Centers for Disease Control and Prevention
MMWR
Morbidity and Mortality Weekly Report
Weekly / Vol. 70 / No. 42
October 22, 2021

HIV Infection and HIV-Associated Behaviors Among Persons Who Inject Drugs — 23 Metropolitan Statistical Areas, United States, 2018

Senad Handanagic, MD[1]; Teresa Finlayson, PhD[1]; Janet C. Burnett, MPH[1]; Dita Broz, PhD[1]; Cyprian Wejnert, PhD[1]; National HIV Behavioral Surveillance Study Group

In the United States, 10% of HIV infections diagnosed in 2018 were attributed to unsafe injection drug use or male-to-male sexual contact among persons who inject drugs (PWID) (*1*). In 2017, among PWID or men who have sex with men and who inject drugs (MSM-ID), 76% of those who received a diagnosis of HIV infection lived in urban areas* (*2*). To monitor the prevalence of HIV infection and associated behaviors among persons who reported injecting drugs in the past 12 months, including MSM-ID, CDC's National HIV Behavioral Surveillance (NHBS) conducts interviews and HIV testing among populations of persons at high risk for HIV infection (MSM, PWID, and heterosexually active adults at increased risk for HIV infection) in selected metropolitan statistical areas (MSAs) (*3*). The estimated HIV infection prevalence among PWID in 23 MSAs surveyed in 2018 was 7%. Among HIV-negative PWID, an estimated 26% receptively shared syringes and 68% had condomless vaginal sex during the preceding 12 months. During the same period, 57% had been tested for HIV infection, and 55% received syringes from a syringe services program (SSP). While overall SSP use did not significantly change since 2015, a substantial decrease in SSP use occurred among Black PWID, and HIV prevalence among Black PWID was higher than that among Hispanic and White PWID. These findings underscore the importance of continuing and expanding HIV prevention programs and community-based strategies for PWID, such as those provided by SSPs, especially following service disruptions created by the COVID-19 pandemic (*4*). Efforts are needed to ensure that PWID have low-barrier access to comprehensive and integrated needs-based SSPs (where legally permissible) that include provision of sterile syringes and safe syringe disposal, HIV and hepatitis C virus (HCV) testing and referrals to HIV and HCV treatment, HIV preexposure prophylaxis, and treatment for substance use and mental health disorders.

In 2018, NHBS staff in 23 MSAs† collected cross-sectional behavioral survey data and conducted HIV testing among

* Urban areas include metropolitan statistical areas with populations of ≥500,000 persons; areas with populations of <500,000 persons were considered nonurban.

† Atlanta, Georgia; Baltimore, Maryland; Boston, Massachusetts; Chicago, Illinois; Dallas, Texas; Denver, Colorado; Detroit, Michigan; Houston, Texas; Los Angeles, California; Memphis, Tennessee; Miami, Florida; Nassau-Suffolk, New York; New Orleans, Louisiana; New York, New York; Newark, New Jersey; Philadelphia, Pennsylvania; Portland, Oregon; San Diego, California; San Francisco, California; San Juan, Puerto Rico; Seattle, Washington; Virginia Beach, Virginia; Washington, District of Columbia.

INSIDE

Continuing Education examination available at https://www.cdc.gov/mmwr/mmwr_continuingEducation.html

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

PWID; participants were recruited by respondent-driven sampling[§] (*5*). Eligible participants[¶] completed a standardized behavioral questionnaire administered in person by trained interviewers. All participants were offered anonymous HIV testing.[**] Incentives were offered for completing the interview, receiving HIV testing, and recruiting additional participants.[††] Participants were asked about high-risk HIV acquisition behaviors in the previous 12 months, including receptive sharing of syringes and injection equipment[§§] or high-risk sexual behaviors,[¶¶] as well as testing for HIV and HCV infection, participation in HIV behavioral interventions,[***] and receipt of syringes from SSPs[†††] and other sources. Because knowledge of personal HIV infection status could influence risk behaviors, analysis of behavioral data was limited to HIV-negative PWID.[§§§] Nonheterosexual sexual behavior is not reported in the analysis of high-risk behaviors because the number of HIV-negative MSM-ID in the sample was too small to produce reliable weighted estimates across all 23 MSAs. Data from each MSA were analyzed by using RDS Analyst version 0.7,

[§] Recruitment chains in each MSA began with four to 28 initial participants identified during formative assessment (the process by which researchers define a community of interest, determine how to access that community, and describe the attributes of the community that are relevant to a specific public health issue). Initial participants who participated in the survey were asked to recruit up to five other persons who inject drugs using a coded coupon system designed to track referrals. All eligible participants were asked to recruit up to five other persons who inject drugs. Respondent-driven sampling analysis was done using RDS Analyst version 0.7.

[¶] Eligible participants were persons who injected drugs that were not prescribed to them by a physician during the previous 12 months, resided in the MSA, were aged ≥18 years, could complete the interview in English or Spanish, and provided informed consent.

[**] All 23 MSAs conducted HIV screening with a rapid test; for supplemental testing to confirm rapid tests, 19 conducted a second orthogonal rapid test, one collected blood via venipuncture, and three collected blood via dried blood spots. A nonreactive rapid test result was considered HIV-negative, and a reactive rapid test result was considered HIV-positive, if supported by a second rapid test or supplemental laboratory-based testing.

[††] The incentive format (cash or gift card) and amount varied by MSA based on formative assessment and local policy. A typical format included $25 for completing the interview, $25 for providing a specimen for HIV testing, and $10 for each successful recruitment (maximum of five).

[§§] Receptive sharing of syringes was defined as using needles that someone else had already used to inject with, and receptive sharing of injection equipment was defined as using equipment such as cookers, cottons, or water used to rinse needles or prepare drugs that someone else had already used.

[¶¶] Condomless vaginal sex and condomless anal sex were defined as sex without a condom at least once in the past 12 months. Ascertainment of male-to-male anal sexual contact includes both insertive and receptive anal sexual contact.

[***] Participating in an individual or group HIV behavioral intervention was defined as a conversation with a counselor or an organized discussion regarding prevention of HIV infection and did not include counseling received as part of an HIV test or conversations with friends.

[†††] Receiving a syringe from an SSP was defined as receiving a sterile syringe or a needle at least once from a needle or syringe exchange program during the previous 12 months. Medication for opioid use disorder includes treatment with methadone, buprenorphine, and Suboxone or Subutex.

[§§§] Behavioral analyses from previous reports (https://doi.org/10.15585/mmwr.mm6701a5) excluded participants reporting a previous HIV-positive test result. A comparison of analysis excluding those who previously had received a positive HIV test result did not yield significantly different estimates.

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

Suggested citation: [Author names; first three, then et al., if more than six.] [Report title]. MMWR Morb Mortal Wkly Rep 2021;70:[inclusive page numbers].

producing estimates adjusted for peer-recruitment patterns and reported network size along with estimated 95% confidence intervals (CIs) (*5*). To calculate aggregated prevalence of HIV and selected behaviors that are generalizable to PWID across the 23 MSAs, NHBS used a weighted average of MSA-level estimates adjusted for the projected size of the population of PWID in each MSA (*6*).¶¶¶ Comparisons were considered significant if there was no overlap in their 95% CIs. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.****

In 2018, 14,716 persons were recruited to participate in NHBS; 3,138 (21%) were ineligible, and 230 (2%) were excluded because data were incomplete.†††† Among the 11,348 PWID who were tested for HIV, 731 (6%) received positive test results and 10,617 (94%) received negative results (Table 1). Weighted HIV prevalence in the 23 MSAs was 7%, with the highest prevalences among MSM-ID (25%), PWID aged 40–49 years (12%), and Black or African American (Black) PWID (12%). HIV prevalence among Black PWID was higher than that among Hispanic (7%) and White (5%) PWID.

Among HIV-negative PWID, 26% receptively shared syringes, 68% had condomless vaginal sex, 23% had condomless heterosexual anal sex, 72% had either condomless heterosexual sex or shared syringes, and 43% had more than one opposite sex partner (Table 2). Receptive syringe sharing was higher among White (36%) than among Hispanic (22%) or Black (16%) PWID. Condomless vaginal sex was higher among White (73%) than among Hispanic (63%) or Black (63%) PWID, and condomless heterosexual anal sex was higher among Hispanic (30%) and White (24%) than among Black PWID (16%).

In the previous 12 months, among HIV-negative PWID, 57% received an HIV test, 33% participated in an HIV behavioral intervention, 55% received syringes from SSPs, and 56% used medication for opioid use disorder (Table 3). Among PWID who were HIV-negative, 83% reported having had a test for HCV in their lifetime and 46% reported being HCV-positive. Fewer White PWID were tested for HIV in the preceding 12 months (53%) than were Hispanic (62%) PWID. Fewer Black PWID received syringes from SSPs (40%) than did Hispanic (63%) or White PWID (63%) or used medication for opioid use disorder (47% versus 65% and 58%, respectively). More PWID with health insurance were tested for HIV infection in the previous 12 months (59%), participated in HIV behavioral interventions (35%), ever tested for HCV infection (86%), and received medication for opioid use disorder (61%) than did PWID without health insurance (47%, 22%, 71%, and 35%, respectively) (Table 3).

¶¶¶ For MSA-level estimates for which CIs could not be calculated, maximally wide CIs (0–1) were used in aggregation. MSA-level estimates with insufficient data for analysis were excluded from the aggregated estimates. Aggregated estimates are included in the tables only if ≥15 out of 23 MSA-level estimates were included in the analysis. The highest number of missing MSA-level estimates for one variable was five.

**** 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.

†††† Data from 230 participants were excluded because of missing recruitment data, lost data during electronic upload, incomplete survey data, and survey responses with questionable validity or invalid HIV test results. Reasons for exclusion were not mutually exclusive.

Discussion

This report provides updated weighted prevalence estimates of HIV infection and behaviors associated with HIV infection since the last NHBS survey among PWID in 2015 (*3*) and represents a snapshot of the HIV prevention landscape for U.S. PWID before the COVID-19 pandemic. In 2018, PWID reported injection and sexual behaviors that placed them at increased risk for HIV infection, highlighting the need for effective and comprehensive prevention services, including access to sterile injection equipment.

From 2015 to 2018, HIV prevalence among PWID in selected MSAs was unchanged at 7%. This analysis found a higher HIV prevalence among Black PWID than among Hispanic or White PWID, despite fewer reported risk behaviors associated with HIV infection among Black PWID. In 2018, when compared with Hispanic or White PWID, fewer Black PWID shared syringes or injection equipment and had condomless anal sex. Overall, SSP use did not significantly increase since 2015 (from 52% to 55%), but a substantial decrease in SSP use among Black PWID (from 51% to 40%), and significantly lower use of SSPs in 2018 among Black PWID compared with Hispanic and White PWID was observed. Lower SSP use among Black PWID in the context of disproportionally higher rates of HIV diagnoses in Black communities (*1*) might lead to increased risk for HIV transmission among Black PWID. It is critical to explore and address the causes for these disparities in SSP use and HIV infection rates.

