6) | 1.4* (1.3–1.6) |
| Fall | 19.0 (16.7–21.3) | Ref | 23.8 (18.9–28.7) | 1.3* (1.1–1.4) |
| Overdose or poisoning | 7.1 (4.9–9.3) | Ref | 10.7 (8.0–13.5) | 1.5* (1.3–1.8) |
| Cut or pierce | 6.9 (5.2–8.6) | Ref | 5.2 (3.7–6.8) | 0.8* (0.6–1.0) |
| Inhalation or suffocation | 0.9 (0.5–1.4) | Ref | —† | — |
| Fire or burn | 0.5 (0.4–0.6) | Ref | — | — |
| **Disposition** | | | | |
| Treated or released | 79.5 (75.8–83.2) | Ref | 81.4 (78.1–84.6) | 1.0 (1.0–1.1) |
| Transferred or hospitalized | 17.8 (13.9–21.6) | Ref | 14.8 (11.9–17.7) | 0.8* (0.7–1.0) |
| Other (AMA/LWBS, Unk, or observation) | 2.8 (1.2–4.4) | Ref | 3.8 (1.8–5.8) | 1.4* (1.0–1.9) |

**Abbreviations:** AMA = against medical advice; LWBS = left without being seen; Ref = referent group; RP = ratio of proportions; Unk = unknown.
* Statistically significant at p<0.05.
† Dashes indicate that values were suppressed because of either small sample size (<20 cases) or a weighted estimate <1,200.

¶¶ https://www.cdc.gov/violenceprevention/communicationresources/pub/technical-packages.html; https://www.cdc.gov/suicide/pdf/suicideTechnicalPackage.pdf
*** https://www.cdc.gov/violenceprevention/communityviolence/index.html; https://www.cdc.gov/violenceprevention/communityviolence/prevention.html
††† https://www.cdc.gov/drugoverdose/strategies/index.html
§§§ https://www.cdc.gov/falls/programs/community_prevention.html


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# School-Based Interventions to Increase Student COVID-19 Vaccination Coverage in Public School Populations with Low Coverage — Seattle, Washington, December 2021–June 2022

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COVID-19 can lead to severe outcomes in children (*1*). Vaccination decreases risk for COVID-19 illness, severe disease, and death (*2*). On December 13, 2020, CDC recommended COVID-19 vaccination for persons aged ≥16 years, with expansion on May 12, 2021, to children and adolescents (children) aged 12–15 years, and on November 2, 2021, to children aged 5–11 years (*3*). As of March 8, 2023, COVID-19 vaccination coverage among school-aged children remained low nationwide, with 61.7% of children aged 12–17 years and approximately one third (32.7%) of those aged 5–11 years having completed the primary series (*3*). Intention to receive COVID-19 vaccine and vaccination coverage vary by demographic characteristics, including race and ethnicity and socioeconomic status (*4–6*). Seattle Public Schools (SPS) implemented a program to increase COVID-19 vaccination coverage during the 2021–22 school year, focusing on children aged 5–11 years during November 2021–June 2022, with an added focus on populations with low vaccine coverage during January 2022–June 2022.† The program included strategic messaging, school-located vaccination clinics, and school-led community engagement. Vaccination data from the Washington State Immunization Information System (WAIIS) were analyzed to examine disparities in COVID-19 vaccination by demographic and school characteristics and trends over time. In December 2021, 56.5% of all SPS students, 33.7% of children aged 5–11 years, and 81.3% of children aged 12–18 years had completed a COVID-19 primary vaccination series. By June 2022, overall series completion had increased to 80.3% and was 74.0% and 86.6% among children aged 5–11 years and 12–18 years, respectively. School-led vaccination programs can leverage community partnerships and relationships with families to improve COVID-19 vaccine access and coverage.

With support from local and state public health officials, SPS conducted school-located vaccination clinics at 54 schools during November 2021–June 2022. WAIIS provides monthly reports on school-required and COVID-19 vaccination coverage to SPS; these data are then linked to school system data. WAIIS data were analyzed to ascertain the monthly proportion of kindergarten through grade 12 students completing the primary COVID-19 vaccination§ series during December 2021–June 2022. The proportions of students completing the primary series were examined by age, race and ethnicity,¶ language status (monolingual versus multilingual),** use of special education services,†† school equity tier,§§ and school baseline vaccination coverage,¶¶ with January 2022 serving as a baseline for assessing subsequent activities to engage groups with low vaccination coverage. Qualitative and descriptive data regarding efforts by SPS to increase primary COVID-19 vaccination series completion during November 2021–June 2022 were also informally collected from approximately 10 SPS staff members and representatives of the Washington Department of Health and Public Health – Seattle & King County (PHSKC) via virtual meetings and e-mail. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.***

* These senior authors contributed equally to this report.

† CDC recommended COVID-19 vaccination for persons aged ≥16 years on December 13, 2020, for children aged 12–15 years on May 12, 2021, and for children aged 5–11 years on November 2, 2021. Booster doses for children aged 12–17 years were recommended in October 2021, and booster doses for children aged 5–11 years were recommended on May 19, 2022. During the period described, SPS focused efforts on children aged 5–11 years to maximize primary series vaccination coverage in that age group, although booster doses were available, advertised, and encouraged as well.

§ Defined as having completed the primary series of a COVID-19 vaccine approved or authorized by the Food and Drug Administration or listed for emergency use by the World Health Organization.

