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# Chronic Pain Among Adults — United States, 2019–2021

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Chronic pain (i.e., pain lasting ≥3 months) is a debilitating condition that affects daily work and life activities for many adults in the United States and has been linked with depression (*1*), Alzheimer disease and related dementias (*2*), higher suicide risk (*3*), and substance use and misuse (*4*). During 2016, an estimated 50 million adults in the United States experienced chronic pain, resulting in substantial health care costs and lost productivity (*5*,*6*). Addressing chronic pain and improving the lives of persons living with pain is a public health imperative. Population research objectives in the National Pain Strategy, which was released in 2016 by the Interagency Pain Research Coordinating Committee, call for more precise estimates of the prevalence of chronic pain and high-impact chronic pain (i.e., chronic pain that results in substantial restriction to daily activities) in the general population and within various population groups to guide efforts to reduce the impact of chronic pain (*3*). Further, a 2022 review of U.S. chronic pain surveillance systems identified the National Health Interview Survey (NHIS) as the best source for pain surveillance data (*7*). CDC analyzed data from the 2019–2021 NHIS to provide updated estimates of the prevalence of chronic pain and high-impact chronic pain among adults in the United States and within population groups defined by demographic, geographic, socioeconomic, and health status characteristics. During 2021, an estimated 20.9% of U.S. adults (51.6 million persons) experienced chronic pain, and 6.9% (17.1 million persons) experienced high-impact chronic pain. New findings from this analysis include that non-Hispanic American Indian or Alaska Native (AI/AN) adults, adults identifying as bisexual, and adults who are divorced or separated are among the populations experiencing a higher prevalence of chronic pain and high-impact chronic pain. Clinicians, practices, health systems, and payers should vigilantly attend to health inequities and ensure access to appropriate, affordable, diversified, coordinated, and effective pain management care for all persons (*8*).

NHIS is a cross-sectional, household survey of the civilian, noninstitutionalized population conducted annually by the National Center for Health Statistics (NCHS).* Data were analyzed using the 2019–2021 Sample Adult Interviews.† Survey questions used to estimate the prevalence of pain included, "In the past three months, how often did you have pain? Would you say never, some days, most days, or every day?" and "Over the past three months, how often did your pain limit your life or work activities? Would you say never, some days, most days,

* https://www.cdc.gov/nchs/nhis/index.htm
† Sample size and response rates for each year of the NHIS were as follows: 2019 (n = 31,997; response rate = 61.1%), 2020 (n = 31,568; response rate = 48.9%), and 2021 (n = 29,482; response rate = 50.9%). More information is available in the NHIS 2019–2021 survey description documents. https://www.cdc.gov/nchs/nhis/data-questionnaires-documentation.htm

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or every day?" If the participant was physically or mentally unable to respond to survey questions, then a knowledgeable proxy was permitted to answer on their behalf. Consistent with previous work, chronic pain was defined as pain on most days or every day during the previous 3 months, and high-impact chronic pain was defined as chronic pain that also limited daily life or work activities on most days or every day during the previous 3 months (*5*).

Using data from the 2019–2021 NHIS, the prevalence of chronic pain and high-impact chronic pain (including estimated number, crude rates, and age-adjusted rates with Korn-Graubard 95% CIs) were estimated for the adult U.S. population overall and within population groups defined by demographic, geographic, socioeconomic, and health status characteristics. Age-adjusted rates were calculated because the prevalence of pain is reported to vary by age (*5*). Estimates not meeting the NCHS reliability standards[§] were not reported. Demographic characteristics included sex, age, race and ethnicity, sexual orientation, marital status, veteran status, and nativity (U.S.-born or non–U.S.-born). Geographic characteristics included region[¶] and urban-rural classification. Socioeconomic characteristics included family income relative to the federal poverty level, education level, employment status, and health insurance coverage (reported separately by NHIS for adults aged <65 years and ≥65 years). Health status characteristics included general health status, disability status, and history of chronic medical conditions. Analysis was conducted using SAS (version 9.4; SAS Institute) and used weight and variance estimation variables[**] that account for the complex survey design of NHIS. All reported differences between subgroups in crude rates and in age-adjusted rates were significantly different on the basis of two-tailed Z-tests ($p<0.05$). This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[††]

Between 2019 and 2021, the prevalence of chronic pain among U.S. adults ranged from 20.5% to 21.8%, and the prevalence of high-impact chronic pain ranged from 6.9% to 7.8% (Figure). During 2021, an estimated 51.6 million U.S. adults (20.9%) experienced chronic pain, and 17.1 million (6.9%) experienced high-impact chronic pain (Table). The age-adjusted prevalence of both chronic pain and high-impact chronic pain was notably higher among certain demographic population groups including AI/AN adults, adults identifying as bisexual, and adults who were divorced or separated. The age-adjusted prevalence of high-impact chronic pain among

[§] https://www.cdc.gov/nchs/data/series/sr_02/sr02_175.pdf

[¶] States are grouped into four regions used by the U.S. Census Bureau. https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf

[**] During 2020, the survey question used to define high-impact chronic pain was only included in quarters 3 and 4. Therefore, weights were doubled to produce annual estimates for high-impact chronic pain for the year 2020.

[††] 5 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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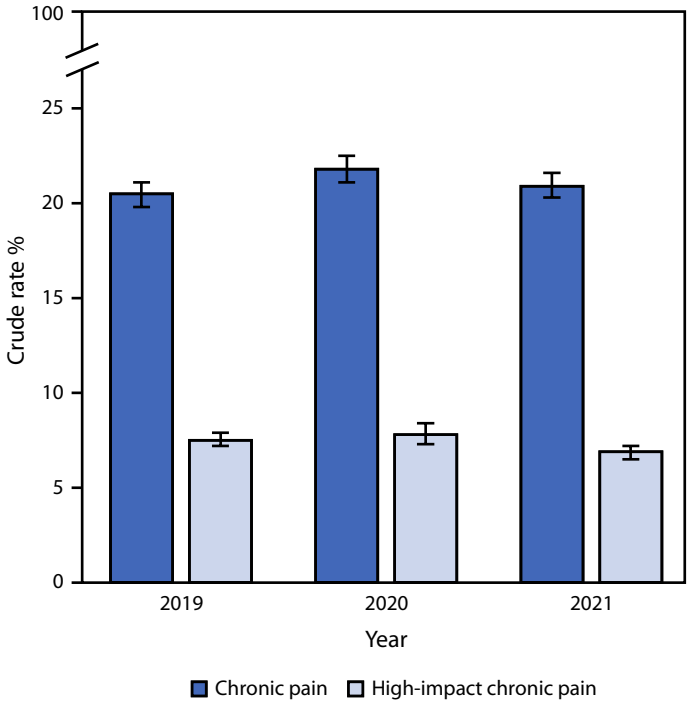
**FIGURE. Prevalence of chronic pain* and high-impact chronic pain† among adults — United States, 2019-2021§,¶**




* Pain reported on most days or every day during the previous 3 months.
† Chronic pain that limited life or work activities on most days or every day during the previous 3 months.
§ Sample sizes for chronic pain and high-impact chronic pain were as follows: 2019 (n = 31,304; n = 31,281), 2020 (n = 31,126; n = 17,409), 2021 (n = 28,759; n = 28,740). Survey responses coded as "refused," "don't know," "not ascertained," or missing responses were excluded from the analysis. In 2020, the survey question used to define high-impact chronic pain was only included in quarters 3 and 4. Therefore, the sample size was smaller, and survey weights were doubled to produce annual estimates for high-impact chronic pain for 2020.
¶ With 95% CIs indicated with error bars.

AI/AN adults (12.8%) was six times as high as among non-Hispanic Asian adults (2.1%) and nearly twice as high as among non-Hispanic White adults (6.5%). The age-adjusted prevalence of chronic pain among adults identifying as bisexual was 32.9%, compared with 19.3% among adults identifying as straight and 20.7% among those identifying as gay or lesbian. The age-adjusted prevalence of chronic pain and high-impact chronic pain among adults who were divorced or separated (29.6% and 10.1%, respectively) was nearly twice as high as among those who were married (18.2% and 5.2%, respectively). The age-adjusted prevalence of chronic pain and high-impact chronic pain among those born in the United States (21.6% and 7.0%, respectively) was nearly twice as high as among those born outside the United States (11.9% and 4.1%, respectively).

Within population groups defined by geographic and socioeconomic characteristics, the age-adjusted prevalence of high-impact chronic pain among adults residing in nonmetropolitan areas (9.2%) and adults with a family income <100% of the federal poverty level (FPL) (14.4%) was approximately two and four times as high, respectively, as among those residing in large central metro areas (5.5%) and those with family income ≥400% FPL (3.5%). Adults reporting poor general health and adults with a disability experienced an exceptionally high prevalence of chronic pain (67.6% and 52.4%, respectively) and high-impact chronic pain (48.7% and 32.0%, respectively). Among all chronic medical conditions reported, the age-adjusted prevalence of chronic pain and high-impact chronic pain was highest among adults with a history of myalgic encephalomyelitis/chronic fatigue syndrome (70.0% and 43.8%, respectively) and dementia (54.9% and 34.2%, respectively).

## Discussion

Chronic pain is a debilitating condition that affects the lives of millions of adults in the United States. During 2021, an estimated 20.9% of U.S. adults experienced chronic pain, similar to the reported estimate of 20.4% in 2016 (*5*). The estimated prevalence of high-impact chronic pain in 2021 (6.9%) was, however, lower than in 2016 (8.0%) (*5*). Further, the age-adjusted prevalence of high-impact chronic pain in 2021 was 6.4%, which is the goal set by the Healthy People 2030 objective to reduce the prevalence of high-impact chronic pain (*9*).

Findings in this report highlight important disparities in the prevalence of chronic pain among certain population groups. Consistent with previous studies, the prevalences of chronic pain and high-impact chronic pain were higher among older adults, females, adults currently unemployed but who worked previously, veterans, adults living in poverty, those residing in nonmetropolitan areas, and those with public health insurance (*5*). This report contributes additional findings that the prevalences of chronic pain and high-impact chronic pain were also higher among AI/AN adults, adults identifying as bisexual, those who are divorced or separated, U.S.-born adults compared with non–U.S.-born adults, adults with a disability, adults in poor health, and adults with a history of certain chronic medical conditions.

Previous studies have identified disparities in the treatment of chronic pain and access to affordable and effective pain management care, yet further work is needed to understand why these disparities exist and to identify opportunities for appropriate and effective interventions (*10*). CDC's 2022 Clinical Practice Guideline for Prescribing Opioids for Pain provides recommendations to promote a multimodal and multidisciplinary approach to pain management and implementation strategies to reduce disparities in pain management care (*8*). In addition, policies and programs that address primary injury prevention, improved access to affordable, culturally

**TABLE. Prevalence of chronic pain* and high-impact chronic pain† among adults, by demographic, geographic, socioeconomic, and health status characteristics — United States, 2021**

| Characteristic | Chronic pain | | | High-impact chronic pain | | |
|---|---|---|---|---|---|---|
| | Estimated no.§ | Crude rate % (95% CI) | Age-adjusted rate¶ % (95% CI) | Estimated no.§ | Crude rate % (95% CI) | Age-adjusted rate¶ % (95% CI) |
| **Overall** | **51,561,000** | **20.9 (20.2–21.5)** | **19.7 (19.1–20.3)** | **17,100,000** | **6.9 (6.6–7.3)** | **6.4 (6.1–6.7)** |
| **Sex** | | | | | | |
| Female | 28,074,000 | 22.0 (21.2–22.9) | 20.5 (19.7–21.3) | 9,739,000 | 7.6 (7.2–8.2) | 7.0 (6.5–7.5) |
| Male | 23,484,000 | 19.7 (18.8–20.5) | 18.8 (18.0–19.6) | 7,360,000 | 6.2 (5.7–6.7) | 5.8 (5.3–6.2) |
| **Age group, yrs** | | | | | | |
| 18–24 | 2,135,000 | 7.5 (6.3–9.0) | NA | 357,000 | 1.3 (0.7–2.0) | NA |
| 25–44 | 11,532,000 | 13.7 (12.8–14.6) | NA | 2,928,000 | 3.5 (3.0–4.0) | NA |
| 45–64 | 21,236,000 | 26.8 (25.7–27.9) | NA | 7,938,000 | 10.0 (9.3–10.8) | NA |
| 65–84 | 14,694,000 | 30.0 (28.8–31.3) | NA | 5,067,000 | 10.4 (9.6–11.2) | NA |
| ≥85 | 1,894,000 | 34.3 (30.6–38.2) | NA | 786,000 | 14.3 (11.8–17.2) | NA |
| **Race and ethnicity**** | | | | | | |
| AI/AN, non-Hispanic | 991,000 | 29.8 (22.4–38.0) | 28.0 (21.5–34.6) | 451,000 | 13.6 (9.2–19.1) | 12.8 (8.6–17.0) |
| Asian, non-Hispanic | 1,136,000 | 7.8 (6.4–9.3) | 7.7 (6.3–9.0) | 305,000 | 2.1 (1.4–3.0) | 2.1 (1.4–2.9) |
| Black or African American, non-Hispanic | 5,352,000 | 18.8 (17.3–20.4) | 18.2 (16.7–19.7) | 2,247,000 | 7.9 (6.8–9.1) | 7.6 (6.5–8.7) |
| White, non-Hispanic | 37,105,000 | 23.8 (23.0–24.6) | 21.8 (21.0–22.5) | 11,631,000 | 7.5 (7.0–7.9) | 6.5 (6.1–6.9) |
| Hispanic or Latino | 6,379,000 | 15.4 (14.0–16.9) | 16.5 (15.0–18.0) | 2,191,000 | 5.3 (4.5–6.1) | 5.7 (4.9–6.6) |
| Other single and multiple race | 599,000 | 18.5 (14.0–23.7) | 20.9 (15.8–26.1) | 274,000 | 8.5 (5.2–12.8) | 10.5 (6.5–14.5) |
| **Sexual orientation** | | | | | | |
| Straight | 47,580,000 | 20.8 (20.2–21.5) | 19.3 (18.7–20.0) | 15,772,000 | 6.9 (6.5–7.3) | 6.3 (5.9–6.6) |
| Gay or lesbian | 960,000 | 19.2 (15.9–22.9) | 20.7 (17.3–24.1) | 332,000 | 6.7 (4.6–9.2) | 7.0 (4.8–9.2) |
| Bisexual | 1,384,000 | 24.3 (20.2–28.7) | 32.9 (27.7–38.1) | 357,000 | 6.3 (4.4–8.7) | 9.9 (6.6–13.1) |
| **Marital status** | | | | | | |
| Married | 26,750,000 | 21.1 (20.3–22.0) | 18.2 (17.3–19.2) | 8,079,000 | 6.4 (5.9–6.9) | 5.2 (4.7–5.6) |
| Widowed | 4,673,000 | 32.9 (30.7–35.1) | 25.9 (19.9–31.9) | 1,836,000 | 12.9 (11.5–14.5) | 8.1 (5.8–10.3) |
| Divorced or separated | 7,820,000 | 32.1 (30.5–33.8) | 29.6 (24.5–34.6) | 3,214,000 | 13.2 (12.0–14.5) | 10.1 (8.9–11.3) |
| Never married | 7,596,000 | 13.0 (12.0–14.1) | 19.2 (17.8–20.5) | 2,339,000 | 4.0 (3.5–4.6) | 6.8 (5.9–7.7) |
| Living with a partner | 4,197,000 | 20.2 (18.1–22.4) | 22.9 (20.6–25.1) | 1,443,000 | 6.9 (5.7–8.3) | 8.5 (7.0–10.1) |
| **Veteran status** | | | | | | |
| Veteran | 5,915,000 | 32.0 (29.9–34.1) | 27.5 (24.9–30.1) | 2,132,000 | 11.6 (10.2–13.0) | 9.1 (7.6–10.5) |
| Not veteran | 45,170,000 | 20.0 (19.3–20.6) | 19.2 (18.6–19.8) | 14,788,000 | 6.5 (6.2–6.9) | 6.2 (5.9–6.6) |
| **Nativity** | | | | | | |
| U.S.-born | 45,340,000 | 22.7 (22.0–23.4) | 21.6 (20.9–22.2) | 14,897,000 | 7.5 (7.1–7.9) | 7.0 (6.6–7.4) |
| Non–U.S.-born | 5,759,000 | 12.8 (11.6–14.1) | 11.9 (10.8–13.1) | 2,028,000 | 4.5 (3.9–5.3) | 4.1 (3.5–4.8) |
| **U.S. Census Bureau region** | | | | | | |
| Northeast | 7,796,000 | 18.2 (16.7–19.7) | 16.8 (15.5–18.3) | 2,309,000 | 5.4 (4.6–6.3) | 4.9 (4.1–5.8) |
| Midwest | 11,526,000 | 22.3 (20.9–23.7) | 20.9 (19.7–22.2) | 3,514,000 | 6.8 (6.1–7.5) | 6.2 (5.5–6.8) |
| South | 20,337,000 | 21.8 (20.7–22.8) | 20.4 (19.4–21.4) | 7,352,000 | 7.9 (7.3–8.5) | 7.2 (6.6–7.8) |
| West | 11,903,000 | 20.2 (18.9–21.6) | 19.6 (18.4–20.8) | 3,926,000 | 6.7 (5.9–7.5) | 6.4 (5.7–7.1) |
| **Urban-rural classification††** | | | | | | |
| Large central metro | 13,387,000 | 17.1 (16.1–18.2) | 16.8 (15.8–17.8) | 4,433,000 | 5.7 (5.1–6.4) | 5.5 (4.9–6.2) |
| Large fringe metro | 11,073,000 | 18.7 (17.6–19.9) | 17.4 (16.3–18.5) | 3,385,000 | 5.7 (5.1–6.4) | 5.2 (4.6–5.8) |
| Medium and small metro | 17,868,000 | 23.4 (22.1–24.7) | 21.9 (20.8–23.1) | 5,780,000 | 7.6 (6.9–8.3) | 6.9 (6.3–7.6) |
| Nonmetropolitan | 9,233,000 | 27.8 (25.7–30.0) | 25.4 (23.5–27.4) | 3,502,000 | 10.6 (9.4–11.8) | 9.2 (8.2–10.3) |
| **Family income§§** | | | | | | |
| <100% FPL | 6,921,000 | 28.5 (26.3–30.9) | 28.8 (26.6–31.0) | 3,444,000 | 14.2 (12.7–15.9) | 14.4 (12.8–16.0) |
| 100% to <200% FPL | 10,803,000 | 25.1 (23.6–26.6) | 24.1 (22.6–25.6) | 4,220,000 | 9.8 (8.9–10.8) | 9.5 (8.6–10.5) |
| 200% to <400% FPL | 15,983,000 | 22.0 (20.9–23.1) | 20.9 (19.9–22.0) | 5,248,000 | 7.2 (6.6–7.9) | 6.7 (6.1–7.3) |
| ≥400% FPL | 17,855,000 | 16.7 (16.0–17.5) | 15.3 (14.6–16.1) | 4,187,000 | 3.9 (3.5–4.3) | 3.5 (3.1–3.9) |
| **Education** | | | | | | |
| No high school diploma or GED | 5,898,000 | 25.7 (23.6–27.9) | 22.6 (20.5–24.8) | 2,464,000 | 10.8 (9.5–12.1) | 8.9 (7.6–10.1) |
| High school diploma or GED | 15,615,000 | 22.5 (21.3–23.7) | 21.7 (20.6–22.9) | 5,756,000 | 8.3 (7.6–9.1) | 7.9 (7.2–8.6) |
| Some college | 15,979,000 | 24.5 (23.3–25.7) | 24.2 (23.0–25.3) | 5,441,000 | 8.3 (7.6–9.1) | 8.1 (7.4–8.9) |
| Bachelor's degree or higher | 13,804,000 | 15.7 (15.0–16.5) | 14.8 (14.0–15.6) | 3,291,000 | 3.8 (3.4–4.2) | 3.4 (3.0–3.7) |