In 2020, the COVID-19 pandemic impeded delivery of prevention services for PWID nationally, resulting in a substantial reduction in SSP operations and provision of medication for opioid use disorder (*4*). This analysis highlights the ongoing need for risk reduction and improved access to HIV prevention services among PWID than existed before the COVID-19 pandemic, especially because access to these services was reduced as a result of the pandemic. Findings from this analysis and continuous monitoring of characteristics and risk behaviors associated with HIV infection of PWID will facilitate estimation of how the pandemic disrupted behaviors as well as access to essential prevention services among PWID.

The findings in this report are subject to at least four limitations. First, because a method of obtaining standard probability-based samples of PWID does not exist, the

TABLE 1. HIV prevalence among persons who inject drugs, by selected characteristics — National HIV Behavioral Surveillance, 23 Metropolitan Statistical Areas, United States, 2018

Characteristic	Total*		HIV-infected*	
	No.†	Column % (95% CI)	No.†	Row % (95% CI)
Total	**11,348**	**100**	**731**	**7 (6–9)**
Gender				
Male	7,826	67 (65–69)	500	7 (6–8)
Female	3,425	32 (30–34)	204	8 (5–11)
Transgender	97	1.0 (0.7–1.3)	27	—§
Race/Ethnicity				
Black, non-Hispanic	3,745	32 (30–34)	335	12 (9–14)
Hispanic¶	2,358	24 (22–26)	188	7 (5–8)
White, non-Hispanic	4,458	42 (40–43)	171	5 (4–6)
Other**	189	2 (1–2)	12	—
Age group, yrs				
18–29	1,618	15 (14–17)	63	4 (3–6)
30–39	2,999	23 (21–25)	138	5 (4–6)
40–49	2,631	24 (22–25)	201	12 (8–15)
≥50	4,100	38 (36–40)	329	8 (6–10)
Injection duration				
≤5 years	2,073	20 (18–21)	77	5 (3–7)
>5 years	9,207	80 (79–82)	647	8 (7–10)
Education				
Less than high school diploma	3,240	29 (27–30)	240	8 (6–10)
High school diploma	4,689	42 (40–44)	310	9 (6–11)
More than high school diploma	3,416	30 (28–31)	181	6 (5–8)
Currently insured				
No	2,940	18 (16–19)	151	5 (4–7)
Yes	8,362	82 (81–84)	580	8 (6–10)
Federal poverty level††				
Above federal poverty level	2,771	25 (23–27)	134	7 (5–9)
At or below federal poverty level	8,505	75 (73–77)	596	8 (6–9)
Drug injected most frequently				
Heroin only	6,031	55 (53–56)	282	6 (4–7)
Other/Multiple§§	5,273	45 (44–47)	444	10 (8–12)
Male-to-male sex, last 12 months (among males only)¶¶				
Yes	753	10 (8–12)	151	25 (19–30)
No	7,067	90 (88–92)	349	5 (4–6)
U.S. Census region***				
Northeast	2,257	36 (22–49)	180	10 (7–14)
South	4,650	29 (16–42)	365	9 (7–11)
Midwest	1,062	8 (0–21)	17	1 (0–2)
West	2,888	26 (12–39)	112	4 (3–5)

Abbreviations: CI = confidence interval; MSA = metropolitan statistical area.

* Aggregate estimates are weighted averages of MSA-level percentages. MSA-level percentages were adjusted for differences in recruitment and the size of participant peer networks of persons who inject drugs, then proportionally weighted by the size of the population of persons who inject drugs in each MSA. MSA-level estimates with insufficient data for analysis were excluded from the aggregated estimates. Aggregated estimates are included in the tables only if at least 15 out of 23 MSA-level estimates were included in the analysis. The average number of MSA-level estimates included in the aggregated estimates for each variable is 21.3.

† Unweighted numbers. Not all categories sum to 11,348 because of missing data.

§ Insufficient data to calculate estimates.

¶ Hispanic persons might be of any race or combination of races.

** Includes American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander, and persons of multiple races.

†† Poverty level is based on household income and household size.

§§ Other drugs injected alone or two or more drugs injected with the same frequency.

¶¶ Ascertainment of male-to-male anal sexual contact was restricted to males and includes both insertive and receptive anal sexual contact.

*** *Northeast:* Boston, Massachusetts; Nassau-Suffolk, New York; New York City, New York; Newark, New Jersey; and Philadelphia, Pennsylvania. *South:* Atlanta, Georgia; Baltimore, Maryland; Dallas, Texas; Houston, Texas; Memphis, Tennessee; Miami, Florida; New Orleans, Louisiana; Virginia Beach, Virginia; and Washington, District of Columbia. *Midwest:* Chicago, Illinois and Detroit, Michigan. *West:* Denver, Colorado; Los Angeles, California; Portland, Oregon; San Diego, California; San Francisco, California; and Seattle, Washington. San Juan, Puerto Rico was not included in any of the Census regions.

representativeness of the NHBS sample cannot be determined. Although adjustments were made to the sampling methodology (*5*), biases related to participants' recruitment behavior or their willingness and ability to participate in the interview might have affected the sample. Second, insufficient numbers of participants in some cities precluded inclusion of these cities in the aggregate estimates. The number of MSAs excluded from aggregate estimates varied based on the analysis

TABLE 2. Estimated percentage* of persons who inject drugs who received negative HIV test results and engaged in behaviors† associated with HIV infection in the preceding 12 months, by selected characteristics — National HIV Behavioral Surveillance, 23 Metropolitan Statistical Areas, United States, 2018

Characteristic	% (95% CI)							
	Receptive syringe sharing†	Receptive injection equipment sharing†	Vaginal sex	Condomless vaginal sex†	Heterosexual anal sex	Condomless heterosexual anal sex†	Condomless heterosexual sex† or receptive syringe sharing	More than one opposite sex partner
Total	**26 (25–28)**	**49 (47–51)**	**77 (75–79)**	**68 (66–70)**	**29 (27–31)**	**23 (22–25)**	**72 (70–74)**	**43 (41–46)**
Sex								
Male	24 (22–26)	48 (46–50)	75 (72–77)	64 (61–66)	28 (26–30)	21 (20–23)	69 (67–72)	41 (39–44)
Female	31 (28–34)	50 (47–54)	81 (78–84)	76 (73–79)	32 (28–35)	27 (24–31)	78 (75–81)	48 (44–51)
Race/Ethnicity§								
Black, non-Hispanic	16 (14–18)	38 (35–41)	75 (72–78)	63 (60–66)	23 (20–25)	16 (14–18)	66 (63–69)	43 (40–46)
Hispanic¶	22 (19–25)	46 (41–51)	73 (68–77)	63 (58–68)	37 (33–42)	30 (26–33)	67 (62–72)	41 (36–45)
White, non-Hispanic	36 (34–39)	59 (56–62)	80 (78–83)	73 (70–75)	29 (26–32)	24 (22–27)	78 (76–81)	45 (42–49)
Age group, yrs								
18–29	41 (36–46)	60 (55–65)	89 (86–92)	84 (81–88)	36 (31–41)	30 (26–35)	87 (84–90)	59 (53–64)
30–39	33 (29–36)	54 (50–57)	86 (84–89)	78 (75–81)	34 (31–37)	29 (26–32)	83 (80–86)	50 (47–54)
40–49	23 (20–26)	49 (45–54)	77 (73–81)	68 (64–72)	32 (28–36)	25 (22–29)	72 (68–76)	43 (39–47)
≥50	18 (16–20)	41 (38–44)	66 (63–70)	55 (52–58)	22 (20–25)	16 (14–18)	60 (57–63)	35 (32–37)
Education								
Less than high school diploma	25 (22–28)	48 (44–51)	74 (70–77)	64 (60–68)	30 (27–34)	23 (20–26)	70 (66–73)	40 (37–44)
High school diploma	27 (25–30)	49 (46–52)	76 (73–79)	67 (63–70)	28 (25–31)	23 (20–25)	71 (68–74)	44 (41–47)
More than high school diploma	27 (24–29)	50 (46–53)	81 (78–84)	72 (69–75)	30 (27–33)	24 (21–27)	75 (71–78)	46 (43–50)
Currently insured								
No	32 (29–35)	49 (46–53)	79 (76–83)	72 (68–75)	30 (27–33)	26 (22–29)	76 (73–80)	50 (46–54)
Yes	25 (23–27)	49 (46–51)	76 (74–78)	67 (64–69)	29 (27–31)	23 (21–24)	71 (69–73)	42 (40–45)
Federal poverty level**								
Above federal poverty level	26 (23–29)	49 (45–53)	83 (80–86)	74 (70–78)	28 (24–32)	22 (19–25)	77 (74–81)	45 (41–49)
At or below federal poverty level	26 (25–28)	49 (47–51)	75 (73–77)	66 (63–68)	30 (28–32)	24 (22–26)	70 (68–73)	43 (41–45)
Drug injected most frequently								
Heroin only	26 (24–28)	49 (47–51)	75 (72–77)	66 (63–68)	25 (23–27)	19 (17–21)	70 (67–73)	38 (36–41)
Other/Multiple††	27 (25–29)	50 (47–53)	79 (77–82)	70 (67–73)	34 (32–37)	28 (25–31)	74 (72–77)	50 (47–53)
U.S. Census region§§								
Northeast	27 (24–30)	50 (46–54)	78 (75–82)	70 (66–74)	37 (33–41)	29 (26–33)	73 (69–77)	45 (41–50)
South	28 (25–30)	50 (47–54)	78 (76–81)	69 (66–72)	25 (22–28)	19 (17–21)	75 (72–78)	43 (40–47)
Midwest	21 (17–25)	36 (32–41)	74 (69–78)	60 (56–65)	19 (15–22)	14 (11–17)	64 (59–69)	35 (30–39)
West	25 (22–28)	49 (45–53)	74 (70–78)	65 (61–69)	26 (23–29)	21 (18–24)	69 (65–74)	44 (40–48)

Abbreviations: CI = confidence interval; MSA = metropolitan statistical area.

* Aggregate estimates are weighted averages of MSA level percentages. MSA-level percentages were adjusted for differences in recruitment and the size of participant peer networks of persons who inject drugs, then proportionally weighted by the size of the population of persons who inject drugs in each MSA. The average number of MSA-level estimates included in the aggregated estimates for each variable is 22.8.

† Receptive syringe sharing was defined as using needles that someone else had already used to inject with, and receptive injection equipment sharing was defined as using equipment such as cookers, cottons, or water used to rinse needles or prepare drugs that someone else had already used. Condomless vaginal or anal sex was defined as sex without a condom.

§ Aggregate estimates for "Other" race and ethnicity (American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander, and person of multiple races) are excluded because of insufficient data.

¶ Hispanic persons might be of any race or combination of races.