¶ Defined by student self-report or caregiver report at time of school registration.

** Language status as monolingual or multilingual learner; multilingual learners were defined as those using English language learning (ELL) services during the 2021–22 school year. Students using ELL services spoke a variety of other languages at home or as a first language, including Amharic, Arabic, Cantonese, Japanese, Mandarin, Oromo, Russian, Somali, Soninke, Spanish, Tigrinya, Toishanese, and Vietnamese.

†† Having an individual education plan during the 2021–22 school year.

§§ School equity tier defined using established SPS methodology. Tier 1 and Tier 2 schools represent higher levels of inequity and are designated for additional support from the state; Tier 3 and Tier 4 schools have lower levels of inequity and do not qualify for additional support. https://www.seattleschools.org/wp-content/uploads/2022/02/tier_methodology23.pdf

¶¶ The proportion of a school's students who had completed the primary series by the first week of January 2022. SPS school health staff members defined schools with low vaccination coverage as those with a student primary COVID-19 vaccination series completion rate of ≤50%; high-coverage schools were those with a completion rate of >50%.

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

SPS serves approximately 50,000 students in 106 schools (Table 1). In December 2021, primary COVID-19 vaccination series completion among SPS students aged 5–18 years was 56.5% overall (Figure) and was lowest among students who were non-Hispanic Black or African American (Black) (27.9%) and multilingual (30.0%). During November–December 2021, 55 school-located vaccination clinics were held, with planning led by SPS and supported by PHSKC. These clinics included school day clinics, where children received immunizations with written parental consent but without requiring that a parent be present, and school-located regional clinics during evening or weekend hours. School-day clinics were strategically located at 41 schools selected because of size or known barriers to care.[†††] COVID-19 vaccines were also readily available at 29 PHSKC-supported school-based health centers that provide comprehensive primary care to their students.

By January 2022, primary COVID-19 vaccination series completion among SPS students aged 5–18 years had increased from 56.5% to 71.5%. After receipt of school-level student vaccination data in early January 2022, efforts during January–June 2022 focused on schools with continued low (baseline) vaccination coverage. Overall, 26 school-located vaccination clinics were conducted, including 19 during January–March 2022 that were in or near low-coverage schools (i.e., those with primary COVID-19 vaccine series completion rates of ≤50%). These clinics took place after school hours or on the weekend and were open to all SPS students and their family members. SPS administered 12,245 COVID-19 vaccine doses during November 2021–June 2022.

School-located vaccination clinics were complemented by strategies implemented to overcome cultural and linguistic barriers with families. For example, SPS conducted weekly communication with families, including email, telephone calls delivering prerecorded messages, and text messaging using TalkingPoints, a two-way communication platform that provided messaging in six languages.[§§§] SPS also provided communications toolkits created by PHSKC in multiple languages to parent-teacher-student associations and community-based organizations to amplify messaging. Vaccine providers were selected based on their cultural competency (e.g., an independent, Black-owned pharmacy with vaccinators with facility in several African languages).

**TABLE 1. Sociodemographic and school-specific characteristics of Seattle Public Schools students — Seattle, Washington, December 2021**

| Characteristic | No. (%) |
|---|---|
| **Total** | **50,864 (100.0)** |
| **Age group, yrs** | |
| 5–11 | 26,341 (51.8) |
| 12–18 | 24,097 (47.4) |
| **Race and ethnicity*** | |
| American Indian or Alaska Native, non-Hispanic | 196 (0.4) |
| Asian, non-Hispanic | 6,385 (12.6) |
| Black or African American, non-Hispanic | 7,460 (14.7) |
| Pacific Islander, non-Hispanic | 208 (0.4) |
| White, non-Hispanic | 23,453 (46.1) |
| Hispanic or Latino | 6,806 (13.4) |
| Multiracial, non-Hispanic | 6,339 (12.5) |
| **Language status†** | |
| Monolingual | 44,177 (86.9) |
| Multilingual | 6,670 (13.1) |
| **Use of special education services§** | |
| No | 43,141 (84.8) |
| Yes | 7,706 (15.2) |
| **School baseline vaccination coverage¶** | |
| Low (<50%; 27 schools) | 7,272 (14.3) |
| High (≥50%; 79 schools) | 43,592 (85.7) |
| **School equity tier**** | |
| Tiers 1 and 2 (low equity) | 17,510 (34.4) |
| Tiers 3 and 4 (high equity) | 32,764 (64.4) |

**Abbreviations:** ELL = English language learner; SPS = Seattle Public Schools.

* Race and ethnicity were based on U.S. Department of Education descriptors. Final guidance on maintaining, collecting, and reporting racial and ethnic data to the U.S. Department of Education is available at https://www.govinfo.gov/content/pkg/FR-2007-10-19/pdf/E7-20613.pdf. If the ethnicity aggregate is Hispanic or Latino, race and ethnicity is listed as Hispanic or Latino. If the ethnicity aggregate is non-Hispanic and one race category is selected, student is listed as that race. If two or more race categories are selected, student is listed as multiracial.

† Language status was either multilingual, defined as student use of ELL services during the 2021–22 school year, or monolingual, with no use of ELL services in 2021–22.

§ Use of special education services was defined as use of an individual education plan during the 2021–22 school year.

¶ Defined as the proportion of a school's students who had completed the primary COVID-19 vaccine series by the first week of January 2022. SPS school health staff members determined in January 2022 that low-coverage schools were those with a student completion rate of ≤50%, and high vaccination coverage schools were those with a completion rate of >50%.