See table footnotes on page 384.

**TABLE. (*Continued*) Prevalence of chronic pain* and high-impact chronic pain† among adults, by demographic, geographic, socioeconomic, and health status characteristics — United States, 2021**

| Characteristic | Chronic pain | | | High-impact chronic pain | | |
|---|---|---|---|---|---|---|
| | Estimated no.§ | Crude rate % (95% CI) | Age-adjusted rate¶ % (95% CI) | Estimated no.§ | Crude rate % (95% CI) | Age-adjusted rate¶ % (95% CI) |
| **Employment status** | | | | | | |
| Employed¶¶ | 24,045,000 | 15.8 (15.1–16.6) | 16.5 (15.7–17.3) | 5,088,000 | 3.4 (3.0–3.7) | 3.7 (3.2–4.1) |
| Not employed, worked previously | 26,093,000 | 30.5 (29.4–31.6) | 26.7 (25.5–28.0) | 11,461,000 | 13.4 (12.6–14.2) | 12.7 (11.8–13.7) |
| Not employed, never worked | 822,000 | 13.1 (10.2–16.3) | 15.6 (12.3–19.0) | 334,000 | 5.3 (3.5–7.6) | 6.8 (4.3–9.3) |
| **Health insurance coverage*** ** | | | | | | |
| **Aged <65 yrs** | | | | | | |
| Private | 21,401,000 | 16.1 (15.4–16.9) | 15.3 (14.6–16.0) | 5,348,000 | 4.0 (3.6–4.5) | 3.7 (3.3–4.1) |
| Medicaid and other public coverage | 6,899,000 | 25.7 (23.7–27.8) | 26.9 (25.0–28.8) | 3,295,000 | 12.3 (10.9–13.8) | 13.1 (11.7–14.4) |
| Other coverage | 2,999,000 | 38.6 (35.1–42.2) | 32.5 (28.9–36.0) | 1,589,000 | 20.5 (17.6–23.6) | 16.9 (13.8–20.0) |
| Uninsured | 3,532,000 | 14.7 (12.9–16.5) | 14.9 (13.1–16.7) | 972,000 | 4.0 (3.2–5.1) | 4.2 (3.2–5.1) |
| **Aged ≥65 yrs** | | | | | | |
| Private | 5,938,000 | 28.8 (27.0–30.7) | 29.1 (27.3–30.9) | 1,734,000 | 8.4 (7.4–9.5) | 8.6 (7.6–9.6) |
| Medicare and Medicaid | 1,595,000 | 43.1 (37.7–48.5) | 43.1 (37.8–48.4) | 800,000 | 21.8 (17.8–26.3) | 21.8 (17.7–25.9) |
| Medicare Advantage | 5,574,000 | 29.8 (27.8–31.8) | 29.9 (27.9–31.8) | 2,005,000 | 10.7 (9.5–12.1) | 10.7 (9.4–12.0) |
| Medicare only, excluding Medicare Advantage | 1,810,000 | 27.1 (23.9–30.6) | 27.2 (23.9–30.5) | 646,000 | 9.7 (7.7–12.0) | 9.8 (7.7–11.9) |
| Other coverage | 1,624,000 | 35.8 (31.7–40.1) | 35.5 (31.4–39.6) | 669,000 | 14.7 (11.9–18.0) | 14.8 (11.8–17.8) |
| Uninsured | 53,000 | —††† | —††† | 9,000 | —††† | —††† |
| **General health status** | | | | | | |
| Excellent | 4,221,000 | 7.0 (6.2–7.7) | 7.4 (6.7–8.2) | 666,000 | 1.1 (0.8–1.5) | 1.2 (0.9–1.5) |
| Very good | 12,421,000 | 14.7 (13.9–15.6) | 14.3 (13.5–15.1) | 2,063,000 | 2.4 (2.1–2.8) | 2.3 (2.0–2.7) |
| Good | 17,659,000 | 25.8 (24.6–27.0) | 23.5 (22.3–24.6) | 5,095,000 | 7.4 (6.8–8.1) | 6.5 (5.9–7.1) |
| Fair | 12,016,000 | 47.0 (44.8–49.4) | 42.5 (39.6–45.4) | 5,684,000 | 22.3 (20.6–24.1) | 19.5 (17.5–21.4) |
| Poor | 5,212,000 | 69.2 (65.4–72.9) | 67.6 (60.5–74.7) | 3,578,000 | 48.3 (44.4–52.2) | 48.7 (41.8–55.7) |
| **Disability status§§§** | | | | | | |
| With disability | 12,489,000 | 58.0 (55.7–60.3) | 52.4 (49.3–55.5) | 7,391,000 | 34.5 (32.5–36.5) | 32.0 (29.3–34.8) |
| Without disability | 39,072,000 | 17.3 (16.7–17.9) | 16.8 (16.2–17.4) | 9,709,000 | 4.3 (4.0–4.6) | 4.1 (3.8–4.4) |
| **Chronic medical conditions¶¶¶** | | | | | | |
| **Cardiovascular** | | | | | | |
| Hypertension | 25,625,000 | 33.0 (31.9–34.2) | 27.3 (25.7–28.9) | 10,268,000 | 13.2 (12.5–14.1) | 10.6 (9.7–11.5) |
| High cholesterol | 21,012,000 | 31.6 (30.3–32.9) | 25.2 (23.6–26.8) | 7,905,000 | 11.9 (11.1–12.8) | 9.0 (8.1–9.9) |
| Coronary heart disease | 4,977,000 | 40.7 (37.9–43.6) | 33.8 (25.4–42.2) | 2,382,000 | 19.5 (17.3–21.9) | 16.6 (11.2–22.0) |
| Angina | 1,906,000 | 50.9 (45.6–56.3) | 44.0 (34.6–53.3) | 1,122,000 | 30.0 (25.2–35.1) | 27.7 (19.3–36.2) |
| Myocardial infarction | 3,319,000 | 44.0 (40.2–47.8) | 40.3 (31.1–49.5) | 1,615,000 | 21.5 (18.6–24.5) | 17.1 (11.8–22.4) |
| Stroke | 3,176,000 | 46.0 (42.2–49.9) | 43.4 (34.8–52.0) | 1,692,000 | 24.8 (21.6–28.3) | 23.8 (17.9–29.7) |
| **Respiratory** | | | | | | |
| COPD, emphysema, or chronic bronchitis | 6,210,000 | 54.5 (51.6–57.4) | 50.0 (44.4–55.5) | 3,130,000 | 27.5 (24.9–30.2) | 23.9 (19.8–28.0) |
| Asthma | 6,926,000 | 35.0 (32.7–37.3) | 33.6 (31.4–35.7) | 2,964,000 | 15.0 (13.4–16.7) | 14.2 (12.7–15.8) |
| **Psychiatric** | | | | | | |
| Anxiety disorder | 15,163,000 | 37.4 (35.7–39.1) | 37.5 (35.9–39.0) | 6,596,000 | 16.3 (15.0–17.6) | 16.3 (15.1–17.5) |
| Depression | 16,776,000 | 39.0 (37.4–40.7) | 38.0 (36.4–39.5) | 7,535,000 | 17.6 (16.4–18.8) | 16.8 (15.7–17.9) |
| **Digestive** | | | | | | |
| Hepatitis | 1,534,000 | 38.9 (33.7–44.2) | 28.2 (23.3–33.2) | 740,000 | 18.8 (14.9–23.1) | 12.9 (9.6–16.2) |
| Cirrhosis or liver condition | 1,120,000 | 50.8 (43.7–57.8) | 40.9 (34.4–47.4) | 643,000 | 29.1 (23.4–35.4) | 22.3 (17.3–27.3) |
| **Musculoskeletal** | | | | | | |
| Arthritis | 26,796,000 | 51.0 (49.5–52.5) | 51.3 (48.3–54.4) | 10,700,000 | 20.4 (19.2–21.6) | 20.0 (17.6–22.4) |
| **Endocrine** | | | | | | |
| Diabetes | 8,954,000 | 37.7 (35.5–39.9) | 29.1 (26.2–32.0) | 3,916,000 | 16.5 (15.1–18.1) | 12.9 (10.9–14.8) |
| **Neurologic** | | | | | | |
| Dementia | 1,151,000 | 44.8 (39.0–50.7) | 54.9 (38.4–71.3) | 648,000 | 25.3 (20.2–30.9) | 34.2 (19.9–48.5) |
| Epilepsy | 1,868,000 | 42.4 (37.0–47.9) | 40.0 (34.8–45.1) | 912,000 | 20.7 (16.7–25.1) | 19.6 (15.7–23.5) |
| **Genitourinary** | | | | | | |
| Chronic kidney disease | 3,760,000 | 53.8 (50.1–57.4) | 48.4 (42.0–54.7) | 1,954,000 | 28.0 (24.7–31.5) | 25.4 (19.8–31.1) |

See table footnotes on page 384.

**TABLE. (*Continued*) Prevalence of chronic pain* and high-impact chronic pain† among adults, by demographic, geographic, socioeconomic, and health status characteristics — United States, 2021**

| Characteristic | Chronic pain | | | High-impact chronic pain | | |
|---|---|---|---|---|---|---|
| | Estimated no.§ | Crude rate % (95% CI) | Age-adjusted rate¶ % (95% CI) | Estimated no.§ | Crude rate % (95% CI) | Age-adjusted rate¶ % (95% CI) |
| **Multiple systems** | | | | | | |
| Cancer | 8,536,000 | 35.1 (33.3–37.0) | 30.6 (26.2–35.0) | 3,258,000 | 13.4 (12.2–14.7) | 11.9 (9.9–13.8) |
| ME/CFS | 1,914,000 | 74.5 (68.5 –79.8) | 70.0 (63.1–76.9) | 1,242,000 | 48.3 (42.2–54.4) | 43.8 (37.0–50.7) |

**Abbreviations:** AI/AN = American Indian or Alaska Native, non-Hispanic; COPD = chronic obstructive pulmonary disease; FPL = federal poverty level; GED = general educational development certificate; ME/CFS = myalgic encephalomyelitis/chronic fatigue syndrome; NA = not applicable; NHIS = National Health Interview Survey.

* Pain reported on most days or every day during the previous 3 months.

† Chronic pain that limits life or work activities on most days or every day during the previous 3 months.

§ Weighted estimates are rounded to the nearest 1,000. Responses coded as "refused," "don't know," "not ascertained," or missing responses were excluded from the analysis.

¶ Estimates are age-adjusted using the projected 2000 U.S. Census Bureau population as the standard population and five age groups (18–24, 25–44, 45–64, 65–84, and ≥85 years) except for health insurance coverage. For health insurance coverage for those aged <65 years, three age groups were used (18–24, 25–44, and 45–64), and for health insurance coverage for those aged ≥65 years, two age groups were used (65–84 and ≥85).

** Persons who reported AI/AN only or AI/AN and another race are included in the AI/AN category. Persons who reported a single race other than Black or African American, Asian, AI/AN, or White, or who reported more than one race not including AI/AN were combined into the "other single and multiple race" category.

†† Based on the 2013 National Center for Health Statistics Urban-Rural Classification Scheme for Counties (https://www.cdc.gov/nchs/data/series/sr_02/sr02_166.pdf). Nonmetropolitan includes counties in micropolitan statistical areas and noncore counties.

§§ Missing data on family income and earnings in the NHIS are imputed using a multiple imputation methodology. Family income is reported as a percentage of the FPL using the weighted average thresholds published annually by the U.S. Census Bureau. https://www.census.gov/data/tables/time-series/demo/income-poverty/historical-poverty-thresholds.html

¶¶ Persons who performed seasonal or contract work and worked during the previous 12 months, or those who were working at a job or business, but not for pay, were considered employed.

*** https://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NHIS/2021/srvydesc-508.pdf

††† Estimates considered unreliable according to the National Center for Health Statistics' standards of reliability. https://www.cdc.gov/nchs/data/series/sr_02/sr02_175.pdf

§§§ Based on the Washington Group Adult Composite Disability Indicator.

¶¶¶ Based on the survey question, "Have you ever been told by a doctor or other health professional that you had…" except for asthma and ME/CFS, which are a combination of the previous question and "Do you still have asthma?," or "Do you still have CFS or ME?"

responsive health care, and more effective pain management therapies can mitigate the burden of chronic pain (*3*).

The findings in this report are subject to at least three limitations. First, the results are generalizable only to the noninstitutionalized, civilian adult population; military personnel and persons in nursing homes and other institutions were excluded. Second, survey responses are self-reported and subject to recall bias. Finally, the COVID-19 pandemic affected the collection of survey responses[§§] and had impacts on health care access and utilization that might affect these results in unknown ways.

Consistent with the population research objectives of the National Pain Strategy to provide more precise estimates of pain among various population groups, this study provides updated estimates of the prevalence of chronic pain and high-impact chronic pain and highlights disparities in the prevalence of pain among certain populations. These findings can guide policymakers, clinicians, and researchers in future research examining the underlying reasons for disparities and in the development of tailored interventions and strategies addressing chronic pain in the United States.

**Summary**

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

An estimated 50 million adults in the United States experienced chronic pain (i.e., pain lasting ≥3 months) in 2016, resulting in substantial health care costs and lost productivity.

**What is added by this report?**

During 2021, an estimated 20.9% of U.S. adults (51.6 million persons) experienced chronic pain, and 6.9% (17.1 million persons) experienced high-impact chronic pain (i.e., chronic pain that results in substantial restriction to daily activities) with a higher prevalence among non-Hispanic American Indian or Alaska Native adults, adults identifying as bisexual, and adults who were divorced or separated.

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

Clinicians, practices, health systems, and payers should vigilantly attend to health inequities and ensure access to appropriate, affordable, diversified, coordinated, and effective pain management care for all persons.