** Poverty level is based on household income and household size.

†† Other drugs injected alone or two or more drugs injected with the same frequency.

§§ *Northeast:* Boston, Massachusetts; Nassau-Suffolk, New York; New York City, New York; Newark, New Jersey; and Philadelphia, Pennsylvania. *South:* Atlanta, Georgia; Baltimore, Maryland; Dallas, Texas; Houston, Texas; Memphis, Tennessee; Miami, Florida; New Orleans, Louisiana; Virginia Beach, Virginia; and Washington, District of Columbia. *Midwest:* Chicago, Illinois and Detroit, Michigan. *West:* Denver, Colorado; Los Angeles, California; Portland, Oregon; San Diego, California; San Francisco, California; and Seattle, Washington. San Juan, Puerto Rico was not included in any of the Census regions.

variable. Third, PWID were interviewed in 23 MSAs with high prevalences of HIV infection; findings from these MSAs might not be generalizable to all PWID, including residents of rural or nonmetropolitan areas. Finally, behavioral data are self-reported and subject to recall and social desirability biases.

Despite decades of evidence regarding the importance of SSPs and regular HIV testing for the prevention of HIV transmission among PWID (*7*,*8*), only approximately one half of PWID used SSPs or were tested for HIV in the 12 months preceding the survey. Since 2015, the number of SSPs and the number of syringes distributed in the United States increased (*9*); however,

TABLE 3. Estimated percentage* of persons who inject drugs who received negative HIV test results and participation in testing or prevention services, by selected characteristics — National HIV Behavioral Surveillance, 23 Metropolitan Statistical Areas, United States, 2018

Characteristic	Participation, % (95% CI)						
	Tested for HIV infection in past 12 months	Participated in HIV behavioral intervention in past 12 months†	Ever tested for hepatitis C	Self-reported positive for hepatitis C	Received sterile syringes from SSP in past 12 months§	Received sterile syringes from pharmacy in past 12 months§	Used medication to treat opioid use disorder in past 12 months¶
Total	**57 (55–59)**	**33 (31–35)**	**83 (82–85)**	**46 (44–49)**	**55 (53–57)**	**36 (34–38)**	**56 (54–58)**
Gender							
Male	56 (54–58)	32 (30–35)	82 (80–84)	47 (44–49)	53 (50–55)	35 (32–37)	56 (53–58)
Female	59 (56–62)	33 (29–36)	86 (84–88)	46 (43–50)	61 (58–64)	38 (34–41)	58 (54–61)
Race/Ethnicity**							
Black, non-Hispanic	59 (55–62)	34 (31–37)	80 (78–82)	39 (36–42)	40 (37–42)	20 (17–23)	47 (44–50)
Hispanic††	62 (58–66)	37 (33–42)	85 (82–87)	51 (47–55)	63 (58–68)	33 (29–38)	65 (61–69)
White, non-Hispanic	53 (50–56)	29 (27–32)	86 (84–89)	51 (48–54)	63 (60–65)	46 (43–49)	58 (55–61)
Age group, yrs							
18–29	59 (54–65)	28 (23–33)	74 (69–79)	29 (24–34)	60 (56–65)	52 (47–56)	52 (47–57)
30–39	60 (56–63)	31 (28–34)	86 (85–88)	43 (40–46)	61 (58–65)	43 (39–46)	61 (57–64)
40–49	60 (57–64)	39 (34–43)	86 (83–88)	49 (45–54)	63 (58–67)	35 (31–39)	60 (56–64)
≥50	52 (49–55)	31 (28–34)	84 (82–87)	54 (50–57)	46 (43–49)	25 (22–27)	52 (49–55)
Education							
Less than high school diploma	59 (55–62)	33 (29–37)	84 (81–86)	51 (47–55)	54 (50–58)	27 (24–30)	59 (55–62)
High school diploma	57 (54–60)	31 (28–34)	82 (79–84)	45 (41–48)	55 (52–57)	37 (34–40)	54 (51–57)
More than high school diploma	55 (52–59)	34 (31–37)	86 (84–88)	45 (41–48)	56 (52–59)	42 (38–45)	56 (53–59)
Health insurance							
No	47 (43–51)	22 (19–25)	71 (68–75)	30 (26–33)	40 (37–43)	36 (32–40)	35 (31–38)
Yes	59 (57–61)	35 (33–37)	86 (84–88)	50 (48–53)	58 (56–60)	36 (33–38)	61 (59–64)
Federal poverty level§§							
Above federal poverty level	52 (48–56)	30 (27–34)	82 (79–86)	43 (39–47)	53 (49–56)	48 (43–52)	53 (49–57)
At or below federal poverty level	58 (56–61)	34 (31–36)	84 (82–85)	48 (45–50)	55 (53–57)	32 (30–34)	57 (55–59)
Drug injected most frequently							
Heroin only	55 (52–57)	31 (29–34)	85 (83–86)	47 (44–50)	57 (55–59)	37 (35–40)	62 (59–64)
Other/Multiple¶¶	61 (58–63)	34 (31–37)	82 (80–85)	47 (44–50)	52 (49–55)	33 (31–36)	51 (48–53)
U.S. Census region***							
Northeast	65 (62–69)	43 (39–47)	88 (85–91)	57 (53–62)	64 (60–68)	37 (33–41)	69 (65–73)
South	57 (54–61)	29 (26–32)	80 (77–82)	39 (36–42)	37 (34–39)	28 (25–31)	46 (43–49)
Midwest	50 (46–55)	28 (24–32)	81 (77–85)	36 (31–41)	43 (38–48)	38 (33–42)	58 (53–62)
West	48 (44–51)	23 (20–26)	84 (80–87)	44 (40–48)	67 (63–71)	42 (38–46)	51 (47–55)

Abbreviations: CI = confidence interval; MSA = metropolitan statistical area; SSP = syringe services program.

* Aggregate estimates are weighted averages of MSA-level percentages. MSA-level percentages were adjusted for differences in recruitment and the size of participant peer networks of persons who inject drugs, then proportionally weighted by the size of the population of persons who inject drugs in each MSA. The average number of MSA-level estimates included in the aggregated estimates for each variable is 22.9.

† Participating in an individual or group HIV behavioral intervention (e.g., a one-on-one conversation with a counselor or an organized discussion regarding HIV prevention) did not include counseling received as part of an HIV test or conversations with friends.

§ Receiving a syringe from an SSP was defined as reporting receiving a sterile syringe or needles at least once from an SSP or syringe/needle exchange program. Receiving a syringe from a pharmacy was defined as reporting receiving a sterile syringe or needles at least once from a pharmacy.

¶ Includes treatment with methadone, buprenorphine, Suboxone or Subutex in the past 12 months.

** Aggregate estimates for "Other" race and ethnicity (American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander, and person of multiple races) are excluded because of insufficient data.

†† Hispanic persons might be of any race or combination of races.

§§ Poverty level is based on household income and household size.

¶¶ Other drugs injected alone or two or more drugs injected with the same frequency.

*** *Northeast:* Boston, Massachusetts; Nassau-Suffolk, New York; New York City, New York; Newark, New Jersey; and Philadelphia, Pennsylvania. *South:* Atlanta, Georgia; Baltimore, Maryland; Dallas, Texas; Houston, Texas; Memphis, Tennessee; Miami, Florida; New Orleans, Louisiana; Virginia Beach, Virginia; and Washington, District of Columbia. *Midwest:* Chicago, Illinois and Detroit, Michigan. *West:* Denver, Colorado; Los Angeles, California; Portland, Oregon; San Diego, California; San Francisco, California; and Seattle, Washington. San Juan, Puerto Rico was not included in any of the Census regions.

this analysis found no significant increase in the overall use of SSPs and a substantial reduction in SSP use among Black PWID compared with 2015. The ongoing drug-use epidemic has increased the potential for HIV outbreaks among PWID, particularly in areas and among groups that have limited access to prevention services such as SSPs and medications for opioid use disorder (*10*).

For progress to be made toward achieving the goals of the federal Ending the HIV Epidemic in the United States initiative,[§§§§] PWID need to have low-barrier access to comprehensive and integrated needs-based SSPs (where legally permissible) that

[§§§§] https://www.hrsa.gov/ending-hiv-epidemic

Summary

What is already known about this topic?

In 2015, the estimated HIV infection prevalence among persons who inject drugs (PWID) in 20 U.S. metropolitan statistical areas was 7%.

What is added by this report?

In 2018, estimated HIV prevalence among PWID remained unchanged, and although overall syringe service program use did not significantly change, a substantial decrease in their use occurred among Black PWID.

What are the implications for public health practice?

Low-barrier access is needed to comprehensive and integrated needs-based syringe service programs (where legally permissible) that include provision of sterile syringes and safe syringe disposal, HIV and hepatitis C virus testing and referrals for treatment, HIV preexposure prophylaxis, and treatment for substance use and mental health disorders for PWID.

include provision of sterile syringes and safe syringe disposal, HIV and HCV testing and referrals to HIV and HCV treatment, HIV preexposure prophylaxis, and treatment for substance use and mental health disorders.

Acknowledgments

National HIV Behavioral Surveillance participants; CDC National HIV Behavioral Surveillance Team.

National HIV Behavioral Surveillance Study Group

Meaghan Abrego, Nassau-Suffolk, New York; Alia Al-Tayyib, Denver, Colorado; Bridget Anderson, Nassau-Suffolk, New York; Narquis Barak, New Orleans, Louisiana; Jeremy M. Beckford, New Orleans, Louisiana; Amisha Bhattari, Portland, Oregon; Kathleen A. Brady, Philadelphia, Pennsylvania; Meredith Brantley, Memphis, Tennessee; Sarah Braunstein, New York City, New York; Sidney Carrillo, New York City, New York; Onika Chambers, San Diego, California; Thomas Clyde, Chicago, Illinois; Sandra Miranda De León, San Juan, Puerto Rico; Jie Deng, Dallas, Texas; Rose Doherty, Boston, Massachusetts; Anna Flynn, San Diego, California; Colin Flynn, Baltimore, Maryland; David Forrest, Miami, Florida; Danielle German, Baltimore, Maryland; Sara Glick, Seattle, Washington; Vivian Griffin, Detroit, Michigan; Emily Higgins, Detroit, Michigan; Abdel R. Ibrahim, Newark, New Jersey; Tom Jaenicke, Seattle, Washington; Antonio D. Jimenez, Chicago, Illinois; Salma Khuwaja, Houston, Texas; Jennifer Kienzle, Virginia Beach, Virginia; Monina Klevens, Boston, Massachusetts; Jessica Lin, San Francisco, California; Zaida Lopez, Houston, Texas; Yingbo Ma, Los Angeles, California; Christopher Mathews, Memphis, Tennessee; Jack Marr, Memphis, Tennessee; María Pabón Martínez, San Juan, Puerto Rico; Willi McFarland, San Francisco, California; David Melton, Atlanta, Georgia; Timothy W. Menza, Portland, Oregon; Desmond Miller, San Francisco, California; Luis Moraga, Newark, New Jersey; Willie Nixon, Miami, Florida; Chrysanthus Nnumolu, Philadelphia, Pennsylvania; Conall O'Cleirigh, Boston, Massachusetts; Jenevieve Opoku, Washington, District of Columbia; E. Roberto Orellana, Portland, Oregon; Paige Padgett, Houston, Texas; Jonathon Poe, Dallas, Texas; Marisa Ramos, San Diego, California; Toyah Reid, Virginia Beach, Virginia; Alexis Rivera, New York City, New York; William T. Robinson, New Orleans, Louisiana; Yadira Rolón-Colón, San Juan, Puerto Rico; Corrine Sanger, Detroit, Michigan; Hugo Santacruz, Los Angeles, California; Ekow Kwa Sey, Los Angeles, California; Jennifer Shinefeld, Philadelphia, Pennsylvania; Daniel Shodell, Denver, Colorado; Brandie Smith, Virginia Beach, Virginia; Emma Spencer, Miami, Florida; Ashley Tate, Nassau-Suffolk, New York; Jeff Todd, Atlanta, Georgia; Afework Wogayehu, Newark, New Jersey; Pascale Wortley, Atlanta, Georgia; Margaret Vaaler, Dallas, Texas.