** School equity tiers were defined as either high levels of inequity (Tier 1 or Tier 2) or low levels of inequity (Tier 3 and Tier 4), based on established SPS methodology. https://www.seattleschools.org/wp-content/uploads/2022/02/tier_methodology23.pdf

Tailored school-specific engagements were also conducted. One school used multilingual staff members from its school-based health center to administer vaccines at students' homes or workplaces if necessary, thereby extending vaccination access beyond the school day. This school increased COVID-19 primary series completion among persons aged 11–21 years from 45% in January 2022 to 93% by June 2022. Another worked with a community health organization to organize health-related events focused on the Somali community and cohosted a school-located vaccination clinic with a local mosque. Each school used different approaches; however, all relied on school health staff members for direct family outreach.

††† Prioritized schools included those with >500 students, Equity Tier 1–3 schools, schools with programs for medically fragile students and with deaf and hard of hearing students, and schools whose students had less access to other large-scale vaccination opportunities.

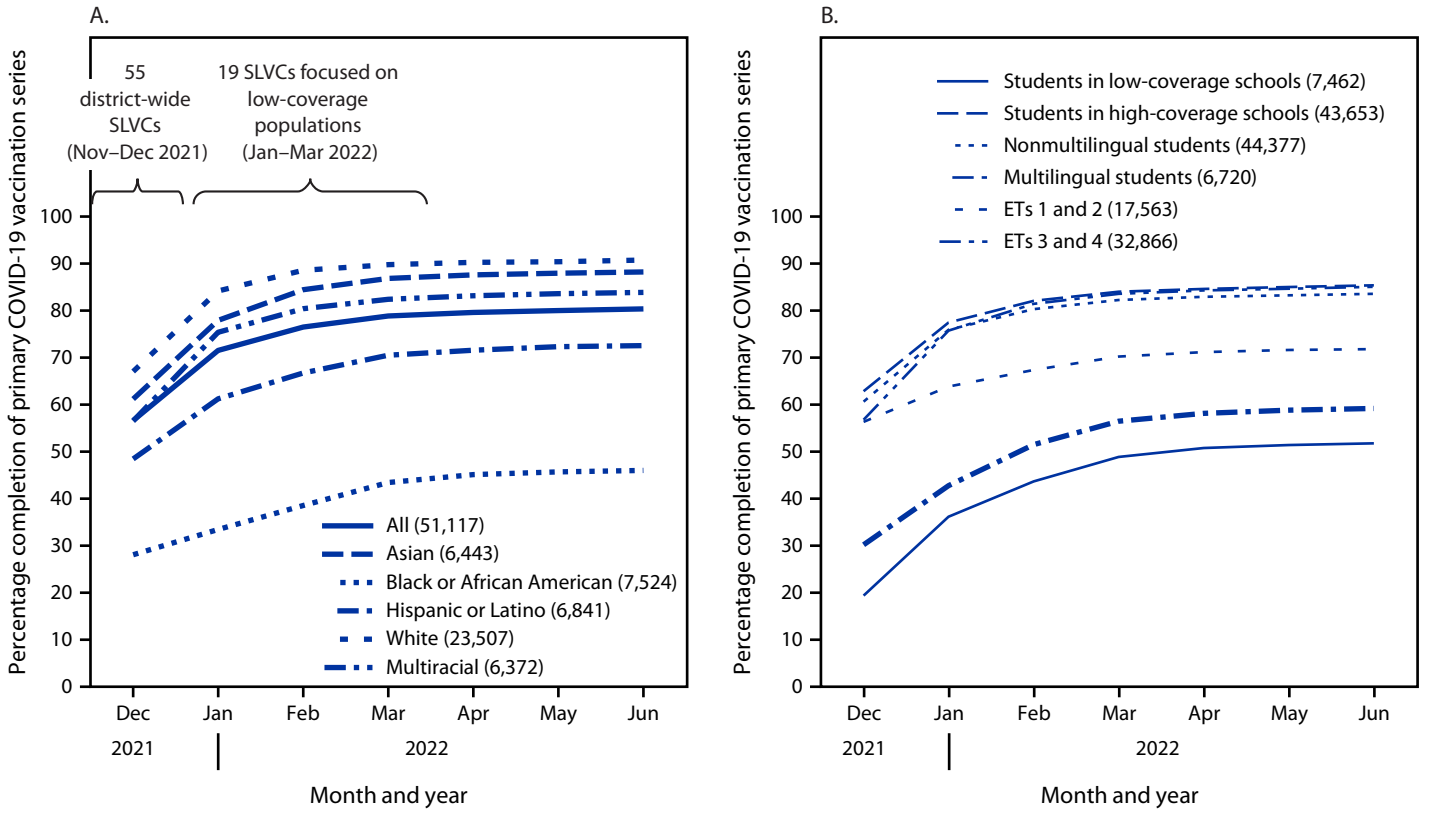
§§§ TalkingPoints is a two-way multilingual communication platform for schools and families. SPS uses this platform to engage with families in multiple languages (Amharic, English, Mandarin, Somali, Spanish, and Vietnamese) about school-related issues, including school-located vaccination clinics for COVID-19 vaccine. https://talkingpts.org/schools