§§ Typical data collection procedures were disrupted, attributable to the COVID-19 pandemic. Additional documentation regarding changes to data collection procedures is available at the NHIS website. https://www.cdc.gov/nchs/nhis/2020nhisdata.htm

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# Secondary Cases of Invasive Disease Caused by Encapsulated and Nontypeable *Haemophilus influenzae* — 10 U.S. Jurisdictions, 2011–2018

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*Haemophilus influenzae* (Hi) can cause meningitis and other serious invasive disease. Encapsulated Hi is classified into six serotypes (a–f) based on chemical composition of the polysaccharide capsule; unencapsulated strains are termed nontypeable Hi (NTHi). Hi serotype b (Hib) was the most common cause of bacterial meningitis in children in the pre-Hib vaccine era, and secondary transmission of Hi among children (e.g., to household contacts and in child care facilities) (*1*,*2*) led to the Advisory Committee on Immunization Practices (ACIP) recommendation for antibiotic chemoprophylaxis to prevent Hib disease in certain circumstances.* High Hib vaccination coverage since the 1990s has substantially reduced Hib disease, and other serotypes now account for most Hi-associated invasive disease in the United States (*3*). Nevertheless, CDC does not currently recommend chemoprophylaxis for contacts of persons with invasive disease caused by serotypes other than Hib and by NTHi (non-b Hi). Given this changing epidemiology, U.S. surveillance data were reviewed to investigate secondary cases of invasive disease caused by Hi. The estimated prevalence of secondary transmission was 0.32% among persons with encapsulated Hi disease (≤60 days of one another) and 0.12% among persons with NTHi disease (≤14 days of one another). Isolates from all Hi case pairs were genetically closely related, and all patients with potential secondary infection had underlying medical conditions. These results strongly suggest that secondary transmission of non-b Hi occurs. Expansion of Hi chemoprophylaxis recommendations might be warranted to control invasive Hi disease in certain populations in the United States, but further analysis is needed to evaluate the potential benefits against the risks, such as increased antibiotic use.

Before the introduction of Hib vaccines in the 1980s, Hib was the most common cause of bacterial meningitis in the United States, accounting for 95%–98% of all cases of invasive Hi disease (*4*). Studies during the pre-Hib vaccine era documented high prevalence of Hib colonization as well as secondary transmission among children exposed to Hib in a household or child care facility setting (*1*,*2*). Reported risk for secondary disease ranged from 1.2% in children aged 12–23 months (*2*) to 6% in infants aged <12 months (*1*). ACIP recommended antibiotic chemoprophylaxis in selected circumstances to prevent secondary Hib transmission. Since licensure and recommendation for Hib vaccines were implemented, the incidence of invasive Hib disease in the United States has declined by approximately 99%, accounting for only 1.3% of invasive Hi disease in 2018. However, invasive disease caused by non-b Hi, particularly serotype a (Hia) and NTHi, has been increasing. During 2008–2017, the overall incidence of Hia increased by 11.1% annually in the United States (*5*). Despite the changing epidemiology of Hi disease, ACIP recommendations for prevention and control of Hib disease in the United States published in 2014 stated that chemoprophylaxis is not recommended for prophylaxis against cases of invasive disease caused by non-b Hi, because secondary transmission has not been documented. Data collected as part of an active, population-based surveillance network were analyzed to investigate possible instances of secondary transmission of Hi.

Cases of invasive Hi disease were identified through Active Bacterial Core surveillance in 10 U.S. jurisdictions.† Clusters of encapsulated Hi disease were defined as cases of invasive disease caused by the same serotype diagnosed in the same county that occurred ≤60 days of one another during 2011–2018. Clusters of unencapsulated Hi disease were defined as cases of invasive NTHi disease in the same county that occurred ≤14 days of one another during 2015–2018; the restricted periods were selected because of the high incidence of NTHi and limited resources. To identify potential secondary transmission among clusters, site personnel reviewed information collected as part of the public health case investigations; patients were not recontacted for this study. Cases were only reviewed through 2018, and the data presented in this analysis is the only available

* Rifampin chemoprophylaxis is recommended for index patients (unless index patients are treated with cefotaxime or ceftriaxone, both of which eradicate Hib colonization) and all household contacts in households with members aged <4 years who are not fully vaccinated or members aged <18 years who are immunocompromised, regardless of their vaccination status. Chemoprophylaxis is recommended in child care facility settings when two or more cases of invasive Hib disease have occurred ≤60 days of one another and unimmunized or underimmunized children attend the facility. https://www.cdc.gov/mmwr/preview/mmwrhtml/rr6301a1.htm

† California (three San Francisco Bay Area counties), Colorado (five Denver-area counties), Connecticut (statewide), Georgia (statewide), Maryland (statewide), Minnesota (statewide), New Mexico (statewide), New York (15 Rochester- and Albany-area counties), Oregon (statewide), and Tennessee (20 counties).

data. Within each cluster, potential secondary transmission was defined as the occurrence of two or more confirmed or suspected epidemiologically linked cases. Pairs of NTHi cases occurring in a mother and infant aged <30 days were excluded from this analysis; the infant cases in these pairs occurred in the first day of life and might have resulted from intrauterine perinatal transmission. If secondary transmission was suspected, whole genome sequencing (WGS) of patient isolates was conducted to evaluate sequence relatedness through single nucleotide polymorphism (SNP) differences. Although no formal threshold for identification of related isolates exists, for this analysis, isolate pairs with fewer than 10 SNP differences were considered closely related, based on a previous analysis of Hi genetic diversity (*6*). Secondary transmission prevalence was calculated as the number of likely secondary cases divided by the total number of reported cases, expressed as a percentage. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[§]

Among 1,584 cases of encapsulated invasive Hi disease reported during 2011–2018, a total of 157 clusters with five instances of likely secondary transmission were identified, for an estimated secondary transmission prevalence among encapsulated Hi cases of 0.32% within 60 days of one another (Table 1). Three case pairs were Hi serotype f, one pair was Hia, and one pair was Hi serotype e; no secondary Hib case pairs occurred. Among 2,426 cases of NTHi disease reported during 2015–2018, a total of 373 clusters with three instances of likely secondary transmission were identified, for an estimated prevalence of secondary transmission among NTHi cases of 0.12% within 14 days of one another. All isolates from possible secondary cases had 0–1 SNP differences from the primary case isolates, indicating the isolates were genetically highly related.

Among five instances of secondary transmission of encapsulated Hi, epidemiologic links identified were in 1) household family contacts (three pairs), 2) residents in the same long-term care facility (one pair), and 3) persons experiencing homelessness (one pair, admitted to the same hospital 11 days apart) (Table 2). Among three instances of likely secondary transmission of NTHi, two pairs occurred among residents of the same long-term care facility and one occurred in residents of the same household (Table 3). All eight likely secondary cases (encapsulated and nontypeable) were diagnosed ≤2 weeks after the primary case, with six occurring ≤7 days after the primary case. All likely secondary cases occurred in patients reported to have an underlying medical condition, and all but one occurred in adults.

## Discussion

Since Hib vaccine became available in the 1980s, most invasive Hi disease in the United States has been caused by non-b serotypes or nontypeable strains. Although this study found no evidence of secondary transmission among Hib clusters, possibly reflecting the effectiveness of vaccination and existing chemoprophylaxis recommendations to prevent secondary Hib infection, the findings do suggest that secondary transmission of non-b Hi likely occurs in the United States in a small percentage of cases. In all instances of likely secondary transmission of non-b Hi, the second patient had one or more underlying medical conditions that might have predisposed them to invasive infections.

Secondary transmission is not routinely assessed as part of national Hi surveillance. Other than the present analysis, the only data on possible secondary transmission of non-b Hi in the

[§] 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.

**TABLE 1. *Haemophilus influenzae* cases, clusters, and pairs of secondary transmission, by serotype — Active Bacterial Core surveillance, 10 U.S. jurisdictions,* 2011–2018**

| Hi type | Reported cases, no. | Possible clusters,[†] no. | Pairs of secondary transmission,[§] no. | Prevalence of secondary transmission, % |
|---|---|---|---|---|
| **Serotype (encapsulated Hi)** | | | | |
| a | 366 | 20 | 1 | 0.27 |
| b | 87 | 6 | 0 | — |
| c | 0 | — | — | — |
| d | 5 | 0 | 0 | — |
| e | 261 | 19 | 1 | 0.38 |
| f | 865 | 112 | 3 | 0.35 |
| All encapsulated Hi[¶] | 1,584 | 157 | 5 | 0.32 |
| **NTHi (unencapsulated)**** | **2,426** | **373** | **3** | **0.12** |

**Abbreviations:** Hi = *Haemophilus influenzae*; NTHi = nontypeable Hi.

* California (three San Francisco Bay Area counties), Colorado (five Denver-area counties), Connecticut (statewide), Georgia (statewide), Maryland (statewide), Minnesota (statewide), New Mexico (statewide), New York (15 Rochester- and Albany-area counties), Oregon (statewide), and Tennessee (20 counties).

† Cases of the same serotype occurring in the same county ≤60 days of one another for encapsulated Hi cases and ≤14 days of one another for cases of NTHi.

§ Confirmed or suspected epidemiologic link between cases and less than 10 single nucleotide polymorphism differences.

¶ Cases occurring during 2011–2018 were reviewed.

** Cases occurring during 2015–2018 were reviewed.

**TABLE 2. Epidemiologic and clinical characteristics of five pairs of secondary transmission of encapsulated *Haemophilus influenzae* within 60 days of one another — Active Bacterial Core surveillance, 10 U.S. jurisdictions,* 2011–2018**

| Characteristic | Pair 1 | Pair 2 | Pair 3 | Pair 4 | Pair 5 |
|---|---|---|---|---|---|
| Serotype | Hia | Hie | Hif | Hif | Hif |
| Year of diagnosis | 2014 | 2017 | 2011 | 2012 | 2017 |
| Epidemiologic link† | Son/Mother | Mother/Son | Twins | Reside at same LTCF | Both experiencing homelessness |
| Sex and age | Male, 15 yrs; female, 56 yrs | Female, 59 yrs; male, 32 yrs | Male, 8 mos; male, 8 mos | Female, 79 yrs; male, 88 yrs | Male, 50 yrs; male, 48 yrs |
| Days between positive cultures | 6 | 4 | 1 | 7 | 11 |
| Clinical syndrome, primary patient | Bacteremic pneumonia | Bacteremic pneumonia | Meningitis, empyema, and septic arthritis | Bacteremic pneumonia | Meningitis |
| Clinical syndrome, secondary patient | Bacteremic pneumonia | Bacteremic pneumonia | Bacteremia and septic arthritis | Bacteremic pneumonia | Bacteremic pneumonia |
| Underlying medical conditions, primary patient | None | Peripheral vascular disease and substance abuse | None | COPD and dementia | Asplenia |
| Underlying medical conditions, secondary patient | Diabetes and obesity | Neuromuscular disorder and seizure disorder | Chronic skin breakdown | Renal insufficiency and dementia | Stroke, cirrhosis, COPD, seizure disorder, and substance abuse |
| Outcomes | Both survived | Both survived | Both survived | Both survived | Both survived |
| Sequence type | ST-56 | ST-18 | ST-124 | ST-124 | ST-124 |
| SNP difference | 1 | 1 | 0 | 1 | 0 |

**Abbreviations:** COPD = chronic obstructive pulmonary disease; Hia = Hi serotype a; Hie = Hi serotype e; Hif = Hi serotype f; LTCF = long-term care facility; SNP = single nucleotide polymorphism; ST = sequence type.
* California (three San Francisco Bay Area counties), Colorado (five Denver-area counties), Connecticut (statewide), Georgia (statewide), Maryland (statewide), Minnesota (statewide), New Mexico (statewide), New York (15 Rochester- and Albany-area counties), Oregon (statewide), and Tennessee (20 counties).
† The primary patient is listed first, and the secondary patient is listed second.

**TABLE 3. Epidemiologic and clinical characteristics of three pairs of secondary transmission of nontypeable *Haemophilus influenzae* within 14 days of one another — Active Bacterial Core surveillance, 10 U.S. jurisdictions,* 2015–2018**

| Characteristic | Pair 1 | Pair 2 | Pair 3 |
|---|---|---|---|
| Year of diagnosis | 2015 | 2017 | 2017 |
| Epidemiologic link | Reside at same LTCF | Reside at same LTCF | Reside in same household |
| Sex and age† | Male, 68 yrs; male, 85 yrs | Female, 81 yrs; female, 94 yrs | Female, 88 yrs; female, 81 yrs |
| Days between positive culture results | 2 | 9 | 2 |
| Clinical syndrome, primary patient | Bacteremic pneumonia | Bacteremic pneumonia | Bacteremic pneumonia |
| Clinical syndrome, secondary patient | Bacteremic pneumonia | Bacteremic pneumonia | Bacteremic pneumonia |
| Underlying medical conditions, primary patient | COPD, congestive heart failure, diabetes, and obesity | Chronic kidney disease, congestive heart failure, dementia, and obesity | ACVD, dementia, and stroke |
| Underlying medical conditions, secondary patient | ACVD, chronic kidney disease, peripheral neuropathy, solid organ malignancy, and stroke | ACVD and obesity | ACVD, diabetes, and stroke |
| Outcomes | Primary patient survived; secondary patient died | Primary patient survived; secondary patient died | Primary patient died; secondary patient survived |
| Sequence type | ST-165 | ST-142 | ST-142 |
| SNP difference | 0 | 1 | 0 |

**Abbreviations:** ACVD = atherosclerotic cardiovascular disease; COPD = chronic obstructive pulmonary disease; LTCF = long-term care facility; NTHi = nontypeable *Haemophilus influenzae*; SNP = single nucleotide polymorphism; ST = sequence type.
* California (three San Francisco Bay Area counties), Colorado (five Denver-area counties), Connecticut (statewide), Georgia (statewide), Maryland (statewide), Minnesota (statewide), New Mexico (statewide), New York (15 Rochester- and Albany-area counties), Oregon (statewide), and Tennessee (20 counties).
† The primary patient is listed first, and the secondary patient is listed second.

**Summary**

What is already known about this topic?

Widespread vaccination has reduced invasive disease caused by *Haemophilus influenzae* (Hi) type b in the United States by approximately 99%, but incidence of disease caused by non-type b Hi has been increasing. CDC does not currently recommend chemoprophylaxis for contacts of persons with invasive disease caused by non-type b Hi.

What is added by this report?

Analysis of Active Bacterial Core surveillance from 10 U.S. jurisdictions identified eight instances of likely secondary transmission of non-type b Hi, all among patients with underlying medical conditions.

What are the implications for public health practice?

These results strongly suggest that secondary transmission of non-type b Hi occurs. Expansion of Hi chemoprophylaxis recommendations might be warranted to control invasive Hi disease in certain populations in the United States, but further analysis is needed to evaluate the potential benefits against the risks, such as increased antibiotic use.

United States are from a 2019 report of two infants with Hia meningitis who attended the same child care facility in Texas and were admitted to the hospital ≤17 days of one another (*7*). WGS conducted at CDC revealed that both isolates were sequence type 576 with no SNP differences. Although no secondary cases were identified during a 2018 Hia outbreak in a small rural Alaskan community, an evaluation found that nasopharyngeal carriage of Hia was highest among close contacts, and no further cases occurred after administration of chemoprophylaxis (*8*).

Given the increasing incidence of non-b Hi disease and the occurrence of Hia outbreaks in some communities in the United States, chemoprophylaxis has been recommended for close contacts of Hia cases by jurisdictions with high Hia disease incidence. In 2018, the Alaska Department of Health and Social Services recommended that clinicians strongly consider offering chemoprophylaxis to close contacts of patients with invasive Hia, particularly when there are household contacts who are aged <4 years or who are immunocompromised.¶ This recommendation is similar to those adopted in tribal communities in the southwest United States that experience an elevated incidence of invasive disease caused by Hia and Hib (*9*). In addition, since 2018, the Committee on Infectious Diseases of the American Academy of Pediatrics recommends that clinicians consider prophylaxis for cases of invasive Hia disease in households with children aged <4 years or children who are immunocompromised and recommends a similar approach to child care facility contacts in consultation with public health officials (*10*).

The findings in this study are subject to at least three limitations. First, prevalence of secondary transmission was likely underestimated because epidemiologic connections were established using only routinely collected data, and WGS was not performed on all isolates. Second, prevalence of secondary NTHi is likely further underestimated because the cluster definition was limited to cases that occurred within 14 days of one another, whereas 60 days is usually used for defining secondary Hi. Additional studies are needed to evaluate secondary cases of NTHi that occurred within 60 days of one another. Finally, data were only available for this analysis through 2018. Although these data might not fully reflect current Hi epidemiology, these findings strongly suggest secondary transmission of non-b Hi occurs in the United States and are relevant to guide updates to current chemoprophylaxis recommendations.

Invasive Hi disease is serious and can be life-threatening. Chemoprophylaxis taken by close contacts is effective in preventing secondary transmission of Hib and might be an important tool for preventing secondary cases of non-b Hi disease. Given the changing epidemiology of Hi in the United States and likely secondary transmission of non-b Hi documented in this report, expanding the current chemoprophylaxis recommendations might be warranted to prevent disease in certain populations and might facilitate clinical and public health decision-making, especially because chemoprophylaxis must often be offered before serotyping results are available. Further analysis is needed to evaluate the potential benefits of changing chemoprophylaxis recommendations for Hi against the risks, such as increased antibiotic use.

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¶ http://www.epi.alaska.gov/bulletins/docs/b2018_09.pdf

meeting on infectious diseases, in her role as associate editor. No other potential conflicts of interest were disclosed.