Corresponding author: Senad Handanagic, ndv9@cdc.gov, 404-718-5659.

[1]Division of HIV Prevention, National Center for HIV, Viral Hepatitis, STD, and TB Prevention, CDC.

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

References

1. CDC. HIV surveillance report: diagnoses of HIV infection in the United States and dependent areas, 2018 (updated). Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/hiv/pdf/library/reports/surveillance/cdc-hiv-surveillance-report-2018-updated-vol-31.pdf
2. CDC. HIV surveillance report: diagnoses of HIV infection among adults and adolescents in metropolitan statistical areas—United States and Puerto Rico, 2017. Atlanta, GA: US Department of Health and Human Services, CDC; 2019. https://www.cdc.gov/hiv/pdf/library/reports/surveillance/cdc-hiv-surveillance-supplemental-report-vol-24-2.pdf
3. Burnett JC, Broz D, Spiller MW, Wejnert C, Paz-Bailey G. HIV Infection and HIV-associated behaviors among persons who inject drugs. MMWR Morb Mortal Wkly Rep 2018;67:23–8. PMID:29324726 https://doi.org/10.15585/mmwr.mm6701a5
4. Glick SN, Prohaska SM, LaKosky PA, Juarez AM, Corcorran MA, Des Jarlais DC. The impact of COVID-19 on syringe services programs in the United States. AIDS Behav 2020;24:2466–8. PMID:32333209 https://doi.org/10.1007/s10461-020-02886-2
5. Salganik MJ, Heckathorn DD. Sampling and estimation in hidden populations using respondent-driven sampling. Sociol Methodol 2004;34:193–240. https://doi.org/10.1111/j.0081-1750.2004.00152.x
6. Tempalski B, Pouget ER, Cleland CM, et al. Trends in the population prevalence of people who inject drugs in US metropolitan areas 1992–2007. PLoS One 2013;8:e64789. PMID:23755143 https://doi.org/10.1371/journal.pone.0064789
7. Branson BM, Handsfield HH, Lampe MA, et al. Revised recommendations for HIV testing of adults, adolescents, and pregnant women in health-care settings. MMWR Recomm Rep 2006;55(RR-14). PMID:16988643 https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5514a1.htm
8. Abdul-Quader AS, Feelemyer J, Modi S, et al. Effectiveness of structural-level needle/syringe programs to reduce HCV and HIV infection among people who inject drugs: a systematic review. AIDS Behav 2013;17:2878–92. PMID:23975473 https://doi.org/10.1007/s10461-013-0593-y
9. Des Jarlais DC, Feelemyer J, LaKosky P, Szymanowski K, Arasteh K. Expansion of syringe service programs in the United States, 2015–2018. Am J Public Health 2020;110:517–9. PMID:32078343 https://doi.org/10.2105/AJPH.2019.305515
10. Lyss SB, Buchacz K, McClung R, Asher A, Oster AM. Responding to outbreaks of human immunodeficiency virus among persons who inject drugs—United States, 2016–2019: perspectives on recent experience and lessons learned. J Infect Dis 2020;222(Suppl 5):S239–49. PMID:32877545 https://doi.org/10.1093/infdis/jiaa112

Self-Management Education Class Attendance and Health Care Provider Counseling for Physical Activity Among Adults with Arthritis — United States, 2019

Lindsey M. Duca, PhD[1,2]; Charles G. Helmick, MD[2]; Kamil E. Barbour, PhD[2]; Dana Guglielmo, MPH[2,3]; Louise B. Murphy, PhD[2]; Michael A. Boring, MS[2]; Kristina A. Theis, PhD[2]; Erica L. Odom, DrPH[2]; Yong Liu, MD[2]; Janet B. Croft, PhD[2]

Arthritis is a highly prevalent and disabling condition among U.S. adults (*1*); arthritis-attributable functional limitations and severe joint pain affect many aspects of health and quality of life (*2*). Self-management education (self-management) and physical activity can reduce pain and improve the health status and quality of life of adults with arthritis; however, in 2014, only 11.4% and 61.0% of arthritis patients reported engaging in each, respectively. To assess self-reported self-management class attendance and health care provider physical activity counseling among adults with doctor-diagnosed arthritis, CDC analyzed 2019 Behavioral Risk Factor Surveillance System (BRFSS) data. In 2019, an age-standardized state median of one in six (16.2%) adults with arthritis reported ever attending a self-management class, and 69.3% reported ever receiving health care provider counselling to be physically active. Prevalences of both differed by state and sociodemographic characteristics; decreased with lower educational attainment, joint pain severity, and urbanicity; and were lower in men than in women. Health care providers can play an important role in promoting self-management class attendance and physical activity by counseling arthritis patients about their benefits and referring patients to evidence-based programs (*3*).

BRFSS is an annual, cross-sectional, state-based telephone survey conducted among the noninstitutionalized U.S. population aged ≥18 years.* In 2019, the median combined landline and cellular survey response rate for 49 states† and the District of Columbia (DC) was 49.4% (range = 37.3%–73.1%).§ Participants were identified as having arthritis if they responded "yes" to the question, "Have you ever been told by a doctor or other health care professional that you have arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia?"¶ Among 135,862 adults with arthritis, self-management class attendance was defined by an affirmative response to the question, "Have you ever taken an educational course or class to teach you how to manage problems related to your arthritis or joint symptoms?" Respondents with arthritis were classified as having received health care provider counseling for physical activity if they answered "yes" to the question, "Has a doctor or other health professional ever suggested physical activity or exercise to help your arthritis or joint symptoms?"

Among adults with arthritis in 49 states and DC, state-specific unadjusted and age-standardized** prevalences (with 95% confidence intervals [CIs]) were calculated for self-management class attendance or having received health care provider counseling (counseling) to be physically active. Differences in the prevalences of these two outcomes by selected characteristics were assessed in age-adjusted†† logistic regression models that included age as a categorical covariate. All analyses accounted for BRFSS's complex sampling design and sampling weights, based on iterative proportional fitting, were applied to make state-specific estimates representative of each state.§§ Analyses were conducted using SAS (version 9.4; SAS Institute) and SUDAAN (version 11.0; RTI International). This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.¶¶

In 2019, among 49 states and DC, a median of 23.6% of respondents reported having arthritis. Among adults with arthritis, the median age-standardized prevalence of reported self-management class attendance was 16.2% (range = 9.8% [DC] to 24.9% [Hawaii]) (Table 1). Age-adjusted prevalence reflected lower self-management class attendance among men (15.4%) than among women (17.0%), among non-Hispanic White (15.6%) or Hispanic (17.0%) persons than among non-Hispanic Asian (20.9%), American Indian or Alaska Native (21.9%), or other or multiple race (21.2%) persons, and among those never married (15.0%) or a member of an unmarried couple (15.8%) than among those married (16.0%) or divorced, separated, or widowed (17.3%) (Table 2). Age-adjusted prevalence increased with higher educational

* https://www.cdc.gov/brfss/about/index.htm

† In 2019, New Jersey did not collect sufficient data to meet the minimum requirement for inclusion in the BRFSS public-use data set.

§ https://www.cdc.gov/brfss/annual_data/2019/pdf/2019-response-rates-table-508.pdf

¶ https://www.cdc.gov/arthritis/basics/types.html

** Estimates were age-standardized to the 2000 U.S. Projected Population aged ≥18 years using three age groups: 18–44, 45–64, and ≥65 years to allow for state-to-state comparisons. https://www.cdc.gov/nchs/data/statnt/statnt20.pdf

†† Age-adjusted estimates were generated in weighted logistic regression models that included age as a categorical covariate with the following cut points: 18–44 years, 45–64 years, and ≥65 years.

§§ http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.684.5837&rep=rep1&type=pdf

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

TABLE 1. Unadjusted and age-standardized* prevalence of self-management education class attendance† and receipt of health care provider counseling about physical activity§ among adults with arthritis¶ aged ≥18 years — Behavioral Risk Factor Surveillance System, United States, 2019**