During the period in which SPS specifically focused on students and schools with low baseline vaccination coverage, primary COVID-19 vaccination series completion among SPS students increased 12.3%, from 71.5% in January 2022, to 80.3% by June 2022; among children aged 5–11 years and 12–18 years, coverage increased 21.3% and 3.6%, respectively (Table 2). Primary series completion increased 37.8% among Black students (from 33.3% to 45.9%), 121.8% (from 13.5% to 29.9%) among those aged 5–11 years, and 14.8% (from 53.6% to 61.5%) among those aged 12–18 years. During the same period among multilingual students, overall primary series completion increased 38.7% (from 42.6% to 59.1%), 74.6% (from 28.9% to 50.4%) and 10.6% (from 65.7% to 72.3%) among those aged 5–11 and 12–18 years, respectively. Primary series completion among students at schools with low baseline vaccination coverage also increased, from 36.0% to 51.7% (43.4% increase) overall, from 34.8% to 51.1% (46.9% increase) among students aged 5–11 years, and from 51.9% to 58.5% (11.5% increase) among those aged 12–18 years.

## Discussion

These data illustrate the potential impact of active school-based engagement on COVID-19 primary vaccination coverage among students. During the evaluation period, primary series completion in Washington among children aged 5–17 years (42.6%) was similar to national coverage in June 2022 (43.4%) (*3*,*6*). Primary series completion among children aged 5–17 years was higher in Seattle and King County (62.2%) than state-wide (42.6%); however, vaccination coverage among children aged 5–18 years in SPS (80.3%) exceeded this completion rate as well (*7*). Focused engagements during January–June 2022 to improve vaccination coverage might have contributed to high primary series completion among children attending SPS schools. Approaches included improved access via school-located vaccination clinics, outreach by school health professionals, and multimodal, multilingual communication from SPS. Coverage among all subgroups with low coverage in January 2022 significantly increased

**FIGURE. Completion of the primary COVID-19 vaccination series by students aged 5–18 years, by race and ethnicity* (A) and school coverage status,† student language status, and equity tier§ (B) — Seattle Public Schools, December 2021–June 2022**




**Abbreviations:** ET = equity tier; SLVC = school-located vaccination clinic.

* Hispanic or Latino students could be of any race; other racial groups were non-Hispanic. American Indian or Alaska Native students (215), Native Hawaiian or other Pacific Islander students (197), and students with missing race and ethnicity data (18) are excluded from figure.

† Low- and high-coverage schools have primary COVID-19 series completion rates of ≤50% and >50%, respectively.

§ Tier 1 and Tier 2 schools represent higher levels of inequity and are designated for additional support from the state; Tier 3 and Tier 4 schools have lower levels of inequity and do not qualify for additional support. https://www.seattleschools.org/wp-content/uploads/2022/02/tier_methodology23.pdf

**TABLE 2. Rates, absolute change, and proportional change in COVID-19 primary vaccination series completion among students aged 5–18 years, by age group, race and ethnicity, and equity tier* — Seattle Public Schools, January–June 2022**

| Category (average no.† of students per category) | % Completion Jan 2022 | % Completion Jun 2022 | Absolute % change Jan–Jun 2022 (95% CI)§ | % Change¶ Jan–Jun 2022 |
|---|---|---|---|---|
| **Total (51,116)** | **71.5** | **80.3** | **8.8 (8.5–9.2)** | **12.3** |
| Asian, non-Hispanic (6,440) | 77.9 | 88.2 | 10.3 (9.5–11.1) | 13.2 |
| Black or African American, non-Hispanic (7,524) | 33.3 | 45.9 | 12.6 (11.5–13.7) | 37.8 |
| White, non-Hispanic (23,560) | 84.2 | 90.8 | 6.6 (6.2–7.0) | 7.8 |
| Hispanic or Latino (6,841) | 61.2 | 72.5 | 11.4 (10.3–12.4) | 18.6 |
| Multiracial, non-Hispanic (6,371) | 75.3 | 83.9 | 8.5 (7.6–9.4) | 11.3 |
| Low-coverage schools (7,462) | 36.0 | 51.7 | 15.6 (14.5–16.8) | 43.4 |
| High-coverage schools (43,653) | 77.4 | 85.4 | 7.9 (7.6–8.3) | 10.3 |
| Monolingual (44,377) | 75.9 | 83.6 | 7.7 (7.3–8.0) | 10.1 |
| Multilingual (6,720) | 42.6 | 59.1 | 16.5 (15.3–17.7) | 38.7 |
| Equity tiers 1 and 2 (low equity) (17,563) | 63.8 | 71.8 | 8.0 (7.3–8.6) | 12.5 |
| Equity tiers 3 and 4 (high equity) (32,866) | 75.7 | 85.0 | 9.4 (8.9–9.7) | 12.4 |
| **Age group 5–11 yrs** | | | | |
| **Total (25,806)** | **61.0** | **74.0** | **13.0 (12.9–13.2)** | **21.3** |
| Asian, non-Hispanic (2,966) | 62.1 | 80.8 | 18.7 (17.2–20.1) | 30.0 |
| Black or African American, non-Hispanic (3,784) | 13.5 | 29.9 | 16.4 (14.9–17.9) | 121.8 |
| White, non-Hispanic (11,995) | 77.9 | 87.9 | 10.0 (9.4–10.6) | 12.8 |
| Hispanic or Latino (3,279) | 45.8 | 62.8 | 17.0 (15.3–18.7) | 37.1 |
| Multiracial, non-Hispanic (3,602) | 68.0 | 80.7 | 12.7 (11.4–14.0) | 18.7 |
| Low-coverage schools (6,839) | 34.8 | 51.1 | 16.3 (15.1–17.5) | 46.9 |
| High-coverage schools (18,943) | 70.1 | 82.8 | 12.7 (12.2–13.3) | 18.2 |
| Monolingual (21,577) | 67.3 | 78.7 | 11.4 (10.9–12.0) | 17.0 |
| Multilingual (4,204) | 28.9 | 50.4 | 21.6 (20.0–23.1) | 74.6 |
| Equity tiers 1 and 2 (low equity) (5,200) | 33.8 | 48.4 | 14.6 (13.2–16.0) | 43.2 |
| Equity tiers 3 and 4 (high equity) (20,339) | 68.0 | 80.6 | 12.6 (12.0–13.1) | 18.5 |
| **Age group 12–18 yrs** | | | | |
| **Total (24,850)** | **82.7** | **86.6** | **3.9 (3.5–4.3)** | **4.7** |
| Asian, non-Hispanic (3,393) | 91.8 | 94.3 | 2.5 (1.7–3.3) | 2.7 |
| Black or African American, non-Hispanic (3,610) | 53.5 | 61.5 | 8.0 (6.4–9.6) | 15.0 |
| White, non-Hispanic (11,420) | 90.9 | 93.6 | 2.6 (2.3–3.1) | 2.9 |
| Hispanic or Latino (3,459) | 75.8 | 81.4 | 5.6 (4.3–6.9) | 7.4 |
| Multiracial, non-Hispanic (2,725) | 85.6 | 88.1 | 2.4 (1.3–3.7) | 2.9 |
| Low-coverage schools (561) | 51.9 | 58.5 | 6.6 (2.7–10.5) | 12.7 |
| High-coverage schools (24,287) | 83.4 | 87.3 | 3.9 (3.5–4.3) | 4.7 |
| Monolingual (22,473) | 84.5 | 88.1 | 3.7 (3.2–4.0) | 4.3 |
| Multilingual (6,720) | 65.7 | 72.3 | 6.6 (4.8–8.4) | 10.0 |
| Equity tiers 1 and 2 (low equity) (17,563) | 77.0 | 81.4 | 4.4 (37–5.1) | 5.7 |
| Equity tiers 3 and 4 (high equity) (12,487) | 88.6 | 91.8 | 3.2 (2.7–3.7) | 3.6 |