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# Update on Wild Poliovirus Type 1 Outbreak — Southeastern Africa, 2021–2022

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Since the Global Polio Eradication Initiative (GPEI) began in 1988, the number of wild poliovirus (WPV) cases has declined by >99.99%. Five of the six World Health Organization (WHO) regions have been certified free of indigenous WPV, and WPV serotypes 2 and 3 have been declared eradicated globally (*1*). WPV type 1 (WPV1) remains endemic only in Afghanistan and Pakistan (*2*,*3*). Before the outbreak described in this report, WPV1 had not been detected in southeastern Africa since the 1990s, and on August 25, 2020, the WHO African Region was certified free of indigenous WPV (*4*). On February 16, 2022, WPV1 infection was confirmed in one child living in Malawi, with onset of paralysis on November 19, 2021. Genomic sequence analysis of the isolated poliovirus indicated that it originated in Pakistan (*5*). Cases were subsequently identified in Mozambique. This report summarizes progress in the outbreak response since the initial report (*5*). During November 2021–December 2022, nine children and adolescents with paralytic polio caused by WPV1 were identified in southeastern Africa: one in Malawi and eight in Mozambique. Malawi, Mozambique, and three neighboring countries at high risk for WPV1 importation (Tanzania, Zambia, and Zimbabwe) responded by increasing surveillance and organizing up to six rounds of national and subnational polio supplementary immunization activities (SIAs).* Although no cases of paralytic WPV1 infection have been reported in Malawi since November 2021 or in Mozambique since August 2022, undetected transmission might be ongoing because of poliovirus surveillance gaps and testing delays. Efforts to further enhance poliovirus surveillance sensitivity, improve SIA quality, and strengthen routine immunization are needed to ensure that WPV1 transmission has been interrupted within 12 months of the first case, thereby preserving the WHO African Region's WPV-free status.

## Detection of WPV1

During November 2021–December 2022, and as of April 7, 2023, nine cases of paralytic polio caused by WPV1 had been detected in southeastern Africa. One case was previously reported in Lilongwe, Malawi (*5*), with onset of paralysis on November 19, 2021, and eight cases were identified in Mozambique (all in Tete Province in the country's northwestern region) (Figure 1), with the latest onset on August 10, 2022. Several of the cases in Mozambique occurred in children and adolescents living close to international borders with Malawi, Zambia, and Zimbabwe. At paralysis onset, patient age ranged from 5 months to 14 years (median = 59 months). Five of the nine cases occurred in children and adolescents aged ≥5 years. Only two of the patients had received ≥3 doses of oral polio vaccine, the minimum required for adequate protection from type 1 polioviruses. Delays were reported in confirming all nine cases: a median of 53 days (range = 36–96 days) elapsed from the onset of paralysis to reporting genomic sequencing results, primarily because of delays in international stool specimen transport but also because of delays in case detection and in testing of stool samples and isolates upon their receipt in the laboratories.

Genomic sequence analysis of all polioviruses isolated in this outbreak demonstrated that the closest relative was a WPV1 lineage detected in Sindh, Pakistan in October 2019 (*5*). Extensive nucleotide changes detected among outbreak isolates indicated that WPV1 had been circulating in southeastern Africa for approximately 2 years before detection of the Malawi case.

## Routine Immunization

Routine immunization of all children with a polio vaccine is the cornerstone to prevention of disease transmission worldwide. In 2021, all five countries involved in this response had gaps in their routine immunization coverage for bivalent oral polio vaccine (bOPV, containing Sabin-strain serotypes 1 and 3), with none reaching the 90% national target recommended by WHO's Global Vaccine Action Plan.† In 2021, national coverage estimates for 3 doses of bOPV were 89% in Malawi, 67% in Mozambique, 70% in Tanzania, 87% in Zambia,

* Polio SIAs are mass immunization campaigns intended to interrupt poliovirus circulation, usually by immunizing every child aged <5 years with 2 oral polio vaccine doses, regardless of previous immunization status.

† https://www.who.int/publications/i/item/global-vaccine-action-plan-2011-2020

and 86% in Zimbabwe. Efforts to strengthen polio routine immunization were made in all countries throughout 2022; the July 2023 release of 2022 global coverage estimates by WHO and UNICEF is anticipated to evaluate the success of these interventions.

## Poliovirus Surveillance

Poliovirus transmission is detected primarily through surveillance for acute flaccid paralysis (AFP) among children and adolescents aged <15 years accompanied by testing of stool specimens at a WHO-accredited laboratory in the Global Polio Laboratory Network. Two core AFP surveillance performance indicators are the nonpolio AFP (NPAFP) rate[§] and stool adequacy rate[¶] (6). During 2022, GPEI supported ministries of health in the two affected and three at-risk countries by deploying staff members to high-risk districts. There they assisted with conducting active surveillance visits to health facilities, sensitizing local clinicians and public health workers regarding AFP recognition and reporting, conducting community case searches for additional children and adolescents with paralysis, performing AFP case investigations and follow-up exams, fast-tracking sample transportation from the point of collection to the laboratory, and conducting other surveillance-strengthening activities.

An NPAFP rate of two or more cases per 100,000 population aged <15 years is the global benchmark for surveillance that is sufficiently sensitive to detect a case of polio. During 2021 (before detection of the Malawi case), review of NPAFP surveillance performance in the outbreak-response countries identified many gaps at the district level (Figure 2). Among 554 districts within the five countries, 370 (67%) achieved this benchmark NPAFP rate. During 2022, subnational NPAFP rates improved markedly; 512 (92%) districts achieved the benchmark.

Among the five countries, two (Tanzania and Zimbabwe) achieved national-level stool adequacy rates of ≥80% in 2021 (98.5% and 91.5%, respectively) and 2022 (98.2% and 91.3%, respectively). However, national data can obscure considerable gaps in stool adequacy at the district level. For example, in 2022, 96% of districts in Tanzania and 87% in Zimbabwe achieved the 80% benchmark. In Malawi, Mozambique, and Zambia, this benchmark was achieved in only 43%, 52%, and 34% of districts, respectively. Without adequate stool specimens being delivered for laboratory analysis, additional cases of polio cannot be detected, and the full scope of the WPV1 outbreak cannot be known.

Environmental surveillance (testing of sewage for poliovirus) can supplement AFP surveillance. Environmental surveillance sites are considered reliably functioning when ≥50% of samples collected yield nonpolio enteroviruses (NPEVs). Before the outbreak, environmental sampling had been established in Mozambique, Tanzania, and Zambia; however, only Tanzania and Zambia had reliable, functioning environmental sampling programs. With intensive efforts by ministries of health and GPEI in 2022, environmental sampling was initiated in Malawi, and the number of sites in Mozambique, Tanzania, and Zambia was increased. The 50% NPEV detection target rate was achieved in six of 12 sites in Malawi, three of 14 in Mozambique, 10 of 11 in Tanzania, and 11 of 11 in Zambia. As of April 7, 2023, no sample collected at an environmental surveillance site during 2021–2022 in any of these countries has tested positive for WPV1.

## Supplementary Immunization Activities

With technical assistance from GPEI, the five outbreak response countries initiated a series of SIAs with bOPV within 33 days of the notification of WPV1 in Malawi; the SIAs targeted children aged <5 years. Four countries (Malawi, Mozambique, Tanzania, and Zambia) synchronized their initial response SIAs conducted in March 2022. However, subsequent rounds were not synchronized because of a variety of logistical constraints. In total, during 2022, Malawi conducted four national rounds, Tanzania and Zambia each conducted three, and Mozambique and Zimbabwe each conducted two. Subnational rounds were conducted in Mozambique (four), Tanzania (one), and Zambia (one).[**] During the sixth SIA in Mozambique, the target age range was increased to children and adolescents aged <15 years from children aged <5 years, because five of Mozambique's eight WPV1 cases were detected in patients aged ≥5 years.

The quality of the SIAs was assessed by lot quality assurance sampling (LQAS) surveys within a week of SIA completion. In each district (lot) surveyed, six settlements were randomly selected, and 10 children from the SIA's target age group were randomly selected within each.[††] If at least 57 of the 60 selected persons had been vaccinated, the SIA was considered to be

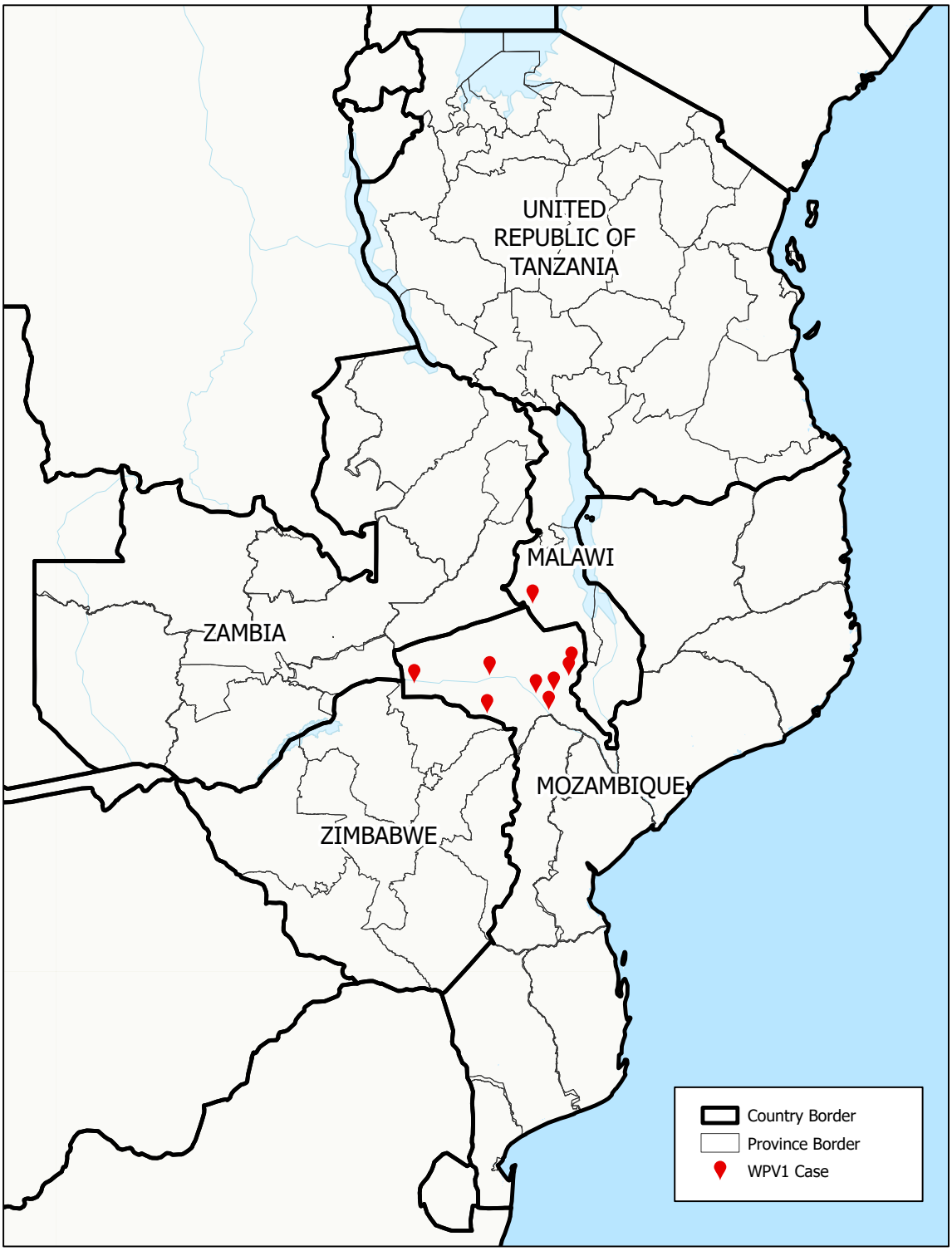
[§] The NPAFP rate is an indicator of surveillance sensitivity; the global benchmark is detection of two or more NPAFP cases per 100,000 children and adolescents aged <15 years per year in nonoutbreak conditions, and three or more NPAFP cases per 100,000 children and adolescents aged <15 years per year during outbreaks.

[¶] Stool adequacy refers to the percentage of AFP patient stool specimens that are collected within 14 days of paralysis onset and arrive at the laboratory in good condition. Stool adequacy rates ≥80%, the global benchmark, demonstrate that poliovirus can be effectively isolated from AFP stool samples if present.

[**] By country, national and subnational rounds occurred during the following approximate date ranges: Malawi (March 21–October 16); Mozambique (March 21–December 11); Tanzania (March 24–December 4); Zambia (March 21–October 30); and Zimbabwe (October 27–December 4).

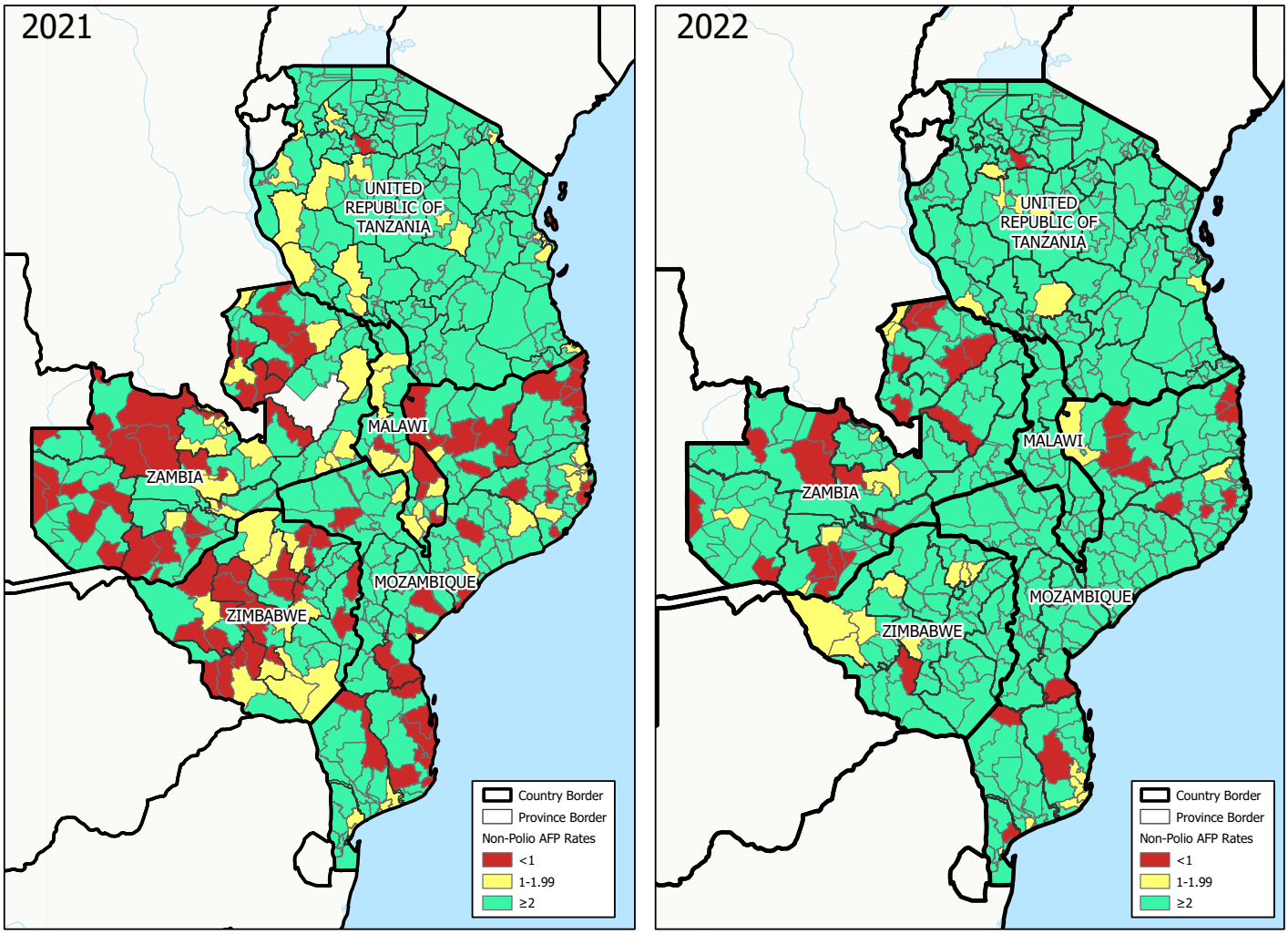
[††] Because the sixth SIA round in Mozambique targeted children and adolescents aged <15 years, the LQAS surveys for this round targeted children and adolescents in this age group.

**FIGURE 1. Location of wild poliovirus type 1 cases and the five outbreak response countries* — southeastern Africa, 2021–2022**




**Abbreviation:** WPV1 = wild poliovirus type 1.
* Malawi, Mozambique, Tanzania, Zambia, and Zimbabwe.

**FIGURE 2: Nonpolio acute flaccid paralysis rates,* by district in the five outbreak response countries† — southeastern Africa, 2021–2022**




**Abbreviation:** AFP = acute flaccid paralysis.
* Cases per 100,000 children and adolescents aged <15 years.
† Malawi, Mozambique, Tanzania, Zambia, and Zimbabwe.

high-quality in that district (i.e., the district passed, with evidence that coverage is approaching 90%).[§§] After the first SIAs in Malawi, Mozambique, and Zambia, fewer than 35% of districts passed based on LQAS results; however, assessed quality improved substantially during subsequent rounds (Figure 3). By the third SIA round in Mozambique and Tanzania, and the fourth round in Malawi and Zambia, more than 70% of districts passed based on LQAS results. Zimbabwe's SIA quality also improved between the country's first and second rounds.