	Persons with arthritis			Self-management education class attendance			Health care provider physical activity counseling		
		% (95% CI)			% (95% CI)			% (95% CI)	
Jurisdiction	Est. no.††	Unadjusted	Age-standardized	Est. no.††	Unadjusted	Age-standardized	Est. no.††	Unadjusted	Age-standardized
Median,§§ %	**NA**	**26.1**	**23.6**	**NA**	**15.7**	**16.2**	**NA**	**70.4**	**69.3**
Alabama	1,273,000	33.9 (32.5–35.3)	30.4 (29.2–31.6)	191,000	15.1 (13.5–16.9)	17.3 (14.4–20.7)	871,000	69.0 (66.7–71.1)	69.1 (65.3–72.6)
Alaska	116,000	21.4 (19.4–23.5)	20.9 (19.2–22.8)	23,000	19.8 (15.7–24.6)	21.1 (14.7–29.2)	83,000	72.3 (68.0–76.2)	75.8 (69.8–80.9)
Arizona	1,301,000	23.6 (22.2–24.9)	21.0 (19.8–22.3)	226,000	17.5 (15.3–19.9)	16.2 (12.6–20.4)	907,000	70.1 (67.1–73.0)	67.1 (61.0–72.7)
Arkansas	715,000	31.2 (29.6–32.9)	28.5 (27.0–30.0)	104,000	14.6 (12.6–16.8)	14.7 (11.6–18.5)	466,000	66.3 (63.4–69.0)	63.2 (58.0–68.1)
California	6,007,000	19.8 (18.9–20.7)	18.4 (17.6–19.2)	1,192,000	19.9 (17.9–22.1)	20.4 (16.9–24.4)	336,000	72.7 (70.4–74.9)	70.3 (66.3–74.1)
Colorado	990,000	22.3 (21.4–23.2)	21.1 (20.2–22.0)	154,000	15.6 (14.0–17.4)	16.5 (13.8–19.7)	678,000	69.8 (67.7–71.9)	69.3 (65.5–72.8)
Connecticut	653,000	23.5 (22.5–24.6)	20.3 (19.4–21.3)	78,000	12.0 (10.6–13.6)	12.8 (9.8–16.5)	467,000	72.6 (70.3–74.7)	71.3 (66.2–75.9)
Delaware	208,000	27.4 (25.6–29.3)	23.6 (22.0–25.3)	33,000	15.6 (13.2–18.4)	15.4 (11.8–19.7)	152,000	73.1 (69.7–76.2)	69.1 (62.2–75.2)
District of Columbia	97,000	17.2 (15.7–18.9)	18.7 (17.3–20.3)	15,000	15.7 (12.9–18.9)	9.8 (7.4–12.7)	73,000	77.3 (72.7–81.3)	74.4 (66.0–81.3)
Florida	4,325,000	25.4 (24.1–26.7)	21.1 (20.0–22.3)	881,000	20.4 (17.9–23.2)	20.8 (16.4–26.2)	3,052,000	71.4 (68.9–73.7)	70.2 (65.4–74.5)
Georgia	1,902,000	23.8 (22.4–25.2)	22.2 (21.0–23.5)	301,000	15.9 (13.7–18.4)	17.0 (12.7–22.3)	1,260,000	67.0 (63.8–70.0)	63.4 (57.5–68.9)
Hawaii	230,000	20.9 (19.8–22.1)	18.4 (17.4–19.5)	48,000	20.8 (18.3–23.5)	24.9 (20.2–30.3)	159,000	69.7 (66.8–72.4)	66.7 (61.4–71.7)
Idaho	329,000	25.1 (23.4–26.8)	23.1 (21.5–24.7)	64,000	19.5 (16.4–23.1)	21.1 (15.4–28.3)	212,000	65.9 (62.3–69.4)	67.1 (61.0–72.6)
Illinois	2,409,000	24.7 (23.5–26.0)	22.5 (21.4–23.7)	415,000	17.2 (15.2–19.5)	15.8 (12.9–19.2)	1,715,000	71.6 (68.9–74.2)	70.5 (65.9–74.6)
Indiana	1,358,000	26.9 (25.9–28.0)	24.7 (23.7–25.7)	216,000	16.0 (14.4–17.7)	16.3 (13.5–19.5)	921,000	68.8 (66.6–70.9)	68.0 (64.2–71.6)
Iowa	618,000	25.7 (24.7–26.6)	23.0 (22.1–23.9)	94,000	15.4 (14.0–16.9)	17.0 (14.5–19.8)	408,000	67.3 (65.3–69.2)	65.5 (62.0–68.9)
Kansas	555,000	25.6 (24.7–26.5)	23.6 (22.7–24.4)	89,000	16.1 (14.6–17.6)	15.7 (13.3–18.4)	374,000	68.6 (66.6–70.5)	65.7 (62.1–69.1)
Kentucky	1,176,000	34.3 (32.7–35.9)	31.3 (29.8–32.9)	157,000	13.4 (11.5–15.4)	14.0 (11.3–17.0)	796,000	68.4 (65.8–70.9)	66.1 (61.9–70.0)
Louisiana	968,000	27.6 (26.1–29.2)	25.5 (24.2–26.9)	140,000	14.6 (12.5–16.8)	15.3 (12.2–18.9)	686,000	71.8 (69.0–74.5)	72.9 (68.5–76.9)
Maine	340,000	31.8 (30.5–33.1)	27.4 (26.1–28.8)	48,000	14.1 (12.6–15.7)	13.7 (11.2–16.8)	238,000	71.3 (69.0–73.4)	70.6 (66.0–74.8)
Maryland	1,107,000	23.9 (23.1–24.8)	21.6 (20.9–22.4)	178,000	16.2 (14.8–17.6)	17.7 (14.7–21.1)	826,000	75.3 (73.7–76.9)	75.2 (71.9–78.2)
Massachusetts	1,316,000	24.5 (23.3–25.7)	21.9 (20.8–23.0)	205,000	15.7 (13.9–17.7)	15.1 (12.3–18.4)	945,000	73.5 (71.1–75.8)	72.0 (67.6–76.0)
Michigan	2,373,000	30.8 (29.6–31.9)	27.2 (26.2–28.2)	345,000	14.6 (13.2–16.0)	14.5 (12.3–17.0)	1,665,000	71.0 (69.0–72.9)	70.6 (66.9–74.0)
Minnesota	928,000	21.7 (20.9–22.4)	19.4 (18.8–20.1)	175,000	19.0 (17.6–20.5)	18.4 (16.2–20.8)	629,000	69.1 (67.3–70.8)	67.5 (64.4–70.5)
Mississippi	650,000	28.8 (27.3–30.4)	26.3 (24.9–27.7)	92,000	14.2 (12.1–16.7)	18.5 (13.9–24.1)	442,000	68.7 (65.8–71.5)	69.5 (64.6–74.0)
Missouri	1,270,000	27.1 (25.8–28.4)	24.1 (22.9–25.2)	194,000	15.3 (13.6–17.3)	14.2 (11.6–17.3)	833,000	66.5 (63.8–69.0)	63.7 (58.9–68.3)
Montana	241,000	28.9 (27.7–30.2)	25.4 (24.3–26.6)	37,000	15.7 (13.9–17.6)	16.2 (13.3–19.5)	152,000	64.6 (62.1–67.0)	64.2 (60.0–68.2)
Nebraska	335,000	23.1 (22.3–24.0)	21.0 (20.2–21.7)	51,000	15.4 (14.0–16.9)	14.6 (12.2–17.4)	223,000	67.2 (65.3–69.1)	64.7 (60.9–68.4)
Nevada	531,000	22.7 (20.6–25.0)	20.7 (18.7–22.8)	96,000	18.2 (14.3–22.9)	15.4 (11.7–20.2)	366,000	69.0 (63.7–73.8)	70.2 (61.9–77.4)
New Hampshire	287,000	26.4 (25.0–27.9)	22.9 (21.5–24.2)	47,000	16.4 (14.5–18.6)	16.2 (12.5–20.6)	197,000	69.8 (67.0–72.6)	64.9 (58.7–70.7)
New Mexico	413,000	25.8 (24.4–27.3)	23.2 (21.9–24.5)	75,000	18.1 (15.8–20.6)	18.8 (15.1–23.2)	295,000	71.7 (68.9–74.3)	68.6 (63.7–73.1)

See table footnotes on the next page.

attainment, urbanicity, federal poverty level, and joint pain severity. Groups with prevalences of self-management class attendance of <15.0% included persons with a high school education or less (12.8%); those employed (14.8%), unemployed (13.4%), or a student or homemaker (12.8%); those residing in micropolitan (14.5%) or rural areas (14.7%); those who were inactive in the last 30 days (12.9%); and those with no to mild joint pain (13.6%). No differences in prevalence by sexual orientation or body mass index were observed.

Among adults with arthritis who reported having received counseling to be physically active, the median age-standardized prevalence was 69.3% (range = 59.9% [North Dakota] to 75.8% [Alaska]) (Table 1). The age-specific percentage of adults with arthritis who reported receipt of counseling was lowest among those aged 18–44 years (Table 2). Age-adjusted reporting of receipt of counseling was less prevalent among those physically inactive (66.5%) in the last 30 days than among those active (73.1%), among non-Hispanic American Indian or Alaska Native (67.8%) or non-Hispanic White (69.2%) persons than among Hispanic (75.3%), or non-Hispanic Asian or Black persons (75.1% and 76.0%, respectively), and among those employed (67.7%) or unemployed (69.6%) than among those who were retired (72.6%) or unable to work or disabled (73.6%). Prevalence of receiving counseling increased with increasing education, urbanicity, body mass index, and joint pain severity. Groups among which <67.0% had received counseling were men (65.3%), those residing in rural areas (66.0%), those who were inactive in the last 30 days (66.5%), those who were underweight or healthy weight (66.9%), and those who had no to mild joint pain (66.3%). Prevalence of receiving physical activity counseling was similar across federal poverty level, marital status, and sexual orientation categories. No clear regional

TABLE 1. (*Continued*) Unadjusted and age-standardized* prevalence of self-management education class attendance† and receipt of health care provider counseling about physical activity§ among adults with arthritis¶ aged ≥18 years — Behavioral Risk Factor Surveillance System, United States, 2019**