* Equity Tier 1 and Tier 2 schools represent higher levels of inequity and are designated for additional support from the state; Tier 3 and Tier 4 schools have lower levels of inequity and do not qualify for support. https://www.seattleschools.org/wp-content/uploads/2022/02/tier_methodology23.pdf
† During January–June 2022. Categories are not mutually exclusive.
§ Absolute percent change from January to June 2022 for each group was compared with the hypothesized mean increase in completion of 5% for all persons aged 5–18 years, 10% for children aged 5–11 years, and 3% for persons aged 12–18 years based on COVID tracker data showing completion rate changes seen nationally during the study period using a paired t-test. The absolute change was statistically significant ($p<0.05$) for each group. Comparison across groups was not completed because many of the groups are not mutually exclusive.
¶ Percent change was calculated as follows: (proportion June 2022 − proportion January 2022) / proportion January 2022.

by June 2022, although overall completion remained lowest among Black and multilingual students.

Schools have the potential to play a critical role in the health of children, and can enhance access to health care services, including preventive care, particularly among those without a traditional medical home. Other studies have described the role of school-located vaccination clinics in increasing human papillomavirus and influenza vaccination coverage among students (*8*,*9*). School-located vaccination clinics can increase vaccination coverage by providing equitable access to vaccines but might be more effective when complemented with school-based messaging and other engagements to improve vaccine confidence.

The findings in this report are subject to at least six limitations. First, the intervention did not include a comparison group; thus, it is not possible to assess the relative contribution of these school-based activities to the changes in primary series completion described. Second, place of vaccination was not reported, and students might have been vaccinated at non-SPS

**Summary**

What is already known about this topic?

Vaccination decreases risk for COVID-19 illness, severe disease, and death. U.S. pediatric COVID-19 vaccination coverage remains low.

What is added by this report?

Seattle Public Schools implemented a COVID-19 vaccination program through multiple community engagements. During December 2021–June 2022, completion of the primary COVID-19 vaccination series among Seattle Public Schools students aged 5–18 years increased from 56.5% to 80.3%.

What are the implications for public health practice?

School health programs can provide critical information about and access to vaccinations. School health providers might also be able to leverage community partners and relationships with families to increase vaccination coverage.

vaccination sites. Third, monthly primary series completion data are cross-sectional, reflecting primary series completion for each subgroup at a single point in time; thus, the change in primary series completion for each subgroup cannot be attributed to individual change in behavior. Fourth, primary series completion data might be inaccurate or missing if students were vaccinated out of state. Fifth, caregivers of children in SPS might be more vaccine-confident compared with those in other U.S. populations, as suggested by high COVID-19 vaccination coverage in Seattle and King County (*6*). Finally, other interventions that affected vaccine confidence or access to care might not have been considered.

These findings illustrate and highlight the critical role that school health can play within the community. School health professionals are likely to be trusted by families (*10*). In this report, school health professionals collaborated with community and public health partners to implement strategic engagements and to facilitate opportunities for COVID-19 vaccination. School-led promotion of vaccination might improve vaccine confidence and provide support and readiness for current and future pandemics.