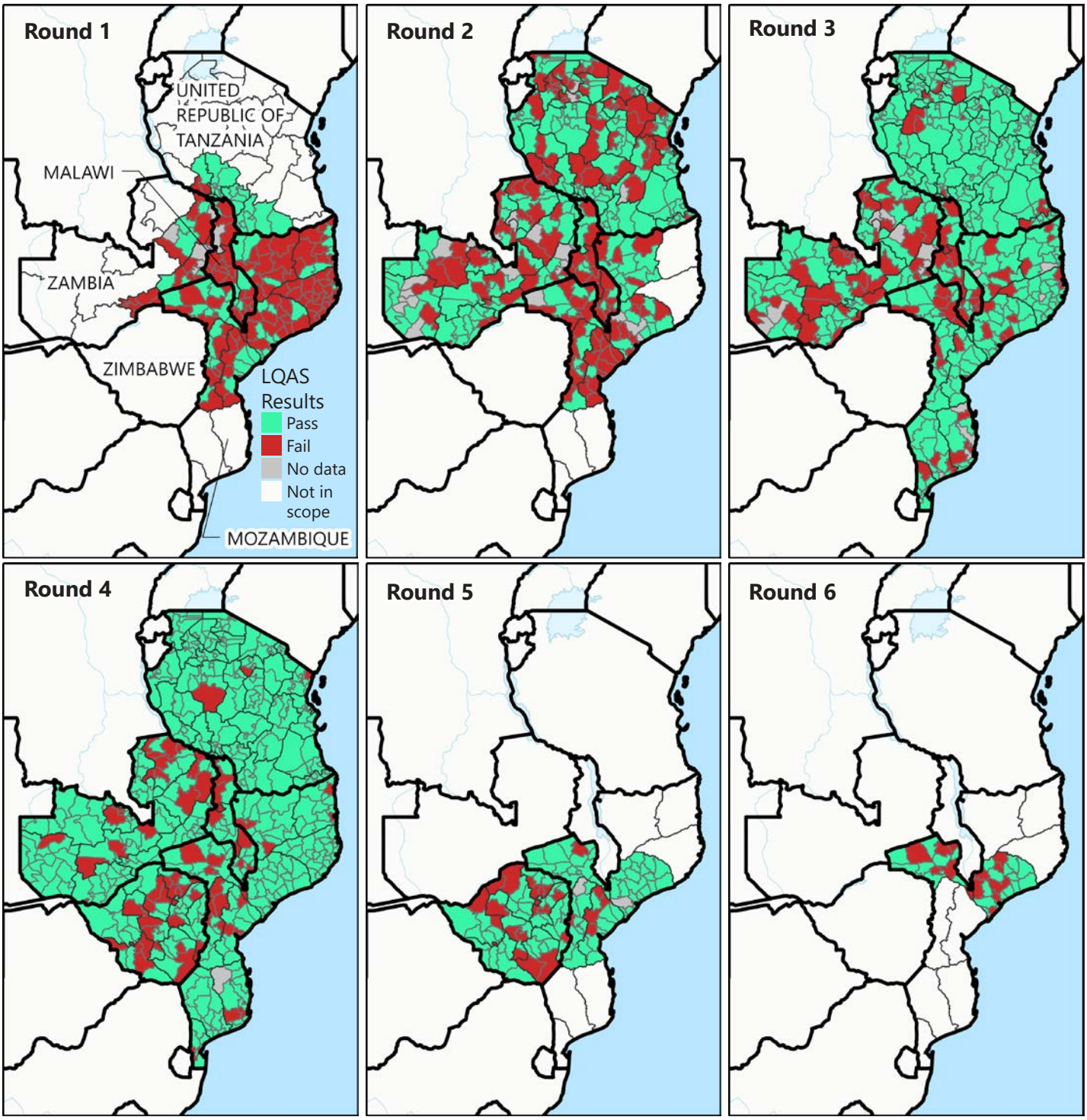
Importantly, three of the six districts in Malawi and Mozambique where WPV1 cases were found failed LQAS in 50% of their countries' SIA rounds; failures occurred in both early and later rounds. In Mozambique, this included the Moatize district, where four of the nine WPV1 cases had been detected during this outbreak.

## Discussion

All countries, including those that are polio-free, must be vigilant against importation of poliovirus and establishment of local transmission. The risk for importation and local transmission has been demonstrated by WPV1 detection in Malawi and transmission in Mozambique. GPEI partners and ministries of health in the five southeastern African countries have exhibited efficient collaboration in this outbreak response, extending from the international coordination level to the dedicated

[§§] https://polioeradication.org/wp-content/uploads/2016/09/Assessing-Vaccination-Coverage-Levels-Using-Clustered-LQAS_Apr2012_EN.pdf

**FIGURE 3. Bivalent oral poliovirus vaccine supplementary immunization activity quality as assessed by lot quality assurance sampling surveys, by supplementary immunization activity and district in the five outbreak response countries* — southeastern Africa, 2022**




**Abbreviation:** LQAS = lot quality assurance sampling.
* Malawi, Mozambique, Tanzania, Zambia, and Zimbabwe.

frontline health workers. Government engagement has been high in all five countries, despite many competing priorities. The establishment of national-level emergency operations centers for poliovirus responses has facilitated increased coordination and collaboration among GPEI partners. Surge GPEI international and national technical support has augmented existing personnel, particularly when addressing hard-to-reach areas and strengthening AFP surveillance efforts for timely detection.

Alongside these successes, the WPV1 outbreak response in southeastern Africa has faced several challenges. Although WPV1 transmission appears to have been interrupted, the identification of circulating vaccine-derived poliovirus (cVDPV) type 1 in Malawi and Mozambique during 2022 indicates ongoing local susceptibility to type 1 poliovirus (*7*). Global bOPV supply limitations led to delayed or smaller-scale SIAs in the outbreak response countries, which might not have been of sufficient magnitude to stop WPV1 transmission. Results of LQAS surveys in the six districts where WPV1 cases were reported indicate that SIAs might also have been of insufficiently high quality to stop transmission. In addition, cocirculation of cVDPV type 1 in Malawi and Mozambique and cVDPV type 2 in Mozambique and Zambia led to resource and logistical constraints in the response to the WPV1 outbreak (*7*). Prevention of further cross-border transmission could be accomplished through continued improved collaboration among bordering countries.

The findings in this report are subject to at least three limitations. First, gaps in poliovirus surveillance and delays in specimen testing could result in ongoing undetected transmission. Second, routine immunization coverage estimates are based on administrative data and might be inaccurate because of errors in recording doses administered or in estimating the target population; as a result, gaps in immunity might be underestimated. Finally, LQAS survey results might not be representative of the true proportion of children reached during each SIA.

The WHO Africa Regional Certification Commission has indicated that this outbreak does not currently affect Africa's WPV-free certification, because it occurred after virus importation from Pakistan. However, if transmission continues ≥12 months after outbreak confirmation, this certification is at risk. For the WHO African Region to remain WPV-free, intensified efforts should focus on enhancing surveillance sensitivity and timeliness, improving SIA quality, and strengthening routine immunization efforts.

**Summary**

What is already known about this topic?

The World Health Organization (WHO) African Region was certified as having interrupted indigenous wild poliovirus (WPV) transmission in August 2020. In 2022, an outbreak of WPV type 1 (WPV1) was detected in southeastern Africa.

What is added by this report?

To date, one WPV1 case was detected in Malawi and eight in Mozambique. These countries and Tanzania, Zambia, and Zimbabwe implemented up to six national and subnational supplementary immunization activities (SIAs) per country and strengthened poliovirus surveillance.

What are the implications for public health practice?

Further enhancing surveillance, implementing high-quality SIAs, and strengthening routine immunization are essential to stopping WPV1 transmission within 12 months of the first case, thereby preserving the WHO African Region's WPV-free status.

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# Racial and Ethnic Disparities in Mpox Cases and Vaccination Among Adult Males — United States, May–December 2022

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As of December 31, 2022, a total of 29,939 monkeypox (mpox) cases* had been reported in the United States, 93.3% of which occurred in adult males. During May 10–December 31, 2022, 723,112 persons in the United States received the first dose in a 2-dose mpox (JYNNEOS)† vaccination series; 89.7% of these doses were administered to males (*1*). The current mpox outbreak has disproportionately affected gay, bisexual, and other men who have sex with men (MSM) and racial and ethnic minority groups (*1*,*2*). To examine racial and ethnic disparities in mpox incidence and vaccination rates, rate ratios (RRs) for incidence and vaccination rates and vaccination-to-case ratios were calculated, and trends in these measures were assessed among males aged ≥18 years (males) (*3*). Incidence in males in all racial and ethnic minority groups except non-Hispanic Asian (Asian) males was higher than that among non-Hispanic White (White) males. At the peak of the outbreak in August 2022, incidences among non-Hispanic Black or African American (Black) and Hispanic or Latino (Hispanic) males were higher than incidence among White males (RR = 6.9 and 4.1, respectively). Overall, vaccination rates were higher among males in racial and ethnic minority groups than among White males. However, the vaccination-to-case ratio was lower among Black (8.8) and Hispanic (16.2) males than among White males (42.5) during the full analytic period, indicating that vaccination rates among Black and Hispanic males were not proportionate to the elevated incidence rates (i.e., these groups had a higher unmet vaccination need). Efforts to increase vaccination among Black and Hispanic males might have resulted in the observed relative increased rates of vaccination; however, these increases were only partially successful in reducing overall incidence disparities. Continued implementation of equity-based vaccination strategies is needed to further increase vaccination rates and reduce the incidence of mpox among all racial and ethnic groups. Recent modeling data (*4*) showing that, based on current vaccination coverage levels, many U.S. jurisdictions are vulnerable to resurgent mpox outbreaks, underscore the need for continued vaccination efforts, particularly among racial and ethnic minority groups.

Data on confirmed and probable cases of mpox were electronically sent by health departments to CDC as part of national case surveillance through a standardized case report form§ or to the National Notifiable Diseases Surveillance System.¶ Data on JYNNEOS vaccine doses administered were reported to CDC by U.S. jurisdictions (*2*) using a reporting system adapted from protocols originally developed for reporting data on COVID-19 vaccine administration. Case and first-dose vaccination data for males** aged ≥18 years across seven racial and ethnic groups†† were included in this analysis; analysis was limited to males because approximately 94% of cases occurred in this group, and 90% of vaccine doses were administered to males. Incidence and vaccination rates were calculated as cases and vaccinations, respectively, per 100,000 MSM because the MSM population was disproportionately affected by the current mpox outbreak. The number of MSM in each racial and ethnic group was estimated by multiplying each racial and ethnic group's adult male population§§ by 3.9%, the estimated

* https://www.cdc.gov/poxvirus/monkeypox/response/2022/demographics.html (accessed January 18, 2023).

† https://www.cdc.gov/poxvirus/monkeypox/response/2022/vaccines_data.html (accessed January 18, 2023).

§ https://www.cdc.gov/poxvirus/monkeypox/health-departments/case-reporting.html

¶ https://www.cdc.gov/nndss/index.html

** For case data, persons who reported their sex at birth as male and gender identity as male were categorized as males. Among persons with information on gender identity but not on sex at birth, those who reported their gender identity as male were categorized as males. Among persons with information on sex at birth and not on gender identity, those who reported their sex at birth as male were categorized as males. Thus, some mpox cases in transgender male persons and gender nonbinary persons might have been included in this analysis. For vaccine administration data, persons who reported their sex at birth as male were categorized as males. Gender identity information was not available for vaccine administration data.

†† All persons who reported Hispanic ethnicity, regardless of race, were categorized as Hispanic. Persons who did not report ethnicity as Hispanic (including missing ethnicity) were categorized as non-Hispanic and self-reported race in the following categories: American Indian or Alaska Native, Asian, Black, Native Hawaiian or other Pacific Islander, White, and multiple races (more than one race category selected) or other race. Persons with missing data on ethnicity and race were categorized as missing or unknown.

§§ https://wonder.cdc.gov/single-race-v2021.html

percentage of U.S. men who reported having sex with a man in the previous 5 years.[¶] (*5*,*6*).

Incidence and vaccination rates were calculated by race and ethnicity (Asian, non-Hispanic American Indian or Alaska Native [AI/AN], Black, non-Hispanic Native Hawaiian or other Pacific Islander, White, Hispanic, and non-Hispanic multiple races or other races). Because Black, Hispanic, and White males accounted for >88% of mpox cases in males and 83% of JYNNEOS doses administered to males, this report focuses primarily on these three groups. RRs for incidence and vaccination rates were calculated for Black and Hispanic males, with White males as the reference population. The vaccination-to-case ratio was calculated as the number of adult males within a group who received a first dose of vaccine during a given period divided by the number of mpox cases in that group during the same period (*3*).[***] This metric was used to ascertain whether higher vaccination rates in racial and ethnic minority groups were proportional to higher mpox incidence in these groups. All disparity measures were calculated for the overall outbreak period (May–December 2022) and for subperiods during 2022: May–June, July, August, September, and October–December (May–June and October–December were combined into single periods, because case and vaccination counts were low during those months). R statistical software (version 4.2.1; R Foundation) was used to conduct all analyses. This activity was reviewed by CDC and was conducted consistent with applicable federal law and policy.[†††]

During May 10–December 31, 2022, a total of 27,946 mpox cases were reported among males aged ≥18 years, including 30.7% in Black males, 29.5% in Hispanic males, and 27.9% in White males (Table 1). Among 648,336 first-dose vaccinations administered to adult males, 11.6%, 20.6% and 51.1% were administered to Black, Hispanic, and White males, respectively. Mpox incidence and vaccination rates were highest in August 2022 for all racial and ethnic groups, with the exception of incidence among White males, which peaked in July. Mpox incidence and vaccination rates subsequently declined through December (Table 2).

During May 10–December 31, 2022, mpox case incidences were higher among racial and ethnic minority males than those among White males, except Asian males, whose incidence was similar to that among White males. Disparities in mpox incidence peaked in August, particularly among Black (RR = 6.9) and Hispanic (RR = 4.1) males, relative to White males. After incidence peaked in August, disparities decreased slightly through December; however, substantial disparities in incidence remained during October–December.

During May 10–December 31, 2022, overall vaccination rates were typically higher among all racial and ethnic minority adult males, except AI/AN males, than rates among White males. However, early in the outbreak (during May–June), vaccination rates among Black and Hispanic males were lower than those among White males (RR = 0.4 and 0.7, respectively), and by August, rates among Black and Hispanic males exceeded those among White males (RR = 1.3 and RR = 1.4, respectively).

The vaccination-to-case ratio aggregated across all racial and ethnic groups during the full analytic period was 23.8. The highest vaccination-to-case ratios were observed among Asian (59.2) and White (42.5) males, whereas those among Hispanic and Black males were the lowest (16.2 and 8.8, respectively). From the beginning of the outbreak (May–June) to its peak (August), all groups showed increases in vaccination-to-case ratios, reflecting higher vaccination availability during this period. However, across each separate period examined, vaccination-to-case ratios were lowest among Black and Hispanic males (Figure).

## Discussion

Analysis of mpox case and vaccine administration data by race and ethnicity provides three important insights. First,

[¶] The number of MSM was estimated by assuming 3.9% of adult males in all racial and ethnic groups are MSM, based on a 2012 meta-analysis of four population-based surveys. This value was applied in subsequent studies to estimate the U.S. MSM population. This analysis used the entire MSM population aged ≥18 years as the denominator for mpox case rates and mpox vaccination rates. However, if racial and ethnic minority groups are disproportionately represented in the subpopulation of MSM at highest risk for mpox (e.g., MSM with HIV and MSM with indications for HIV preexposure prophylaxis), the use of subpopulations of MSM with highest risk for mpox as the denominator for mpox incidence rates could mask racial and ethnic incidence disparities. For example, assuming that all MSM at high risk for mpox have the same monthly risk for acquiring mpox, but MSM in racial and ethnic minority groups are more likely to be at high risk for mpox than White MSM, no racial and ethnic incidence disparities would be observed when the analysis was limited to MSM at high risk. Conversely, using the entire MSM population as the denominator for mpox vaccination rates could mask racial and ethnic mpox vaccination disparities among those most in need of vaccination. However, using the same denominator (all MSM) for mpox case rates and mpox vaccination rates allowed for consistency in comparing racial and ethnic disparities in these two outcomes.

[***] CIs for disparity measures in reported mpox incidence and vaccination rates were not calculated because the numerators of these rate calculations were the actual number of reported cases and vaccinations, not estimates of the number of cases and vaccinations. Although an estimate (the MSM population size) was used in the denominators of the mpox incidence and vaccination rates, use of the estimated MSM population size affected only the absolute magnitude of the rates, not the relative comparisons of rates across racial and ethnic groups. Because the MSM population was estimated assuming MSM account for 3.9% of adult males in each racial and ethnic group, using the entire adult male population as the denominator would result in incidence and vaccination rates that are approximately 3.9% as high (for all racial and ethnic groups) as the rates when estimated using the MSM population as the denominator and would have practically no effect on the rate ratios and vaccination-to-case ratios.