	Persons with arthritis			Self-management education class attendance			Health care provider physical activity counseling		
		% (95% CI)			% (95% CI)			% (95% CI)	
Jurisdiction	Est. no.††	Unadjusted	Age-standardized	Est. no.††	Unadjusted	Age-standardized	Est. no.††	Unadjusted	Age-standardized
New York	3,302,000	22.1 (21.2–23.0)	19.9 (19.1–20.7)	472,000	14.4 (12.9–15.9)	12.8 (10.8–15.0)	2,357,000	72.1 (70.0–74.1)	69.6 (65.7–73.1)
North Carolina	2,172,000	27.0 (25.5–28.5)	24.4 (23.0–25.8)	412,000	19.0 (16.6–21.7)	21.5 (17.5–26.2)	607,000	74.5 (71.5–77.3)	75.0 (70.4–79.2)
North Dakota	147,000	25.4 (23.9–26.9)	24.2 (22.8–25.6)	18,000	12.6 (10.6–14.8)	12.6 (9.4–16.7)	93,000	64.6 (61.4–67.7)	59.9 (54.3–65.3)
Ohio	2,751,000	30.6 (29.5–31.8)	27.5 (26.4–28.6)	422,000	15.4 (13.9–17.1)	15.5 (13.2–18.2)	1,926,000	70.9 (68.8–72.8)	70.6 (67.0–73.9)
Oklahoma	790,000	27.0 (25.7–28.3)	25.0 (23.9–26.2)	128,000	16.3 (14.5–18.2)	16.7 (13.7–20.2)	522,000	67.1 (64.5–69.6)	65.0 (60.4–69.3)
Oregon	863,000	26.3 (25.0–27.6)	23.6 (22.5–24.8)	175,000	20.5 (18.3–22.8)	21.7 (18.5–25.2)	605,000	71.4 (68.7–74.0)	69.2 (65.1–72.9)
Pennsylvania	2,910,000	29.1 (27.7–30.5)	25.1 (24.0–26.3)	372,000	12.8 (11.2–14.7)	12.7 (10.0–15.9)	2,031,000	70.7 (68.2–73.1)	72.9 (68.8–76.6)
Rhode Island	224,000	26.8 (25.3–28.3)	23.8 (22.5–25.2)	33,000	14.9 (12.9–17.0)	15.3 (11.6–20.0)	168,000	75.7 (73.0–78.2)	75.5 (69.4–80.6)
South Carolina	1,114,000	28.2 (26.9–29.5)	25.0 (23.8–26.3)	172,000	15.5 (13.7–17.4)	13.6 (11.2–16.5)	760,000	68.8 (66.2–71.2)	64.7 (60.0–69.1)
South Dakota	176,000	26.7 (24.6–28.9)	24.1 (22.1–26.1)	32,000	18.0 (15.0–21.5)	18.1 (13.5–23.7)	120,000	69.2 (65.0–73.0)	70.2 (63.6–76.1)
Tennessee	1,598,000	30.6 (29.1–32.2)	28.0 (26.6–29.4)	241,000	15.2 (13.3–17.4)	16.2 (13.1–19.9)	1,071,000	67.9 (65.2–70.6)	66.5 (61.9–70.7)
Texas	4,398,000	20.7 (19.5–22.0)	20.1 (19.0–21.2)	602,000	13.9 (11.9–16.1)	13.9 (11.0–17.3)	3,125,000	72.0 (68.9–74.9)	69.4 (64.0–74.2)
Utah	519,000	23.1 (22.2–24.0)	24.0 (23.2–24.8)	85,000	16.5 (14.9–18.2)	17.6 (15.3–20.3)	366,000	71.7 (69.8–73.6)	71.2 (68.4–73.9)
Vermont	135,000	27.0 (25.6–28.6)	23.0 (21.7–24.4)	21,000	15.4 (13.4–17.5)	17.4 (13.3–22.6)	95,000	70.8 (67.9–73.6)	69.4 (63.2–75.0)
Virginia	1,730,000	26.3 (25.2–27.4)	24.0 (23.0–25.1)	286,000	16.6 (14.9–18.5)	17.7 (14.6–21.1)	1,206,000	70.7 (68.5–72.9)	71.6 (67.6–75.2)
Washington	1,439,000	24.6 (23.7–25.5)	22.5 (21.7–23.3)	248,000	17.3 (15.8–18.8)	17.0 (14.6–19.7)	1,007,000	70.8 (69.0–72.6)	71.5 (68.3–74.4)
West Virginia	585,000	41.4 (39.7–43.1)	36.4 (34.9–38.0)	73,000	12.4 (11.0–14.0)	12.1 (10.0–14.5)	383,000	66.1 (63.7–68.3)	65.4 (61.4–69.1)
Wisconsin	1,244,000	27.8 (26.3–29.3)	24.6 (23.3–26.0)	196,000	15.8 (13.7–18.1)	19.7 (15.3–25.0)	880,000	71.6 (68.8–74.2)	74.3 (69.6–78.5)
Wyoming	109,000	25.1 (23.5–26.8)	22.8 (21.3–24.3)	14,000	12.9 (10.8–15.3)	11.1 (8.3–14.7)	69,000	64.3 (60.8–67.7)	64.5 (58.0–70.5)
Guam	17,000	16.1 (14.0–18.5)	17.7 (15.6–20.0)	3,000	16.3 (12.5–21.0)	17.2 (12.2–23.6)	12,000	72.7 (64.3–79.8)	66.8 (57.0–75.3)
Puerto Rico	574,000	21.2 (20.0–22.4)	18.4 (17.4–19.4)	48,000	8.3 (6.8–10.2)	11.4 (7.8–16.4)	412,000	72.5 (69.5–75.3)	73.2 (67.5–78.2)

Abbreviations: CI = confidence interval; Est. = estimated; NA = not applicable.

* Estimates were age-standardized to the 2000 Projected U.S. Population aged ≥18 years using three age groups: 18–44, 45–64, and ≥65 years. https://www.cdc.gov/nchs/data/statnt/statnt20.pdf

† Respondents were classified as attending a self-management education course if they answered "yes" to the question, "Have you ever taken an education course or class to teach you how to manage problems related to your arthritis or joint symptoms?"

§ Respondents were classified as receiving health care provider counseling to be physically active if they answered "yes" to the question, "Has a doctor or other health professional ever suggested physical activity or exercise to help your arthritis or joint symptoms?"

¶ Respondents were classified as having arthritis if they responded "yes" to the question, "Have you ever been told by a doctor or other health care professional that you have arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia?"

** In 2019, New Jersey did not collect enough data to meet the minimum requirement for inclusion in the Behavioral Risk Factor Surveillance System public-use data set.

†† Estimated number represents the weighted estimated number of adults with arthritis who reported the outcome of interest (e.g., health care provider counseling to be physically active and self-management education class attendance) rounded to the nearest thousand.

§§ Median calculated for 49 states and the District of Columbia.

patterns in the unadjusted and age-standardized prevalence of either self-management class attendance or counseling to be physically active were noted.

Discussion

The prevalence of self-management class attendance and receipt of health care provider counseling to be physically active among adults with arthritis varied considerably across states and by participant characteristics, with no clear regional patterns. Among adults with arthritis, self-management class attendance was low among all persons. The specific groups identified with low self-management class attendance and receipt of physical activity counseling were men, persons with a high school education or less, and those residing in small cities or rural areas. Opportunities for increasing health care provider counseling and interventions focused on improving self-management class attendance and physical activity among persons living with arthritis should continue for all, but especially for those groups with lower engagement in these activities.

The benefits of self-management courses and counseling to engage in physical activity are well established health goals for the nation, each of which was codified and evaluated in Healthy People 2020. The relevant Healthy People 2020 arthritis objective target*** of 11.7% of persons with arthritis attending self-management classes indicated slow progress and was almost attained in 2014 (11.4%) as reported in the National Health Interview Survey (NHIS) (*4*). Similarly, advancement

*** Healthy People 2020 self-management education objective AOCBC-8, "Increase the proportion of adults with doctor-diagnosed arthritis who have had effective, evidence-based arthritis education as an integral part of the management of their condition." https://www.healthypeople.gov/2020/topics-objectives/topic/Arthritis-Osteoporosis-and-Chronic-Back-Conditions/objectives

TABLE 2. Overall, age-adjusted, and age-specific* prevalence of self-management education class attendance† and receipt of health care provider counseling for physical activity§ among adults with arthritis aged ≥18 years,¶ by selected characteristics — Behavioral Risk Factor Surveillance System, United States, 2019**

Characteristic	Unweighted sample size	% (95% CI)	
		Self-management education class attendance	Health care provider counseling for physical activity
Overall (unadjusted)	135,862	16.4 (15.9–16.8)	70.8 (70.3–71.2)
Overall (age-adjusted)	135,862	16.3 (15.9–16.7)	70.8 (70.3–71.3)
Age-specific estimates			
Age group, yrs††			
18–44	11,665	16.9 (15.7–18.1)	67.9 (66.4–69.4)
45–64	47,991	16.4 (15.8–17.1)	71.2 (70.4–71.9)
≥65	76,206	16.1 (15.5–16.7)	71.4 (70.8–72.1)
Age-adjusted estimates			
Sex			
Female	83,885	17.0 (16.5–17.6)	74.5 (73.9–75.1)
Male	51,977	15.4 (14.7–16.0)	65.3 (64.4–66.1)
Race/Ethnicity			
White, NH	112,595	15.6 (15.2–16.0)	69.2 (68.7–69.7)
Black, NH	10,407	18.1 (16.8–19.5)	76.0 (74.5–77.5)
Hispanic	5,317	17.0 (15.0–19.2)	75.3 (72.9–77.5)
Asian, NH	1,174	20.9 (15.7–27.2)	75.1 (69.5–80.0)
American Indian or Alaska Native, NH	2,323	21.9 (17.7–26.8)	67.8 (63.2–72.0)
Other or multiple race, NH	4,046	21.1 (18.7–23.7)	72.6 (69.9–75.1)
Marital status			
Married	67,122	16.0 (15.5–16.6)	70.7 (70.0–71.4)
Divorced, separated, or widowed	52,525	17.3 (16.6–18.1)	70.4 (69.6–71.2)
Never married	12,615	15.0 (13.7–16.5)	71.7 (70.1–73.3)
Member of an unmarried couple	2,906	15.8 (13.4–18.6)	71.0 (67.9–73.8)
Highest level of education			
Less than high school graduate	10,894	12.8 (11.5–14.1)	67.2 (65.6–68.8)
High school graduate or equivalent	39,281	12.8 (12.1–13.5)	69.2 (68.3–70.1)
Technical school or some college	40,588	19.2 (18.4–20.0)	72.4 (71.5–73.2)
College degree or higher	44,763	18.9 (18.2–19.7)	72.6 (71.7–73.4)
Employment status			
Employed or self-employed	42,601	14.8 (14.1–15.5)	67.7 (66.8–68.6)
Unemployed	4,487	13.4 (11.5–15.4)	69.6 (67.0–72.1)
Retired	62,828	17.6 (16.7–18.5)	72.6 (71.6–73.5)
Unable to work or disabled	18,080	19.3 (18.2–20.5)	73.6 (72.4–74.8)
Other (student or homemaker)	6,533	12.8 (11.4–14.3)	72.6 (70.4–74.7)
Federal poverty level§§			
≤125% FPL	21,802	16.1 (15.1–17.2)	71.8 (70.6–73.0)
>125% to ≤200% FPL	21,593	15.9 (14.9–17.0)	70.7 (69.5–71.9)
>200% to ≤400% FPL	32,007	16.4 (15.6–17.2)	70.9 (69.9–71.9)
>400% FPL	34,014	17.1 (16.2–17.9)	70.6 (69.6–71.6)

See table footnotes on the next page.

toward the Healthy People 2020 arthritis objective target††† of 57.4% of adults with arthritis receiving physical activity counseling indicated good progress and was surpassed in the 2014 NHIS, when 61.0% of adults with arthritis reported receiving such counseling (*5*).