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# Notes From the Field

## Prevalence of Previous Dengue Virus Infection Among Children and Adolescents — U.S. Virgin Islands, 2022

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In May 2019, the Food and Drug Administration issued approval for Dengvaxia (Sanofi Pasteur), a live-attenuated, chimeric tetravalent dengue vaccine (*1*). In June 2021, the Advisory Committee on Immunization Practices (ACIP) recommended vaccination with Dengvaxia for children and adolescents aged 9–16 years with laboratory confirmation of previous dengue virus infection and who live in areas with endemic dengue transmission, such as the U.S. Virgin Islands (USVI)[†] (*2*). Confirming previous dengue virus infection before vaccine administration (prevaccination screening) is important because 1) although Dengvaxia decreases hospitalization and severe disease from dengue among persons with a previous infection, it increases the risk for these outcomes among persons without a previous infection; 2) many dengue virus infections are asymptomatic; and 3) many patients with symptomatic infections do not seek medical attention or receive appropriate testing (*3*). Sufficient laboratory evidence of previous dengue virus infection includes a history of laboratory-confirmed dengue[§] or a positive serologic test result that meets ACIP-recommended performance standards for prevaccination screening, defined as high specificity (≥98%) and sensitivity (≥75%). A seroprevalence of 20% in the vaccine-eligible population (corresponding to a positive predictive value of ≥90% for a test with minimum sensitivity of 75% and minimum specificity of 98%) is recommended to maximize vaccine safety and minimize the risk for vaccinating persons without a previous dengue virus infection (*2*).

The USVI Department of Health (VIDOH) requested assistance from CDC to determine the prevalence of previous dengue virus infection in children and adolescents within the age range eligible for dengue vaccination. During April–May 2022, a serosurvey was conducted that included children and adolescents in grades 3–7 enrolled in 15 schools. Schools were selected either through a one-stage cluster sampling design (10 schools) stratified by the two health districts in USVI (St. Thomas/St. John or St. Croix) with inclusion probabilities proportional to the size of third grade enrollment or through direct selection by VIDOH (five schools). All children and adolescents in the eligible grade levels at the selected schools were invited to participate. Children and adolescents with parental permission received testing for previous dengue virus infection using a dengue immunoglobin G rapid diagnostic test with 89.6% sensitivity and 95.7% specificity from approximately 5 $\mu$L of whole blood obtained by fingerstick (CDC, unpublished data, 2022). Design weights were computed from 10,000 simulations of the inclusion methodology, and then adjusted by raking to the two districts' estimated population age and sex distributions from the 2022 U.S. Census Bureau population estimates. Weighted estimates of seroprevalence and 95% CIs were adjusted to reflect screening test performance. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[¶]

Among 372 children and adolescents who received testing, 218 (59%) received a negative result, 152 (41%) received a positive result, and two received an indeterminate result (Table). Estimated seroprevalence was similar for males and females. The estimated seroprevalence was lowest in children aged 8 years (27%), and highest in those aged 12 years (69%). Seroprevalence was estimated to be higher in St. Thomas/St. John than in St. Croix. Among children and adolescents aged 9–13 years, the age group eligible for the dengue vaccine, estimated seroprevalence was 51%.

Dengue seroprevalence in USVI among age groups eligible for vaccination exceeds the 20% threshold that corresponds to a positive predictive value of ≥90% when implementing prevaccination screening with a test meeting ACIP-recommended performance standards. Dengue vaccination with prevaccination screening should be considered as part of a comprehensive dengue control and prevention strategy in USVI (*3*). Other U.S. jurisdictions with endemic transmission of dengue virus should evaluate the risks, benefits, and feasibility of incorporating the dengue vaccine into their local vaccine schedule and consider serosurveys to guide this evaluation.

* These authors contributed equally to this report.
† https://www.cdc.gov/dengue/areaswithrisk/around-the-world.html
§ https://ndc.services.cdc.gov/case-definitions/dengue-virus-infections-2015/
¶ 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

**TABLE. Estimated seroprevalence of dengue virus immunoglobin G antibodies among children and adolescents aged 8–13 years, by sex, age, and health district — U.S. Virgin Islands, April–May 2022**

| Characteristic | Children and adolescents | | Estimated seroprevalence,* % (95% CI) |
|---|---|---|---|
| | No. who received testing | No. with positive test results | |
| **Total** | **372** | **152** | **47 (29–68)** |
| **Sex** | | | |
| Female | 204 | 87 | 50 (22–80) |
| Male | 168 | 65 | 45 (31–59) |
| **Age, yrs** | | | |
| 8 | 56† | 14 | 27 (17–39) |
| 9 | 76 | 28 | 41 (16–71) |
| 10 | 100 | 39 | 42 (26–60) |
| 11 | 52 | 20 | 50 (24–77) |
| 12 | 58 | 36 | 69 (45–88) |
| 13 | 30 | 15 | 54 (18–89) |
| **Health district** | | | |
| St. Croix | 192 | 64 | 34 (21–50) |
| St. Thomas/St. John | 180 | 88 | 59 (30–86) |

* Percentage estimates were weighted and standardized to the age and sex of the 2022 U.S. Census Bureau population estimated distribution across the two districts.
† Test results were indeterminate for two children.