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

**TABLE 1. Characteristics of adult males* with mpox and those who received JYNNEOS vaccine — United States, May 10–December 31, 2022†**

| Characteristic | No. (%)§ | | |
|---|---|---|---|
| | Mpox cases | JYNNEOS first-dose¶ vaccines | JYNNEOS vaccine total doses (first and second doses) |
| **Total** | **27,946** | **648,336** | **1,039,633** |
| **Age group, yrs**** | | | |
| 18–30 | 8,598 (30.8) | 156,214 (24.1) | 235,585 (22.7) |
| 31–40 | 11,247 (40.2) | 200,848 (31.0) | 318,614 (30.6) |
| 41–50 | 5,362 (19.2) | 114,283 (17.6) | 186,764 (18.0) |
| 51–60 | 2,299 (8.2) | 108,261 (16.7) | 181,438 (17.5) |
| ≥61 | 440 (1.6) | 68,730 (10.6) | 117,232 (11.3) |
| **Race and ethnicity††** | | | |
| AI/AN | 103 (0.4) | 2,648 (0.4) | 4,208 (0.4) |
| Asian | 747 (2.7) | 44,259 (6.8) | 71,659 (6.9) |
| Black or African American | 8,577 (30.7) | 75,496 (11.6) | 118,275 (11.4) |
| NH/OPI | 67 (0.2) | 1,630 (0.3) | 2,580 (0.2) |
| White | 7,793 (27.9) | 331,020 (51.1) | 545,728 (52.5) |
| Hispanic or Latino | 8,248 (29.5) | 133,759 (20.6) | 207,910 (20.0) |
| Multiple races or other | 794 (2.8) | 38,682 (6.0) | 58,699 (5.6) |
| Missing or unknown | 1,617 (5.8) | 20,842 (3.2) | 30,574 (2.9) |
| **U.S. Census Bureau region§§** | | | |
| Northeast | 6,177 (22.1) | 159,288 (24.6) | 250,150 (24.1) |
| Midwest | 2,761 (9.9) | 79,443 (12.3) | 129,393 (12.4) |
| South | 11,126 (39.8) | 175,657 (27.1) | 280,221 (27.0) |
| West | 7,745 (27.7) | 230,973 (35.6) | 374,697 (36.0) |
| Puerto Rico | 137 (0.5) | 2,975 (0.5) | 5,172 (0.5) |

**Abbreviations:** AI/AN = American Indian or Alaska Native; mpox = monkeypox; NH/OPI = Native Hawaiian or other Pacific Islander.

* Sex and gender data were missing for 442 (1.5%) mpox patients and 12,507 (1.7%) vaccine recipients. Data from these persons were not included.

† Case data updated through January 8, 2023, at 2:00 p.m. Eastern Time. Vaccination data updated through January 10, 2023.

§ Percentages might not sum to 100% because of rounding.

¶ At least 1 JYNNEOS vaccine dose received.

** Age was missing for 278 (0.9%) mpox patients and 10 (0.001%) vaccine recipients.

†† All persons who reported Hispanic or Latino (Hispanic) ethnicity, regardless of race, were categorized as Hispanic. Persons who did not report ethnicity as Hispanic (including missing ethnicity) were categorized as non-Hispanic and self-reported race in the following categories: AI/AN, Asian, Black or African American, NH/OPI, White, and multiple races (more than one race category selected) or other race. Persons with missing data on ethnicity and race were categorized as missing or unknown.

§§ https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf. Puerto Rico is not included in any U.S. Census Bureau region.

there are notable disparities in mpox incidence, characterized by higher rates among males in most racial and ethnic minority groups compared with rates among White males. Second, males in most racial and ethnic minority groups had slightly higher vaccination rates than White males; however, these higher vaccination rates were not sufficiently high to fully offset the disproportionate mpox incidences in these groups. Finally, vaccination-to-case ratios indicated that there is a higher unmet vaccination need among racial and ethnic minority groups, particularly among Black and Hispanic males.

Concerted efforts to increase vaccination among racial and ethnic groups might have contributed to increases in vaccination rates among racial and ethnic minority males (*2*). For example, in September 2022, CDC implemented the mpox vaccine equity pilot program to ensure that vaccination efforts reached communities most affected by the outbreak.§§§ In addition, initiation of intradermal vaccine administration on August 9, 2022,¶¶¶ increased available doses by three to five–fold, leading to increased access to vaccination (*1*,*7*,*8*).

The vaccination-to-case ratio, a novel measure of vaccination relative to incidence, estimated that approximately 43 White males were vaccinated for each reported mpox case among White males, whereas only nine Black and 16 Hispanic males received mpox vaccination for each reported mpox case within these groups. These findings suggest that the higher vaccination rates among Black and Hispanic males compared with White males (RR = 1.2 and 1.4, respectively) were not commensurate with their higher mpox incidence (RRs = 5.8 and 3.6, respectively). These groups still had higher unmet vaccination needs relative to their mpox incidence. Accordingly, substantially higher vaccination rates among Black and Hispanic males are needed to address the disproportionate incidence and unmet vaccination needs in these groups.

§§§ https://www.cdc.gov/poxvirus/monkeypox/health-departments/vaccine-equity-pilot.html

¶¶¶ https://www.cdc.gov/poxvirus/monkeypox/interim-considerations/overview.html

**TABLE 2. Mpox incidence and JYNNEOS first-dose administration rates, relative measures of racial and ethnic disparity, and vaccination-to-case ratios among adult males,* by race and ethnicity† and month — United States, May 10–December 31, 2022**

| Metric | Overall | May–Jun§ | Jul | Aug | Sep | Oct–Dec |
|---|---|---|---|---|---|---|
| **Mpox case incidence (cases per 100,000 MSM)¶** | | | | | | |
| AI/AN | **291.2** | 2.8 | 53.7 | 144.3 | 62.3 | 28.3 |
| Asian | **258.5** | 15.2 | 91.4 | 100.8 | 31.6 | 19.8 |
| Black or African American | **1,467.8** | 31.5 | 432.4 | 608.8 | 265.4 | 137.4 |
| NH/OPI | **728.6** | 43.5 | 163.2 | 348.7 | 142.2 | 32.9 |
| White | **252.7** | 16.3 | 89.8 | 88.4 | 37.3 | 21.1 |
| Hispanic or Latino | **907.9** | 36.5 | 286.5 | 364.9 | 146.9 | 76.0 |
| Multiple races or other | **968.6** | 28.1 | 318.5 | 350.1 | 168.3 | 107.1 |
| **JYNNEOS vaccine first dose** administration rates (doses administered per 100,000 MSM)¶** | | | | | | |
| AI/AN | **7,486.6** | 33.9 | 939.0 | 3,283.3 | 2,019.1 | 1,416.0 |
| Asian | **15,315.3** | 60.9 | 2,980.5 | 7,985.0 | 3,198.3 | 1,945.3 |
| Black or African American | **12,920.1** | 25.5 | 1,795.3 | 7,313.1 | 2,673.9 | 1,678.4 |
| NH/OPI | **17,725.1** | 87.0 | 3,003.9 | 9,403.1 | 3,839.5 | 2,550.2 |
| White | **10,735.4** | 65.2 | 2,046.0 | 5,433.1 | 2,213.5 | 1,389.8 |
| Hispanic or Latino | **14,723.5** | 47.6 | 2,533.9 | 7,651.2 | 3,147.3 | 2,132.4 |
| Multiple races or other | **47,188.7** | 189.1 | 7,120.7 | 25,432.9 | 14,545.1 | 10,598.3 |
| **Relative disparities in mpox incidence¶** | | | | | | |
| Black or African American:White RR | **5.8** | 1.9 | 4.8 | 6.9 | 7.1 | 6.5 |
| Hispanic or Latino:White RR | **3.6** | 2.2 | 3.2 | 4.1 | 3.9 | 3.6 |
| **Relative disparities in JYNNEOS first-dose** vaccination rates¶** | | | | | | |
| Black or African American:White RR | **1.2** | 0.4 | 0.9 | 1.3 | 1.2 | 1.2 |
| Hispanic or Latino:White RR | **1.4** | 0.7 | 1.2 | 1.4 | 1.4 | 1.5 |
| **Vaccination-to-case ratio††** | | | | | | |
| AI/AN | **25.7** | 12.0 | 17.5 | 22.5 | 31.1 | 47.0 |
| Asian | **59.2** | 4.0 | 32.6 | 76.9 | 90.6 | 85.2 |
| Black or African American | **8.8** | 0.8 | 4.2 | 11.8 | 9.3 | 11.0 |
| NH/OPI | **24.3** | 2.0 | 18.4 | 26.2 | 23.8 | 66.0 |
| White | **42.5** | 4.0 | 22.8 | 60.2 | 55 | 59.7 |
| Hispanic or Latino | **16.2** | 1.3 | 8.8 | 20.5 | 19.4 | 24.6 |
| Multiple races or other | **48.7** | 6.7 | 22.3 | 67.6 | 60.2 | 59.0 |
| **Overall (aggregated measure)** | **23.8** | **2.7** | **13.2** | **31.0** | **28.2** | **32.8** |

**Abbreviations:** AI/AN = American Indian or Alaska Native; mpox = monkeypox; MSM = gay, bisexual, and other men who have sex with men; NH/OPI = Native Hawaiian or other Pacific Islander; RR = rate ratio.

* For incidence and vaccination rates, the numerators were the numbers of cases and first-dose vaccinations, respectively, among all adult males and were not limited to MSM. To obtain meaningful rates, and because MSM were disproportionately affected by the outbreak, the denominators included only MSM, (i.e., incidence and vaccination rates were calculated as cases and vaccinations in all adult males, respectively, per 100,000 MSM). Case data updated through January 8, 2023, at 2:00 p.m. Eastern Time. Vaccination data updated through January 10, 2023.

† All persons who reported Hispanic or Latino (Hispanic) ethnicity, regardless of race, were categorized as Hispanic. Persons who did not report ethnicity as Hispanic (including missing ethnicity) were categorized as non-Hispanic and self-reported race in the following categories: AI/AN, Asian, Black or African American (Black), NH/OPI, White, and multiple races (more than one race category selected) or other race. Persons with missing data on ethnicity and race were categorized as missing or unknown.

§ The first mpox case reporting period in this analysis is May 10–June 30. The first date of JYNNEOS vaccination is May 22, 2022. May–June and October–December were combined into single periods, because vaccination and case counts were low during those months.

¶ Denominators for incidence and vaccine administration rates were MSM aged ≥18 years: CDC Wonder 2021 estimates for males aged ≥18 years were multiplied by 3.9% to calculate MSM by race and ethnicity, resulting in the following: Black = 584,332; Hispanic = 908,470; White = 3,083,431; Asian = 288,985; AI/AN = 35,370; NH/OPI = 9,196; and multiple races or other race = 81,973. The number of cases in each period was subtracted from the denominator for the following period. For vaccination administration rates, the number of adult males who were vaccinated in each period was subtracted from the denominator for the following period.

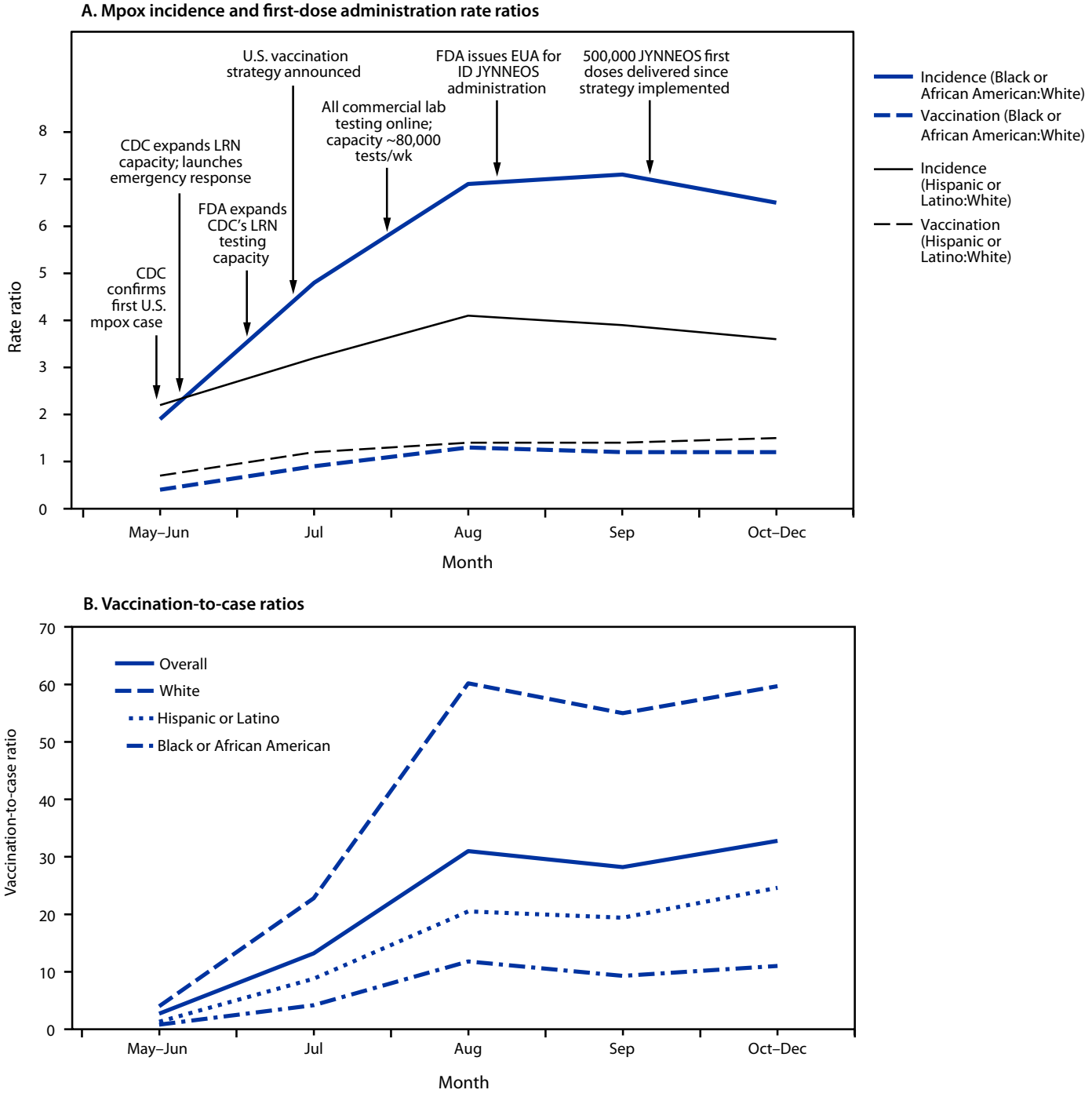
** At least 1 dose administered; includes those with 1 or 2 doses administered.

†† The number of adult males vaccinated within a racial and ethnic group in a period divided by the number of cases in that racial and ethnic group during the same period.

Racial and ethnic disparities in mpox incidence are driven by several factors, including social determinants of health. Black and Hispanic males might face barriers to prevention, including access to information and to mpox vaccines resulting from gaps in dissemination of information, language barriers, racism, homophobia, xenophobia, stigma, discrimination, unemployment, and poverty (*9*). In addition, homophily in sexual partnership selection patterns has been associated with increased disparities in the incidence of sexually transmitted infections such as HIV (*10*) and might be associated with disparities in mpox incidence.

The findings in this report are subject to at least four limitations. First, because of data availability, this analysis was limited to adult males and might not be representative of other population groups. Second, data on the race and ethnicity for 6% of patients and 3% of vaccine recipients were missing, which might limit the interpretation of some racial and ethnic disparities. Third, when calculating reported cases and

**FIGURE. Mpox incidence* and JYNNEOS first-dose administration† rate ratios (A) and vaccination-to-case ratios (B) among adult males, by race and ethnicity§ — United States, May 10–December 31, 2022**




**Abbreviations:** EUA = Emergency Use Authorization; FDA = Food and Drug Administration; ID = intradermal; LRN = Laboratory Response Network; mpox = monkeypox; MSM = gay, bisexual, and other men who have sex with men.

* Cases among males per 100,000 MSM; numerators were the numbers of cases among all adult males and were not limited to MSM. To obtain meaningful rates, and because MSM were disproportionately affected by the outbreak, denominators included only MSM.

† JYNNEOS vaccine doses administered to adult males per 100,000 MSM; numerators were the numbers of doses administered to all adult males and were not limited to MSM. As with incidence, denominators included only MSM.

§ All persons who reported Hispanic or Latino (Hispanic) ethnicity, regardless of race, were categorized as Hispanic. Persons categorized as Black or African American or White included only those who did not report Hispanic ethnicity (i.e., those who reported non-Hispanic ethnicity and those with missing ethnicity data).

**Summary**

What is already known about this topic?

Racial and ethnic disparities in monkeypox (mpox) incidence and vaccination have been described.

What is added by this report?