Among the known benefits of physical activity for adults with arthritis are improved mood, strength, and endurance and reduced arthritis-related joint pain, stiffness, and fatigue (*6*). Multiple professional organizations recommend that health care providers counsel adults with arthritis to engage in physical activity (*7*); however, a barrier commonly reported by providers is having insufficient training to counsel patients with arthritis (*8*). Health care providers can counsel patients about safely increasing physical activity using evidence-based, arthritis-appropriate, physical activity programs§§§ available in communities across the country. These include low-impact group aquatic exercise (e.g., Arthritis Foundation Aquatic

††† Healthy People 2020 health care provider counseling for physical activity objective AOCBC-7.2, "Increase the proportion of adults with doctor-diagnosed arthritis who receive health care provider counseling for physical activity or exercise." https://www.healthypeople.gov/2020/topics-objectives/topic/Arthritis-Osteoporosis-and-Chronic-Back-Conditions/objectives

§§§ https://www.cdc.gov/arthritis/interventions/physical-activity.html

TABLE 2. (*Continued*) Overall, age-adjusted, and age-specific* prevalence of self-management education class attendance† and receipt of health care provider counseling for physical activity§ among adults with arthritis aged ≥18 years,¶ by selected characteristics — Behavioral Risk Factor Surveillance System, United States, 2019**

Characteristic	Unweighted sample size	% (95% CI)	
		Self-management education class attendance	Health care provider counseling for physical activity
Urban-rural status¶¶			
Large central metro	16,929	17.8 (16.7–18.9)	73.6 (72.3–74.9)
Large fringe metro	23,940	16.1 (15.2–16.9)	71.4 (70.3–72.4)
Medium metro	28,118	16.6 (15.9–17.4)	71.0 (70.1–71.9)
Small metro	19,627	16.2 (15.2–17.1)	68.4 (67.2–69.6)
Micropolitan	23,087	14.5 (13.7–15.4)	68.1 (66.9–69.2)
Rural (non-core)	24,161	14.7 (13.8–15.6)	66.0 (64.7–67.3)
Sexual orientation***			
Straight	73,022	15.9 (15.3–16.4)	71.1 (70.4–71.8)
Lesbian, gay, bisexual, queer, or questioning	4,264	15.5 (13.0–18.5)	72.3 (69.5–75.0)
Engaged in physical activity in past month†††			
Yes	87,299	18.0 (17.5–18.6)	73.1 (72.5–73.7)
No	42,960	12.9 (12.3–13.6)	66.5 (65.6–67.4)
Body mass index (kg/m^2)			
Underweight or healthy weight (<25)	32,173	16.4 (15.5–17.3)	66.9 (65.8–67.9)
Overweight (25 to <30)	43,153	16.2 (15.5–17.0)	69.4 (68.5–70.3)
Obesity (≥30)	50,837	16.5 (15.8–17.2)	74.5 (73.7–75.2)
Joint pain severity§§§			
None/Mild	62,913	13.6 (13.0–14.2)	66.3 (65.5–67.0)
Moderate	32,184	17.8 (16.9–18.7)	74.7 (73.7–75.7)
Severe	38,465	19.1 (18.3–19.9)	74.5 (73.6–75.3)

Abbreviations: CI = confidence interval; FPL = federal poverty level; NH = non-Hispanic.

* Except for the age groups category and the unadjusted overall variables, age-adjusted estimates were generated in weighted logistic regression models that included age as a categorical covariate using the following cut points: 18–44, 45–64, and ≥65 years.

† Respondents were classified as attending a self-management education course if they responded "yes" to the question, "Have you ever taken an education course or class to teach you how to manage problems related to your arthritis or joint symptoms?"

§ Respondents were classified as receiving health care provider counseling to be physically active if they responded "yes" to the question, "Has a doctor or other health professional ever suggested physical activity or exercise to help your arthritis or joint symptoms?"

¶ Respondents were classified as having arthritis if they responded "yes" to the question, "Have you ever been told by a doctor or other health care professional that you have arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia?"

** In 2019, New Jersey did not collect sufficient data to meet the minimum requirement for inclusion in the Behavioral Risk Factor Surveillance System public-use data set.

†† Age-specific estimates.

§§ Federal poverty level is the ratio of total family income to federal poverty guideline per family size.

¶¶ Urban-rural status was categorized using the National Center for Health Statistics 2013 Urban-Rural Classification Scheme for Counties. https://www.cdc.gov/nchs/data/series/sr_02/sr02_166.pdf

*** Sexual orientation was asked in 30 states (Alaska, Arizona, Colorado, Connecticut, Delaware, Florida, Georgia, Hawaii, Idaho, Iowa, Kansas, Louisiana, Maryland, Minnesota, Mississippi, Montana, New York, North Carolina, Ohio, Oklahoma, Rhode Island, South Carolina, Tennessee, Texas, Utah, Vermont, Virginia, Washington, West Virginia, and Wisconsin).

††† Physical activity was defined using the question, "During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, calisthenics, golf, gardening, or walking for exercise?"

§§§ For the question, "On a scale of 0 to 10 where 0 is no pain or aching and 10 is pain or aching as bad as it can be, during the past 30 days, how bad was your joint pain on average," an answer of 0–4 was defined as none or mild, an answer of 5–6 was defined as moderate, and an answer of 7–10 was defined as severe.

Program); EnhanceFitness, which incorporates balance activities; Fit and Strong!, which emphasizes flexibility, strength training, aerobic walking and health education to promote behavior change; and Walk with Ease, which combines self-paced walks with instruction on health-related topics and can be delivered as a group or self-directed activity, both of which accommodate physical distancing, as recommended during the COVID-19 pandemic.

Recommending self-management class attendance while counseling persons with arthritis to engage in physical activity might be the most effective strategy for increasing physical activity. A health care provider's recommendation to attend a self-management workshop is strongly associated with self-management class attendance (*9*). A meta-analysis of health outcomes, health behaviors, and health care utilization related to self-management programs found that persons with arthritis who received a health care provider recommendation to attend a self-management class were nine times more likely to attend a class than were those who did not receive a recommendation (*10*). The analysis found that aerobic physical activity increased after attendance in the generic, evidence-based self-management

Summary

What is already known about this topic?

Arthritis is a prevalent chronic condition. Self-management education and health care provider counseling encouraging engagement in physical activity can improve the health of adults with arthritis; however, in 2014, only 11.4% and 61.0% of arthritis patients reported engaging in each, respectively.

What is added by this report?

In 2019, a median of 16.2% adults with arthritis attended a self-management class, and 69.3% received provider counseling for physical activity. Prevalences differed by state and sociodemographic characteristics.

What are the implications for public health practice?

Equipping health care providers with the tools to counsel arthritis patients about the benefits of physical activity and self-management education and support referrals to evidence-based programs is needed to improve adoption of these behaviors.

course[¶¶¶] (Chronic Disease Self-Management Program [CDSMP]) and persisted for 1 year after attending the class (*10*). CDSMP is a workshop tailored to adults with chronic conditions (including arthritis) and other comorbidities which are also common among adults with arthritis (*1*); the workshop teaches improved self-efficacy and skills, resulting in better arthritis outcomes. Benefits of CDSMP include improved health status (e.g., reduced pain, and improved function and psychological health), improved health behaviors (e.g., increased physical activity, and improved healthful eating, pain-coping strategies, and medication adherence), and improved communication with health care providers. CDSMP is offered in a Spanish-language version (Tomando Control de su Salud) and virtually by the Better Choices, Better Health program.

The findings in this report are subject to at least three limitations. First, BRFSS data rely on self-report and might be subject to recall, social desirability, and other biases. Second, low response rates that differ by state might bias study findings; however, the weighting methodology accounts for nonresponse. Finally, the question to ascertain self-management class attendance did not establish whether respondents attended an evidence-based self-management course. A strength of this study is the use of recent data with a large sample size that allowed analyses of detailed characteristics in 49 states, DC, and two U.S. territories. In addition, the prevalence estimates generated are representative at the state level.

Self-management class attendance and health care provider counseling for physical activity varied by state and sociodemographic characteristics among adults with arthritis. Public health professionals and medical groups can help improve patient self-management behaviors and outcomes among patients with arthritis by equipping health care providers[****] with the tools and information they need to counsel adults with arthritis to be active and recommend evidence-based physical activity and self-management programs.

[¶¶¶] https://www.cdc.gov/arthritis/interventions/self_manage.htm

[****] https://www.cdc.gov/arthritis/healthcare/index.html

Corresponding author: Lindsey M. Duca, 404-498-2798, pgz5@cdc.gov.

[1]Epidemic Intelligence Service, CDC; [2]Division of Population Health, National Center for Chronic Disease Prevention and Health Promotion, CDC; [3]Oak Ridge Institute for Science and Education, Oak Ridge, Tennessee.

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

References

1. Barbour KE, Helmick CG, Boring M, Brady TJ. Vital signs: prevalence of doctor-diagnosed arthritis and arthritis-attributable activity limitation—United States, 2013–2015. MMWR Morb Mortal Wkly Rep 2017;66:246–53. PMID:28278145 https://doi.org/10.15585/mmwr.mm6609e1
2. Barbour KE, Boring M, Helmick CG, Murphy LB, Qin J. Prevalence of severe joint pain among adults with doctor-diagnosed arthritis—United States, 2002–2014. MMWR Morb Mortal Wkly Rep 2016;65:1052–6. PMID:27711038 https://doi.org/10.15585/mmwr.mm6539a2
3. CDC. Arthritis: lifestyle management programs. Atlanta, GA: US Department of Health and Human Services, CDC; 2021. https://www.cdc.gov/arthritis/interventions/index.htm
4. Murphy LB, Brady TJ, Boring MA, et al. Self-management education participation among U.S. adults with arthritis: who's attending? Arthritis Care Res (Hoboken) 2017;69:1322–30. PMID:27748081 https://doi.org/10.1002/acr.23129
5. Hootman JM, Murphy LB, Omura JD, et al. Health care provider counseling for physical activity or exercise among adults with arthritis—United States, 2002 and 2014. MMWR Morb Mortal Wkly Rep 2018;66:1398–401. PMID:29300722 https://doi.org/10.15585/mmwr.mm665152a2
6. 2018 Physical Activity Guidelines Advisory Committee. 2018 Physical Activity Guidelines Advisory Committee scientific report. Washington, DC: U.S. Department of Health and Human Services; 2018. https://health.gov/sites/default/files/2019-09/PAG_Advisory_Committee_Report.pdf
7. Kolasinski SL, Neogi T, Hochberg MC, et al. 2019 American College of Rheumatology/Arthritis Foundation guideline for the management of osteoarthritis of the hand, hip, and knee. Arthritis Rheumatol 2020;72:220–33. PMID:31908163 https://doi.org/10.1002/art.41142
8. Lillie K, Ryan S, Adams J. The educational needs of nurses and allied healthcare professionals caring for people with arthritis: results from a cross-sectional survey. Musculoskelet Care 2013;11:93–8. PMID:23065861 https://doi.org/10.1002/msc.1035
9. Murphy LB, Theis KA, Brady TJ, Sacks JJ. Supporting self-management education for arthritis: Evidence from the Arthritis Conditions and Health Effects Survey on the influential role of health care providers. Chronic Illn 2021;17:217–31. PMID:31475576 https://doi.org/10.1177/1742395319869431
10. Brady TJ, Murphy L, O'Colmain BJ, et al. A meta-analysis of health status, health behaviors, and health care utilization outcomes of the Chronic Disease Self-Management Program. Prev Chronic Dis 2013;10:120112. PMID:23327828 https://doi.org/10.5888/pcd10.120112

Morbidity and Mortality Weekly Report

Mycobacterium porcinum Skin and Soft Tissue Infections After Vaccinations — Indiana, Kentucky, and Ohio, September 2018–February 2019