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# Notes From the Field

## First Evidence of Locally Acquired Dengue Virus Infection — Maricopa County, Arizona, November 2022

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On November 7, 2022, dengue virus (DENV), which is not endemic in the continental United States (*1*), was identified in a Maricopa County, Arizona resident by reverse transcription–polymerase chain reaction (RT-PCR) testing at Arizona State Public Health Laboratory (ASPHL). The patient (patient A) was admitted to a hospital on October 19 for a dengue-like illness, 7 days after traveling to and remaining in Mexicali, Mexico for <4 hours. Patient A was hospitalized for 3 days and subsequently recovered. Maricopa County Environmental Services Department (MCESD) conducted retrospective testing for DENV in samples collected from 21 mosquito pools located within 5 miles (8 km) of patient A's residence during October 1–November 3. A sample collected from one mosquito pool (pool A) on October 5 was positive for DENV. Whole genome sequencing by CDC's Dengue Branch later revealed that closely related DENV-3 strains not known to be circulating in the patient's travel region were identified in both patient A and pool A, suggesting local DENV transmission.

Based on a preexisting, joint Maricopa County Department of Public Health (MCDPH), MCESD, and Arizona Department of Health Services locally acquired mosquitoborne disease response plan, MCDPH and MCESD activated an incident command office on November 10. MCDPH took the following actions: 1) prioritized prospective investigations of health care provider and laboratory reports of DENV and suspected arboviral visits queried from the National Syndromic Surveillance Program's BioSense Platform (BioSense)*; 2) retrospectively reviewed confirmed, probable, and suspected dengue cases investigated during July 1–November 10 for evidence of local DENV transmission; 3) alerted health care providers of the possible local transmission; and 4) advised providers to test for and report suspected DENV to MCDPH. No evidence of local acquisition was identified in 13 suspected arboviral visits identified in the Biosense database, 10 reviews of closed cases, and 10 new case investigations. MCESD retrospectively tested samples collected during September 18–November 19 from an additional 4,299 mosquito pools located throughout the county, including the mosquito pools within 5 miles of patient A's residence collected during the expanded testing time frame, for DENV by RT-PCR; all were negative. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.†

After discussions with CDC's Dengue Branch and Florida Public Health (*2*,*3*) regarding current best practices for managing locally acquired DENV infections, during November 17–19, MCDPH and MCESD canvassed residences within a 0.09-mile (150-m) radius (*4*) of patient A's residence and pool A to interview residents, collect human specimens for DENV testing, and assess properties for mosquito breeding. Teams approached 241 households; residents of 72 households (29.9%) consented to environmental assessments, and 73 persons in 59 (24.5%) households were interviewed. Among these 73 interviewees, 12 (16.4%) reported onset of dengue-like symptoms within 14 days of their interview and received testing; all results were negative for DENV by RT-PCR at ASPHL. A serum enzyme immunoassay for DENV immunoglobulin M testing was performed by ASPHL on blood specimens from 53 (72.6%) interviewees; among these, one (1.9%) result was positive. CDC Arboviral Diseases Branch confirmed DENV-3 by plaque reduction neutralization testing. The person with the positive test result reported no travel during the 2 weeks preceding symptom onset. One of this person's household members reported dengue-like symptoms but declined testing; both have since recovered. Environmental assessment of this residence identified *Aedes aegypti* mosquitoes and breeding sites; mosquitoes collected in a professional BG-Sentinel mosquito trap§ tested negative for DENV by RT-PCR. The outbreak (consisting of two autochthonous DENV infections) ended January 4, 2023, after >45 days without additional locally acquired cases, as indicated by most recent guidance (*4*).

Coordinated surveillance and response activities identified the first locally acquired human DENV infections in Maricopa County, Arizona. Established partnerships and preexisting plans were essential to mounting a rapid, coordinated response to nonendemic arboviral transmission. MCDPH and MCESD will enhance future surveillance activities to identify and prevent autochthonous DENV transmission, including additional mosquito trap placement around patient residences and public mosquito exposure prevention education.¶ A countywide health care provider education campaign is being implemented

* https://www.cdc.gov/nssp/overview.html

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

§ https://www.bg-sentinel.com/

¶ www.maricopa.gov/fightthebite

to increase provider awareness of local DENV transmission and encourage testing for patients with compatible illness, irrespective of travel history.

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Blanca Caballero, Maricopa County Environmental Services Department; Angela Moreth, Nicholas Moyte, Sonia Singh, Maricopa County Department of Public Health Office of Communications and Marketing; Maricopa Medical Reserve Corps, Maricopa County Department of Public Health Office of Preparedness and Response; Guillermo Adame, Richard Turner, Arizona Department of Health Services; Arizona State Public Health Laboratory; Dengue Branch, CDC; Arboviral Diseases Branch, CDC; Andrea Morrison, Danielle Stanek, Florida Department of Health; Maricopa County survey participants.

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# Correction and Republication:

## Early Estimates of Bivalent mRNA Vaccine Effectiveness in Preventing COVID-19–Associated Emergency Department or Urgent Care Encounters and Hospitalizations Among Immunocompetent Adults — VISION Network, Nine States, September–November 2022

On December 16, 2022, *MMWR* published "Early Estimates of Bivalent mRNA Vaccine Effectiveness in Preventing COVID-19–Associated Emergency Department or Urgent Care Encounters and Hospitalizations Among Immunocompetent Adults — VISION Network, Nine States, September–November 2022" (*1*). On January 25, 2023, one of the sites contributing data to the analysis notified CDC co-authors about an error in reporting history of receipt of bivalent doses. *MMWR* was notified about these concerns on February 10, 2023. The site corrected its vaccination history reporting, and the authors have corrected the report and confirmed that the reporting issue did not change the interpretation or the conclusions of the original report. In accordance with December 2017 guidance from the International Committee of Medical Journal Editors (*2*), *MMWR* is republishing the report (*3*). The republished report includes the original report with clearly marked corrections as supplementary materials.