During May 10–December 31, 2022, mpox incidence among non-Hispanic Black or African American (Black) and Hispanic or Latino (Hispanic) males was higher than that among non-Hispanic White (White) males. Although overall ≥1-dose JYNNEOS vaccination rates were higher among Black and Hispanic males than White males, they were not high enough to fully offset the disproportionate incidence. Overall, 43 White, nine Black, and 17 Hispanic males were vaccinated for each reported mpox case within these groups.

What are the implications for public health practice?

Sustained equity-based strategies, such as tailored messaging and expanding vaccination services to reach racial and ethnic minority groups, are needed to prevent disparities in future mpox outbreaks.

vaccine recipients, it was not possible to confirm that all males included in the reported case and vaccine recipient numerators were members of the denominator (MSM). Finally, incidence and vaccination rates were calculated using MSM population estimates as the denominator; using population estimates of MSM at increased risk for mpox as the denominator might have substantially increased the estimated incidence and vaccination rates. Using population estimates of the entire adult male population as the denominator would have decreased the estimated incidence and vaccination rates; however, in both scenarios the incidence RRs, vaccination RRs, and vaccination-to-case ratios would be similar to findings in this report.

Findings from this analysis indicate that racial and ethnic disparities in mpox incidence rates peaked during August and September 2022 and decreased slightly toward the end of December 2022, potentially as a result of focused public health efforts. However, racial and ethnic disparities in incidence still exist, and eliminating these disparities remains a priority for continued mpox response efforts. Higher mpox vaccination rates among racial and ethnic minority groups are encouraging, but an unmet vaccination need relative to incidence in racial and ethnic minority groups remains. These findings illustrate the potential impact of and continued need for equity-based vaccination strategies, such as community-specific tailored messaging and expansion of vaccination services to reach racial and ethnic minority groups. Recent modeling data (*4*) showing that, based on current vaccination coverage levels, many U.S. jurisdictions are vulnerable to resurgent mpox outbreaks, underscore the need for continued vaccination efforts, particularly among racial and ethnic minority groups.

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# Epidemiologic and Clinical Features of Mpox-Associated Deaths — United States, May 10, 2022–March 7, 2023

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As of March 7, 2023, a total of 30,235 confirmed and probable monkeypox (mpox) cases were reported in the United States,† predominantly among cisgender men§ who reported recent sexual contact with another man (*1*). Although most mpox cases during the current outbreak have been self-limited, cases of severe illness and death have been reported (*2–4*). During May 10, 2022–March 7, 2023, 38 deaths among persons with probable or confirmed mpox¶ (1.3 per 1,000 mpox cases) were reported to CDC and classified as mpox-associated (i.e., mpox was listed as a contributing or causal factor). Among the 38 mpox-associated deaths, 94.7% occurred in cisgender men (median age = 34 years); 86.8% occurred in non-Hispanic Black or African American (Black) persons. The median interval from symptom onset to death was 68 days (IQR = 50–86 days). Among 33 decedents with available information, 93.9% were immunocompromised because of HIV. Public health actions to prevent mpox deaths include integrated testing, diagnosis, and early treatment for mpox and HIV, and ensuring equitable access to both mpox and HIV prevention and treatment, such as antiretroviral therapy (ART) (*5*).

Data included in this report were collected during May 10, 2022–March 7, 2023. Jurisdictional health departments electronically reported confirmed and probable mpox cases and associated deaths as part of national case surveillance. Case data were shared with CDC through a standardized case report form or through the National Notifiable Diseases Surveillance System.** Additional data (e.g., clinical course, co-occurring health conditions, and treatments received) about some decedents were collected during consultations between treating clinicians and CDC clinical officers.†† Cause of death was most commonly determined by the treating health care provider and reported on the death certificate. Jurisdictional health departments shared cause-of-death data as reported on the death certificate to support classification of deaths. Deaths were classified as mpox-associated if mpox was listed on Part I or Part II of the death certificate (chain of events that directly caused the death or significant conditions contributing to death, respectively). Deaths were classified as non–mpox-associated if mpox was not listed on the death certificate, or if mpox appeared to be incidental to death. Deaths were classified as being under investigation§§ if jurisdictions were reviewing the cause-of-death with health care providers at the time of this analysis.

Descriptive statistics on demographics (e.g., age, gender identity, race and ethnicity, and state of residence) and clinical characteristics (i.e., treatments received and timing of treatments) were calculated for all patients with an mpox-associated death and were compared between decedents and patients who are presumed to have survived after confirmed or probable mpox (survivors). SAS statistical software (version 9.4; SAS Institute) was used for all analyses. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.¶¶

CDC received reports of 52 deaths among persons with confirmed or probable mpox. Thirty-eight deaths (73.1%) were classified as mpox-associated, three (5.8%) were

* These authors contributed equally to this report.
† https://www.cdc.gov/poxvirus/mpox/response/2022/us-map.html (Accessed March 20, 2023).
§ Among mpox-associated deaths (38), data on gender identity was available for 28 (73.7%) decedents. For 10 (26.3%) persons for whom self-reported gender was missing, sex assigned at birth was substituted for gender identity.
¶ Case counts include those who received a positive test result for either *Monkeypox virus* or orthopoxvirus.
** https://www.cdc.gov/nndss/index.html (Accessed March 20, 2023).
†† CDC provides clinical consultations upon request to jurisdictions and clinicians treating patients with mpox. Health care providers seeking additional clinical guidance can contact the CDC Emergency Operations Center by telephone (770-488-7100) or by email (eocevent482@cdc.gov).
§§ Discrepancies between laboratory reports and the cause of death as reported on the death certificate prompted three jurisdictions to seek clarification to reconcile the data.
¶¶ 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.
*** Causes of death included suicide and drug overdose.

non–mpox-associated,*** and 11 (21.2%) deaths remain under investigation. Among the 38 mpox-associated deaths, 25 (65.8%) occurred during October–November 2022 (Figure).

The median age of decedents was 34 years (range = 22–58 years), and 36 (94.7%) were cisgender men (Table 1). A higher proportion of decedents than survivors were Black (86.8% versus 32.9%). Nearly one half of decedents (47.4%) resided in the U.S. Census Bureau South Region††† compared with 39.4% of survivors who lived in this region. Nine of the 10 decedents with recent sexual or intimate contact information had sexual or intimate contact with cisgender men in the 3 weeks preceding symptom onset. Two decedents reported nonsexual close contact exposures (e.g., co-sleeping and caring for a household member) to persons with mpox. Five of 11 decedents with available data were experiencing homelessness. Among 87% of decedents and 45% of survivors with available information, HIV infection was more prevalent among decedents than survivors (93.9% versus 38.3%).

Among 27 (71.0%) decedents with available clinical data, the median interval from symptom onset to death was 68 days (range = 1–146 days; IQR = 50–86 days), and 87.0% (20 of 23) were admitted to an intensive care unit during hospitalization (Table 2). Overall, 25 (92.6%) of 27 decedents with available treatment information received mpox-directed medical therapeutics§§§ at some point during their clinical care, including 25 who received tecovirimat, 18 of 24 who received vaccinia immunoglobulin intravenous (VIGIV), nine of 22 who received cidofovir, and six of 15 who received brincidofovir. Among the 25 decedents who received tecovirimat, 15 (60.0%) received it within 3 days of mpox diagnosis; however, for six (24.0%) decedents, tecovirimat was not administered until ≥3 weeks after diagnosis (median overall interval = 2 days; IQR = 0–20 days). Among 24 decedents with available data, all had lesions described as necrotic, diffuse, or worsened after a 14-day course of tecovirimat.

Two decedents did not receive any mpox therapeutics based on clinician discretion; in one case because of concerns regarding contraindication associated with other comorbidities. The other decedent was on ART for HIV with an undetectable viral load at the time of initial assessment for mpox care. Approximately 1 month later, at a wellness check, the patient was found deceased with diffuse lesions characteristic of mpox. Seven of 27 decedents for whom information was available refused therapeutic or intravenous medications or left the hospital against medical advice at some point during their clinical course of treatment. Among 24 decedents with information on receipt of steroids, more than one half (54.2%) received steroids for mpox complications or concerns about immune reconstitution inflammatory syndrome (IRIS), a hyperinflammatory response that can occur in patients with HIV during the first 6 months of ART (*6*).

Nearly all decedents with complete data on HIV infection were HIV-positive (93.9%; 31 of 33). Among 24 decedents with HIV and available data, all (100%) had CD4 counts <200 cells/mm$^3$; 23 (95.8%) had CD4 counts <50 cells/mm$^3$. Among the two immunocompromised decedents who did not have HIV, one was presumed to have been immunocompromised as a consequence of undiagnosed diabetes; the patient experienced diabetic ketoacidosis, a severe life-threatening complication of diabetes, at the time of mpox diagnosis. The second decedent was severely immunocompromised because of a recent renal transplant complicated by acute rejection.

Only two of the 25 persons with HIV (8.0%) reported taking ART before mpox diagnosis; in one of these decedents, HIV was poorly controlled. ART was initiated for 19 of the 20 decedents who were not receiving ART, including one decedent who received a diagnosis of HIV infection 5 days after the mpox diagnosis. One decedent refused treatment for advanced HIV. ART treatment status was not known for three of the 25 decedents with HIV. ART was either delayed or interrupted for seven decedents because of clinician concerns about IRIS.

## Discussion

During the 2022 mpox outbreak, 1.3 mpox-associated deaths per 1,000 cases occurred in the United States and approximately 1.2 deaths per 1,000 mpox cases occurred worldwide.¶¶¶ Nearly all U.S. mpox decedents were immunocompromised at the time of diagnosis. Almost 90% of U.S. mpox-associated deaths occurred in Black men, whereas fewer than one in three mpox survivors were Black men. Although mpox exposure data were not available for all decedents, nearly all cisgender male decedents who reported recent sexual contact reported cisgender male partners.

Most decedents received one or more prompt mpox-directed treatments and intensive care. However, nearly one quarter of decedents experienced delays of 3–7 weeks between diagnosis and treatment, and two patients did not receive any mpox-directed treatment. Before the 2022 mpox epidemic, severe cases mainly occurred in resource-constrained settings where transmission is endemic and where treatments, such as tecovirimat, cidofovir, and VIGIV, are not routinely available (*6*).

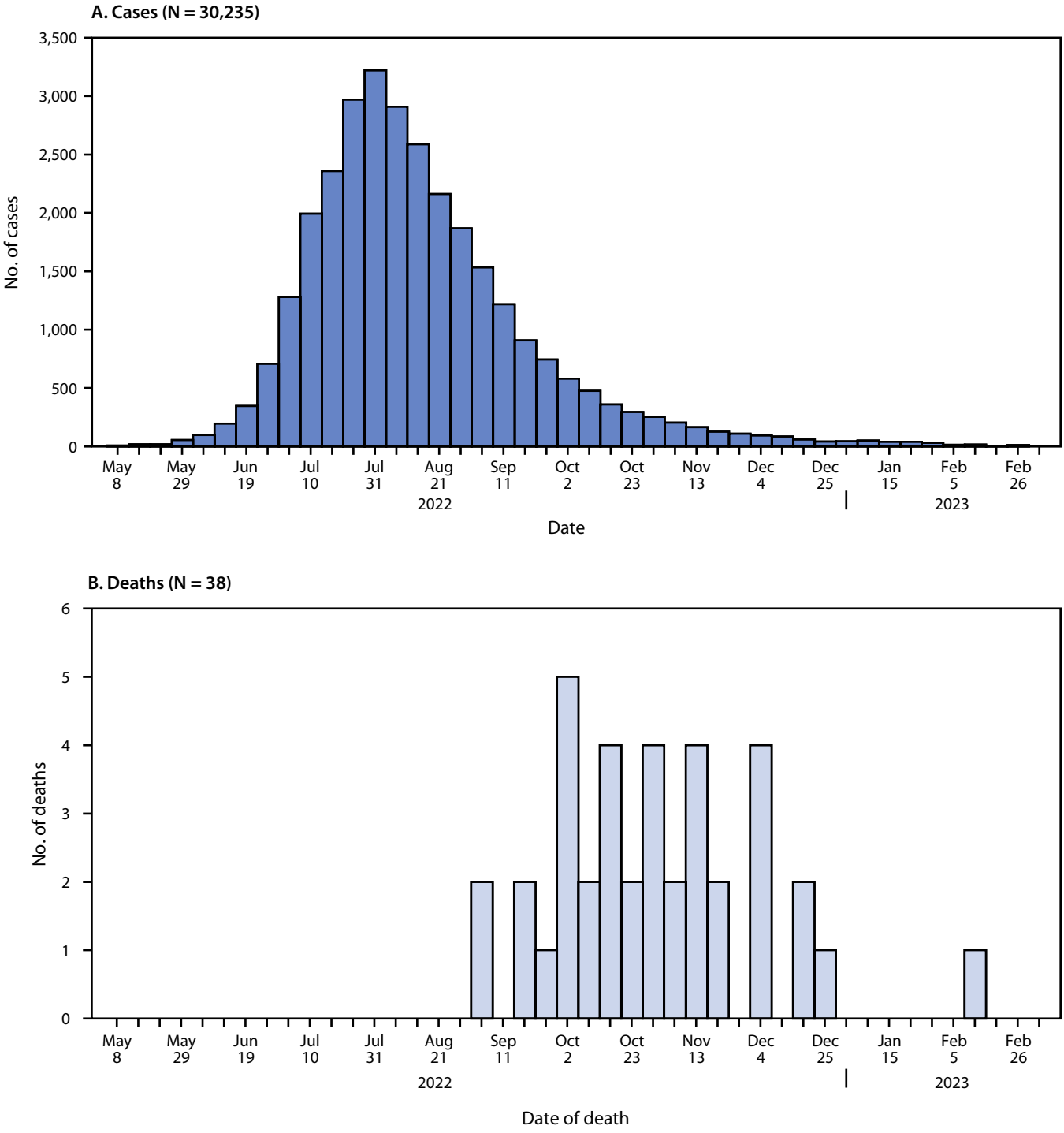
The lengthy course of illness experienced by most decedents is likely related to a reduced capacity to respond to

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

§§§ Treatment classification includes report of tecovirimat (oral or intravenous), VIGIV, cidofovir, or brincidofovir in the clinical consultation data.

¶¶¶ https://www.cdc.gov/poxvirus/mpox/response/2022/world-map.html (Accessed March 5, 2023).

**FIGURE. Weekly confirmed and probable* mpox cases (A)† and mpox-associated deaths (B),§ by week — United States, May 10, 2022—March 7, 2023**




* https://www.cdc.gov/poxvirus/mpox/clinicians/case-definition.html
† The earliest date available regarding the case, beginning with date of illness or rash onset, diagnosis date, positive laboratory test report date, CDC call center reporting date, or case data entry date into the National Notifiable Diseases Surveillance System.
§ Date of death as reported on the death certificate.

**TABLE 1. Demographic and epidemiologic characteristics of persons who survived or died* from mpox-related illness — United States, May 10, 2022–March 7, 2023**

| Characteristic | Mpox cases, no. (%)† Survivors (n = 30,183) | Decedents (n = 38) |
|---|---|---|
| **Demographic** | | |
| **Median age, yrs (range)** | **34 (0–89)** | **34 (22–58)** |
| **Sex or gender,§ total** | **26,082 (86.4)** | **38 (100.0)** |
| Cisgender man | 24,759 (94.9) | 36 (94.7) |
| Cisgender woman | 806 (3.1) | 1 (2.6) |
| Transgender man | 55 (0.2) | 0 (—) |
| Transgender woman | 227 (0.9) | 1 (2.6) |
| Another gender identity | 235 (0.9) | 0 (—) |
| Unknown | 4,101 | 0 |
| **Race and ethnicity, total** | **28,233 (93.5)** | **38 (100.0)** |
| American Indian or Alaska Native, non-Hispanic | 115 (0.4) | 0 (—) |
| Asian, non-Hispanic | 786 (2.8) | 0 (—) |
| Black or African American, non-Hispanic | 9,295 (32.9) | 33 (86.8) |
| Native Hawaiian or other Pacific Islander, non-Hispanic | 68 (0.2) | 0 (—) |
| White, non-Hispanic | 8,277 (29.3) | 3 (7.9) |
| Hispanic or Latino | 8,849 (31.3) | 2 (5.3) |
| Other race, non-Hispanic | 668 (2.4) | 0 (—) |
| Multiple races, non-Hispanic | 175 (0.6) | 0 (—) |
| Unknown | 1,950 | 0 |
| **U.S. Census Bureau region,¶ total** | **30,183 (100.0)** | **38 (100.0)** |
| Northeast | 6,600 (21.9) | 6 (15.8) |
| Midwest | 3,164 (10.5) | 9 (23.7) |
| South | 11,882 (39.4) | 18 (47.4) |
| West | 8,330 (27.6) | 5 (13.2) |
| Puerto Rico | 207 (0.7) | 0 (—) |
| **Experiencing homelessness** | **NA** | **11 (40.7)** |
| Yes | NA | 5 (45.5) |
| No | NA | 6 (54.5) |
| Unknown | 30,183 | 16 |
| **Clinical** | | |
| **Sexual or intimate contact in the 3 wks before symptom onset** | **18,385 (60.9)** | **16 (42.1)** |
| Sexual contact in the past 3 wks | 15,061 (81.9) | 10 (62.5) |
| Recent partners exclusively men | 12,759 (69.4) | 9 (56.2) |
| Recent partners women or other genders (no men) | 898 (4.9) | 0 (—) |
| Recent partners include men and other genders | 503 (2.7) | 0 (—) |
| Gender of all partners unknown/ Not specified | 901 (4.9) | 1 (6.3) |
| No recent sexual contact | 3,324 (18.1) | 6 (37.5) |
| Unknown | 11,798 | 22 |
| **Interval from illness onset to testing, days, median (IQR)**** | **7 (4–10)** | **7 (3–10)** |
| **HIV-positive or immunocompromised††** | **13,549 (44.9)** | **33 (86.8)** |
| Yes, HIV-positive | 5,186 (38.3) | 31 (93.9) |
| Yes, other immunocompromising conditions | 654 (4.8) | 2 (9.1) |
| No | 7,709 (56.9) | 0 (—) |
| Unknown | 16,634 | 5 |
| **Received JYNNEOS vaccine§§** | **11,316 (37.5)** | **13 (34.2)** |
| Yes | 8,238 (72.8) | 1 (7.7) |
| No | 3,078 (27.2) | 12 (92.3) |
| Unknown | 18,867 | 25 |

**Abbreviation:** NA = not available.

* Mpox was listed as directly causing or significantly contributing to death on the death certificate.

† Percentages were calculated with nonmissing data.

§ Among decedents whose death was mpox-associated (38), self-reported data on gender identity was available for 28 (73.7%) decedents. Sex assigned at birth was substituted for 10 (26.3%) decedents for whom gender identity was missing.

¶ https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf (Accessed March 24, 2023). Puerto Rico is not included in any U.S. Census Bureau region.

** Illness onset is the date any reported symptoms first started.

†† Non-HIV immunocompromising conditions included renal transplant (one) and uncontrolled diabetes (one).

§§ At least 1 dose.

infection because of co-occurring immunocompromise. When mpox is suspected, providers should consider early treatment with mpox-directed therapy, especially for patients with immunocompromising conditions who are at highest risk for severe outcomes.

The gender and racial disparities in mpox-associated deaths align with previous reports, in which most patients hospitalized for severe manifestations of mpox were Black men with uncontrolled HIV (*4*) and parallel racial and ethnic disparities in HIV infection and mortality. In 2020, 75% of all-cause deaths among adults with HIV occurred in males, 39% of whom were Black males.**** Disparities and barriers are apparent at all levels of HIV care including recognition of HIV risk, access to testing, and access to and receipt of preexposure prophylaxis and ART (*7*).

Most decedents with advanced HIV were not on ART at the time mpox was diagnosed. Boosting immune function via ART and avoidance of immunosuppressives, such as steroids, are critical to mpox recovery (6). ART was delayed or discontinued for several decedents because of concerns of IRIS, wherein a sudden improvement of immune function paradoxically worsens an infection. To date, no evidence exists indicating that IRIS contributes to poor mpox outcomes.

The Ending the HIV Epidemic initiative†††† has highlighted the need to address HIV transmission in the United States through response, prevention, diagnosis, and treatment efforts. All patients with suspected mpox should be evaluated for

**** The number of deaths from all causes in patients with HIV infection was calculated using CDC's Atlas Plus. https://gis.cdc.gov/grasp/nchhstpatlas/tables.html

†††† https://www.cdc.gov/endhiv/index.html

**TABLE 2. Selected clinical characteristics* of mpox-associated deaths with available clinical data (N = 27) — United States, May 10, 2022–March 7, 2023**

| Characteristic (no. with information) | Mpox-associated deaths, no. (%)† |
|---|---|
| **Clinical** | |
| **Days from symptom onset to death (26), median (IQR)** | **68 (50–86)** |
| **Admitted to ICU** | **23 (85.2)** |
| Yes | 20 (87.0) |
| No | 3 (13.0) |
| Unknown | 4 |
| **Medical treatment§** | |
| **Received any mpox-directed treatment** | **27 (100.0)** |
| Yes | 25 (92.6) |
| No | 2 (7.4) |
| Unknown | 0 |
| **Days from first mpox treatment date to death (21), median (IQR)** | **58 (32–66)** |
| **Specific mpox-directed treatment received** | |
| **Tecovirimat** | **27 (100.0)** |
| Yes | 25 (92.6) |
| No | 2 (7.4) |
| Unknown | 0 |
| **Interval from mpox diagnosis to initiation of tecovirimat treatment (20), days, median (IQR)** | **2 (0–20)** |
| **VIGIV** | **24 (88.9)** |
| Yes | 18 (75.0) |
| No | 6 (25.0) |
| Unknown | 3 |
| **Cidofovir** | **22 (81.5)** |
| Yes | 9 (40.9) |
| No | 13 (59.1) |
| Unknown | 5 |
| **Brincidofovir** | **15 (55.6)** |
| Yes | 6 (40.0) |
| No | 9 (60.0) |
| Unknown | 12 |
| **Necrotic, diffuse, or worsened lesions¶** | **24 (88.9)** |
| Yes | 24 (100.0) |
| No | 0 (—) |
| Unknown | 3 |
| **Received steroids for mpox complications or IRIS concerns** | **24 (88.9)** |
| Yes | 13 (54.2) |
| No | 11 (45.8) |
| Unknown | 3 |
| **HIV-positive or immunocompromised**** | **27 (100.0)** |
| HIV-positive | 25 (92.6) |
| CD4 ≥500 | 0 (—) |
| CD4 ≥200 to <500 | 0 (—) |
| CD4 ≥50 to <200 | 1 (4.2) |
| CD4 <50 | 23 (95.8) |
| CD4 Unknown | 1 |
| Immunocompromised (HIV-negative) | 2 (7.4) |
| Unknown | 0 |
| **Receiving ART (HIV-positive persons)** | **22 (88.0)** |
| Yes, before mpox diagnosis | 2 (9.1) |
| Yes, after mpox diagnosis | 19 (86.4) |
| No, refused | 1 (4.5) |
| Unknown | 3 |
| **Interval from mpox diagnosis to initiation of ART (9), days, median (IQR)** | **15 (5–26)** |

**Abbreviations:** ART = antiretroviral treatment; ICU = intensive care unit; IRIS = immune reconstitution inflammatory syndrome; VIGIV = vaccinia immune globulin intravenous.

* Reported or collected during clinical consult with treating physician.
† Percentages calculated with nonmissing data. Percentages calculated based on total number in each subgroup.
§ Treatment classification includes report of tecovirimat (oral or intravenous), VIGIV, cidofovir, or brincidofovir in the clinical consultation data.
¶ Reported during clinical consultation with treating physician or through expert assessment of photographs.
** Non-HIV immunocompromising conditions included renal transplant (one) and uncontrolled diabetes (one).

preexisting immunocompromising conditions such as HIV (*7*). Persons with diagnosed mpox who have HIV (even if newly diagnosed) who are not on ART should be started on ART as soon as possible. For persons who are HIV-negative, indications for HIV pre-exposure prophylaxis should be assessed.

Previous studies of mpox patients, in Nigeria, have documented anxiety, depression (*8*), and suicide (*9*). It has been suggested (*9*) that these outcomes resulted from stigma and the implications of acquiring a sexually associated infection, such as mpox, as well as the isolation experienced during prolonged treatment. Black and Hispanic or Latino males in the United States might face additional psychosocial pressures related to language barriers, homophobia, and discrimination (*10*). One


**Summary**

What is already known about this topic?

Severe manifestations of mpox have occurred in the United States, particularly among persons with uncontrolled viral spread resulting from moderately to severely immunocompromising conditions.

What is added by this report?

Thirty-eight mpox-associated deaths occurred in the United States during May 10, 2022–March 7, 2023 (1.3 mpox-associated deaths per 1,000 cases). Most decedents were non-Hispanic Black or African American (87%) persons and cisgender men (95%). Among 24 decedents with HIV for whom data were available, all had advanced HIV, typically with a CD4 count <50.

What are the implications for public health practice?

Equitable and early access to prevention and treatment for both mpox and HIV is critical to reducing mpox-related mortality.

suicide was noted among the decedents of non–mpox-associated deaths, and one decedent persistently declined treatment for HIV. These data highlight the need to strengthen psychosocial support services as part of the mpox epidemic response.

The findings in this report are subject to at least two limitations. First, deaths might be undercounted. Delays in reporting laboratory results, cases, and deaths are expected because reporting guidance was developed concurrently with the outbreak. Because reports from clinical consults were passively obtained, some deaths related to patients with mpox might not have been recorded. Second, some data (e.g., housing status, treatment, HIV status, and CD4 count) were more frequently available for decedents than for survivors because of additional reporting requirements for those who received intensive mpox treatments, thus limiting the comparisons between these two groups.

These findings highlight the importance of integrating prevention, testing, and treatment for multiple sexually associated infections (e.g., mpox and HIV, among others). Equitable access to prevention, treatment, and engagement and retention in care for both mpox and HIV should be prioritized, particularly among Black men and other persons at risk for sexually associated infections. These results underscore previous recommendations that providers offer HIV testing to all patients with probable or confirmed mpox and consider early mpox-directed treatment in highly immunocompromised patients (*4,5,7*). Further, combining therapies for mpox and boosting immune function might also reduce mortality from severe mpox (*5*).

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# Notes From the Field

## Campylobacteriosis Outbreak Associated with Consumption of Raw Water — Montana, 2022

Rachel Hinnenkamp, MPH[1]; Shawn Sorenson, MPH[2]; Edward Evanson, MS[1]; Jonathan Yoder, MPH[3]; Mia Mattioli, PhD[3]

Consumption of raw water (water that has not been disinfected or filtered) has become an emerging trend in the United States and could pose serious health consequences (*1*). Drinking water collected directly from outdoor freshwater sources such as lakes, rivers, and streams that has not been adequately treated (i.e., to remove pathogens) can cause disease and outbreaks (*2*). This report describes how a community in Western Montana responded to an outbreak of 19 cases of diarrheal illness associated with consuming untreated surface water.

On May 9, 2022, Sanders County, Montana, reported to the state health department six active cases of *Campylobacter* infection in their community; this case count represented a substantial increase above the 5-year average of six reported cases annually during 2017–2021. All infected persons reported drinking water from watering point A, an outlet of surface water from a creek near Paradise, Montana (Figure), before their onset of symptoms, which began on or after May 4. During the next 6 weeks, 13 additional cases of *Campylobacter jejuni* infection among persons exposed to the same water source were identified through laboratory testing (two by culture-independent confirmation and four by culture confirmation) or epidemiologic linkage (seven). One person was hospitalized, and no deaths were reported.

On May 16, Sanders County Public Health environmental health staff members collected 23 liters of water from watering point A. The Montana Laboratory Services Bureau performed membrane filtration on 15 liters of the water sample, using four separate filters (0.45 µm [44 mm] pore size). The filters were then plated on media for *Campylobacter* culture and isolation following standard methods (*3*); investigators did not culture for or find any other pathogens. On May 24, the water sample was confirmed positive for *Campylobacter* by culture. On June 3, staff members performed whole genome sequencing on one *Campylobacter* isolate from the water sample and isolates from two human outbreak specimens; sequences were compared by both core genome multilocus sequence typing and whole genome multilocus sequence typing (*4*). *Campylobacter* isolates from the human specimens and water samples were highly genetically related (0–1 allele apart). Together, whole genome sequencing analysis and epidemiologic data provided confirmatory evidence that this outbreak was the result of drinking water directly from watering point A.

Watering point A is located within the Montana Department of Transportation highway right-of-way on railroad property. The watering point was constructed, most likely during the early 1900s, to prevent the creek from eroding the track bed. Owners of adjacent land began using the water for domestic and agricultural purposes. Since then, the public has used watering point A as a drinking water source. Although watering point A contains untreated surface water, many community members believe that it is a natural spring. Users filled containers by placing them directly under water spilling out of the concrete box of the watering point, by placing containers directly into the water in the box, or by placing pumps or suction lines into the water to fill large containers. Signage posted by the Montana Department of Transportation before the outbreak warned the public that the watering point was not an approved public water source.

An unoccupied bird's nest was found inside the box where the water sample was collected. Birds are a known source of *Campylobacter*, and although no birds were present at the time of sample collection, the presence of the nest indicates birds could have been the primary contamination source that led to this outbreak.

The combined strength of the epidemiologic, environmental, and laboratory evidence in this outbreak was sufficient to remove the watering source from operation. After a June 16 meeting with stakeholders, the Montana Department of Environmental Quality stated the source met the definition of a public water supply and therefore needed to meet the requirements of the Safe Drinking Water Act (*5*), or access had to be permanently removed. The Montana Department of Transportation permanently removed public access on June 28, 2022, by rerouting the creek water so that it remained underground (Figure). No additional cases have been identified since June 16, 2022. Persons drinking water from outdoor sources, including creeks, rivers, and streams, should always treat the water before drinking it. Boiling water is the most reliable way to kill germs, but treatment including filtration will also reduce the risk of illness from drinking water from outdoor sources.*

* https://www.cdc.gov/healthywater/drinking/travel/backcountry_water_treatment.html

**FIGURE. Watering point A, before any intervention (A) and after the water supply was permanently turned off (B) — Montana, 2022**


Photo/Shawn Sorenson

Photo/Kent Newbold

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# Erratum

## Vol. 72, No. 11

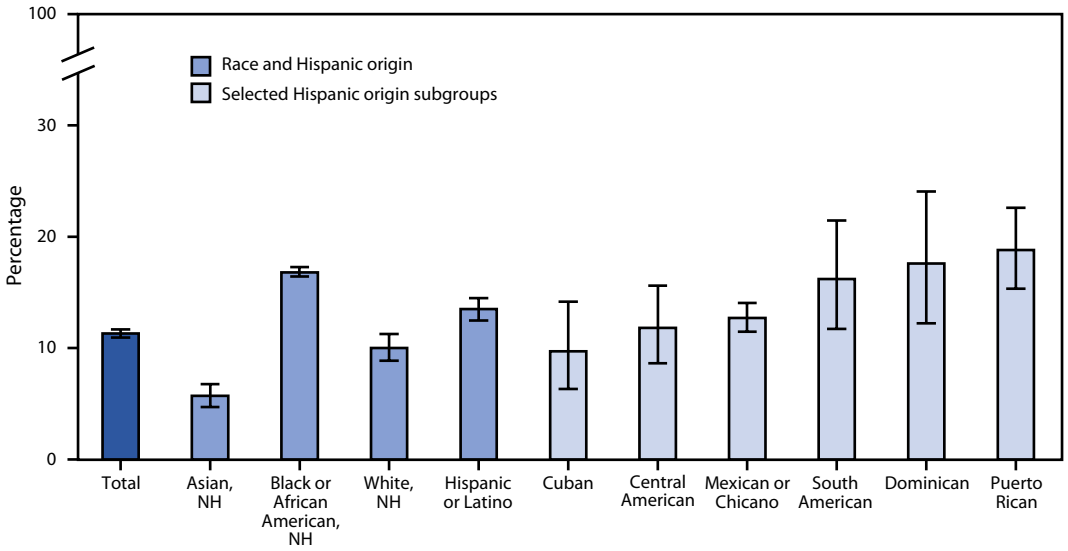
In the report, "Trends in Reported Babesiosis Cases — United States, 2011–2019," on page 273, the first sentence in the third paragraph should have read, "The first case of human ***Babesia microti*** **infection** acquired in the United States was identified in 1969 on Nantucket Island, Massachusetts (*4*)."

# QuickStats

Please note: This report has been corrected. An erratum has been published.

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

## Percentage* of Adults† Who Were in Families Having Problems Paying Medical Bills During the Previous 12 Months,§ by Race and Selected Hispanic¶ Origin Subgroups — National Health Interview Survey, United States, 2020–2021**




**Abbreviation:** NH = non-Hispanic.

* With 95% CIs indicated by error bars.

† Estimates are based on household interviews of a sample of the civilian, noninstitutionalized U.S. population and are derived from the 2020 and 2021 National Health Interview Survey.

§ "Problems paying medical bills" is based on a positive response to a question asking, "In the past 12 months, did you/anyone in the family have problems paying or were unable to pay any medical bills? Include bills for doctors, dentists, hospitals, therapists, medication, equipment, nursing home, or home care."

¶ Hispanic or Latino includes all Hispanic adults, including other Hispanic origin subgroups not shown separately.

** Total includes all adults, including other race groups not shown separately.

During 2020–2021, the percentage of U.S. adults who were in families having problems paying medical bills during the previous 12 months was 11.3%. Non-Hispanic Black or African American adults (16.8%) were most likely to be in families having problems paying medical bills followed by Hispanic or Latino (13.5%), non-Hispanic White (10.0%), and non-Hispanic Asian (5.7%) adults. Among the Hispanic or Latino origin subgroups shown, the percentage of adults in families having problems paying medical bills ranged from 9.7% among Cuban to 18.8% among Puerto Rican adults.

**Source:** National Health Interview Survey, 2020 and 2021 data. https://www.cdc.gov/nchs/nhis.htm

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