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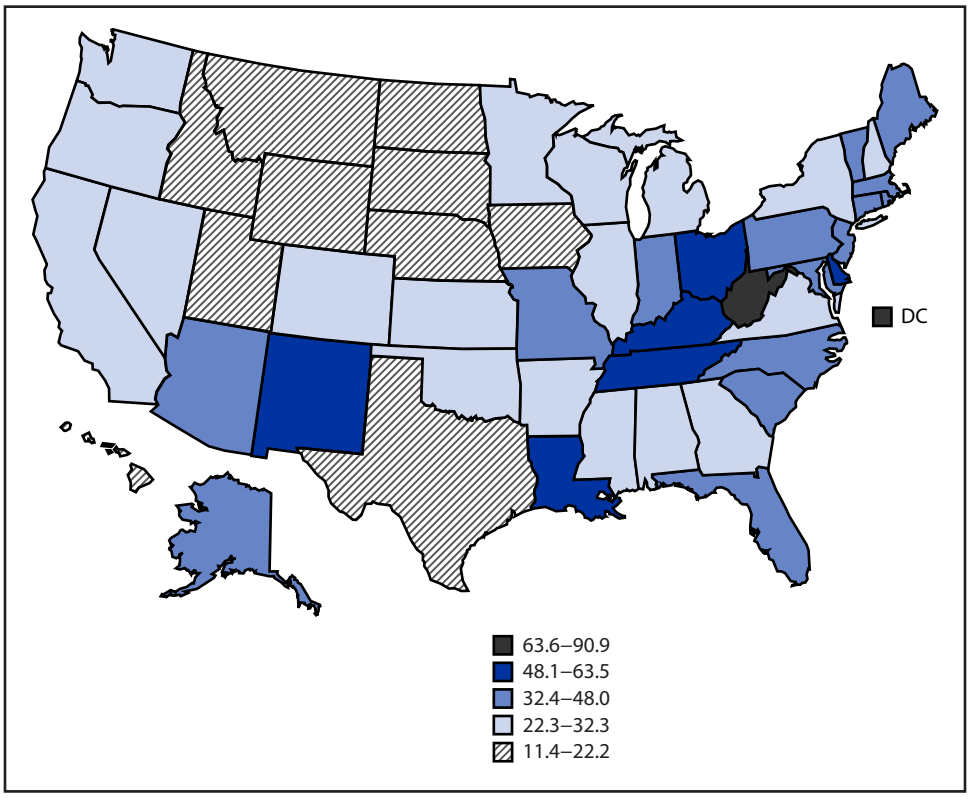
1. Tenforde MW, Weber ZA, Natarajan K, et al. Early estimates of bivalent mRNA vaccine effectiveness in preventing COVID-19–associated emergency department or urgent care encounters and hospitalizations among immunocompetent adults—VISION Network, nine states, September–November 2022. MMWR Morb Mortal Wkly Rep 2022;71:1616–24. PMID:36580430 https://doi.org/10.15585/mmwr.mm715152e1
2. International Committee of Medical Journal Editors (ICMJE). Corrections, retractions, republications and version control. Vancouver, Canada: International Committee of Medical Journal Editors (ICMJE); 2017. https://www.icmje.org/recommendations/browse/publishing-and-editorial-issues/corrections-and-version-control.html
3. Tenforde MW, Weber ZA, Natarajan K, et al. Early estimates of bivalent mRNA vaccine effectiveness in preventing COVID-19–associated emergency department or urgent care encounters and hospitalizations among immunocompetent adults—VISION Network, nine states, September–November 2022. MMWR Morb Mortal Wkly Rep 2022;71:1637–47. Corrected and republished from: MMWR Morb Mortal Wkly Rep 2022;71:1616–24 https://www.cdc.gov/mmwr/volumes/71/wr/mm7153a1.htm?s_cid=mm7153a1_w

# QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

## Age-Adjusted Drug Overdose Death Rates,*,† by State — National Vital Statistics System, United States, 2021




* Deaths per 100,000 standard population. Age-adjusted drug overdose death rates were calculated using the direct method and the 2000 U.S. Census Bureau standard population. In 2021, the age-adjusted drug overdose death rate was 32.4 per 100,000 standard population.

† Drug overdose deaths were identified using *International Classification of Diseases, Tenth Revision* underlying cause-of-death codes X40–X44, X60–X64, X85, and Y10–Y14.

In 2021, the U.S. age-adjusted drug overdose death rate was 32.4 per 100,000 population. The highest rates were in West Virginia (90.9) and the District of Columbia (63.6); the lowest rates were in the Upper Midwest and Texas. The lowest state rates were those in Nebraska (11.4), South Dakota (12.6), and Iowa (15.3).

**Source:** National Center for Health Statistics, National Vital Statistics System, Mortality Data. https://www.cdc.gov/nchs/nvss/deaths.htm

**Reported by:** Arialdi M. Miniño, MPH, avm9@cdc.gov; Merianne R. Spencer, MPH.

For more information on this topic, CDC recommends the following link: https://www.cdc.gov/drugoverdose/index.html

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