Erin F. Blau, DNP[1,2]; Andrea Flinchum, MPH[2]; Kathryn L. Gaub, DVM[1,3]; Kathleen P. Hartnett, PhD[1,4]; Michael Curran[2]; Virginia K. Allen[5]; Allison Napier, MBA[5]; Elisabeth M. Hesse, MD[1,4]; Anne M. Hause, PhD[4]; Rachel Cathey, MPH[3]; Christine Feaster, MS[3]; Marika Mohr, MS[6]; Sietske de Fijter, MS[6]; Sarah Mitchell, MS[6]; Heather A. Moulton-Meissner, PhD[4]; Isaac Benowitz, MD[4]; Kevin B. Spicer, MD[2,4]; Douglas A. Thoroughman, PhD[2,7]

During December 2018–February 2019, a multistate investigation identified 101 patients with vaccination-associated adverse events among an estimated 940 persons in Kentucky, Indiana, and Ohio who had received influenza; hepatitis A; pneumococcal; or tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis (Tdap) vaccines at the workplace during September 11–November 28, 2018. These vaccines had been administered by staff members of a third-party health care company contracted by 24 businesses. Company A provided multiple vaccine types during workplace vaccination events across 54 locations in these adjoining states. Injection-site wound isolates from patients yielded *Mycobacterium porcinum*, a nontuberculous mycobacteria (NTM) species in the *Mycobacterium fortuitum* group; subtyping using pulsed-field gel electrophoresis of all 28 available isolates identified two closely related clusters. Site visits to company A and interviews with staff members identified inadequate hand hygiene, improper vaccine storage and handling, lack of appropriate medical record documentation, and lack of reporting to the Vaccine Adverse Event Reporting System (VAERS). Vaccination-associated adverse events can be prevented by training health care workers responsible for handling or administering vaccines in safe vaccine handling, administration, and storage practices, timely reporting of any suspected vaccination-associated adverse events to VAERS, and notifying public health authorities of any adverse event clusters.

On December 4, 2018, a local health department notified the Kentucky Department for Public Health (KDPH) of three patients who had been evaluated at a local public health clinic for injection-site skin abscesses that occurred after receipt of workplace vaccinations administered by company A. The local health department contacted company A regarding these events and determined that company A had received similar reports from additional patients in early November 2018, but had not reported these events to VAERS or local public health authorities. The local health department instructed company A to immediately cease administration of all vaccines, file VAERS reports, and sequester all remaining vaccines and supplies.

On December 6, 2018, KDPH issued a health alert notice to notify local health care providers of vaccination-associated adverse events that occurred in the five counties where company A reported conducting vaccination clinics at seven businesses after September 1, 2018. Health care providers were also provided with recommendations for medical evaluation, and were requested to report any adverse events to KDPH. The health alert notice was reissued statewide on December 13, 2018.*

An investigation was subsequently initiated by KDPH to identify cases, establish cause, and prevent further infections. During December 2018, KDPH investigators conducted two site visits to company A. Interviews conducted with company A's owner and staff members elicited information about vaccine storage, handling, and administration practices as well as protocols regarding hand hygiene and infection control. Investigators obtained vaccination clinic and patient records and collected predrawn syringes with doses of influenza and hepatitis A vaccines and open vaccine multidose vials.† Investigators also collected tap water samples and swabs of surfaces where vaccines were stored, drawn up into syringes, and packed into coolers. All samples were sent to CDC for culture and vaccine antigen detection. Vaccine manufacturer and lot numbers were collected and reported to CDC for review of VAERS reports from other providers.

Details of company A vaccine administration were documented for 355 persons from workplace vaccination clinics at the seven identified businesses. No adverse events associated with the vaccine manufacturers or lot numbers had been reported to VAERS. From observations during company A site visits and interviews with the company owner and staff members, investigators identified breaches in hand hygiene protocols and deviations from recommended vaccine storage and administration practices (*1*). Company A's owner did not report use of a diluent during vaccine preparation. During vaccination events, hand sanitizer was not used, nor were hands routinely washed, even at events with sink access. Vaccines were stored without temperature monitoring in the office and during off-site vaccination events. Vaccines were predrawn from multidose vials into individual syringes at company A; predrawn syringes were stored for hours to weeks before vaccines were administered to patients. Unlabeled syringes were stored in plastic bags with vaccine type and lot numbers written on the bag. Multidose vaccine vials were stored with food in a

* https://www.lexingtondoctors.org/2018/12/14/vaccination-abscess-provider-alert/
† https://www.cdc.gov/injectionsafety/providers/provider_faqs_multivials.html

compact, dormitory-style refrigerator not recommended for vaccine storage (*1*). The owner and employees lacked clinical licensure and had no formal training in vaccine storage, handling, or administration. Although company A staff members were operating under a physician's license, no evidence of direct physician oversight was available.

KDPH investigators notified the seven businesses first identified by company A of the ongoing outbreak investigation and interviewed a representative from each business to confirm and supplement information provided by company A, including vaccination dates, number of persons who received vaccines, and number of persons reporting postvaccination symptoms. From these surveys, investigators learned of 17 additional businesses that company A had failed to report to investigators, including facilities in Indiana and Ohio. KDPH notified the Indiana State Department of Health and the Ohio Department of Health, and a multistate investigation was initiated. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[§]

The investigation identified 24 businesses, including the initial seven, that had contracted company A to provide vaccinations at 54 locations across Indiana, Kentucky, and Ohio. Among an estimated 940 persons who received workplace vaccinations during September 11–November 28, 2018, vaccination-associated adverse events occurred in 101 persons. The respective state health departments sent letters to all businesses for distribution to vaccine recipients, notifying them of the risk for vaccination-associated adverse events, advising them to seek medical care for signs or symptoms, and to request that persons report adverse events to their state health department to receive additional guidance regarding medical treatment and revaccination.

Persons reporting vaccination-associated adverse events to their state health department were interviewed and asked about vaccine administration sites, dates, type of vaccines received, symptoms, and any medical treatment received. A case was defined as a self-reported vaccination-associated adverse event characterized by severe redness or swelling, nodule, pustule, abscess, or drainage at the injection site in a vaccine recipient within 150 days of vaccination by company A after September 1, 2018.

Overall, 179 persons contacted their state health department and completed interviews; among these persons, 101 (56.4%) had a vaccination-associated adverse event that met the case definition, with a median symptom onset of 14 days (range = 0–126 days) after injection (Table). Persons with vaccination-associated adverse events were vaccinated during September 27–November 28, 2018 (with majority of persons

[§] 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. Demographic and clinical characteristics of persons reporting vaccination-associated adverse events* after receipt of vaccine by company A† — Indiana, Kentucky, and Ohio, September 2018–February 2019

Characteristic	No. (%)	
	Overall (N = 101)§	*Mycobacterium fortuitum*-group culture (n = 26)¶
Age, yrs, mean (range)	49 (24–79)	46 (24–65)
Male sex	49 (48.5)	10 (38.5)
State of residence		
Indiana	4 (4.0)	0 (—)
Kentucky	71 (70.3)	25 (96.2)
Ohio	26 (25.7)	1 (3.8)
Incubation period, days, median (range)**	14 (0–126)	21 (0–79)
No. of vaccines received, median (range)	1 (1–4)	2 (1–4)
Vaccines received††		
Influenza	91 (90.1)	22 (84.6)
Hepatitis A	54 (53.5)	17 (65.4)
Pneumococcal	12 (11.9)	5 (19.2)
Tdap	3 (3.0)	2 (7.7)
Vaccine administration site		
Right arm	27 (26.7)	7 (26.9)
Left arm	27 (26.7)	4 (15.4)
Both arms	47 (46.5)	15 (57.7)
Reaction site§§		
Right arm	41 (40.6)	9 (34.6)
Left arm	39 (38.6)	7 (26.9)
Both arms	21 (20.8)	10 (38.5)
Reported signs and symptoms		
Nodule	97 (96.0)	25 (96.2)
Redness	91 (90.1)	25 (96.2)
Pain	85 (84.2)	25 (96.2)
Drainage	58 (57.4)	15 (57.7)
Lymphadenitis	8 (7.9)	3 (11.5)
Fever	8 (7.9)	1 (3.8)
Chills	4 (4.0)	0 (—)
Lymphangitis	4 (4.0)	0 (—)
Reported medical treatment		
Sought medical care	77 (76.2)	24 (92.3)¶¶
Incision and drainage by a medical professional	35 (34.7)	17 (65.4)
Surgical excision by a medical professional	13 (12.9)	7 (26.9)

Abbreviation: Tdap = tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccine.

* A case was defined as a vaccination-associated adverse event characterized by severe redness or swelling, nodule, pustule, abscess, or drainage at the injection site in a vaccine recipient ≤150 days after vaccination by company A after September 1, 2018.

† A third-party company located in Kentucky had administered multiple vaccine types in workplace vaccination events across Indiana, Kentucky, and Ohio during September 2018–February 2019.

§ Denominator for "Overall" column is 101 unless otherwise noted.

¶ Denominator represents number of patients with cultures yielding *Mycobacterium porcinum* and having completed an interview.

** Incubation period was calculated using date of first vaccine administration from company A to date of first symptom onset.

†† Total vaccines administered is greater than 101 because some persons reported receiving multiple vaccines from company A.

§§ A total of 122 adverse events were reported by 101 patients; this does not include recurrent infections.

¶¶ At the time of interview, two of the 26 patients with cultures ultimately yielding *M. porcinum* had not yet sought medical treatment (samples were collected at the time of treatment). After interviews and additional guidance, both persons with symptoms sought medical treatment and had their infection sites cultured by a medical provider.

vaccinated on either October 3 or October 8); symptom onset dates ranged from October 3, 2018, to February 6, 2019 (Figure 1). Frequently reported symptoms were nodule (97; 96.0%), redness (91; 90.1%), and pain (85; 84.2%) at the injection site. Seventy-seven persons (76.2%) sought medical care for their symptoms, and 35 (34.6.%) reported incision and drainage procedures. Clinical specimens collected by providers were sent to public health laboratories for culture; 30 specimens yielded *M. porcinum* and 28 available specimens were sent to CDC's environmental and applied microbiology laboratory. Pulsed-field gel electrophoresis of *M. porcinum* isolates yielded two closely related clusters with one band difference; isolates within each cluster are indistinguishable (Figure 2).

Samples collected during company A site visits yielded *Neisseria mucosa* and *Pantoea* sp. from a predrawn syringe of influenza vaccine, and *Streptococcus mitis*, *Rothia mucilaginosa*, and *Staphylococcus hominis* from a predrawn syringe of hepatitis A vaccine. Environmental samples yielded no NTM. Four of six predrawn influenza vaccine syringes had lower than expected hemagglutinin antigen for all four influenza vaccine antigen subtypes by mass spectrometry (Supplementary Table, https://stacks.cdc.gov/view/cdc/110592), and two had no detectable hemagglutinin antigen.

On January 10, 2019, KDPH notified the Kentucky Board of Medical Licensure of the investigation involving a Kentucky licensed physician (the sole ordering and supervising physician of company A). The investigation focus was delegation of vaccination responsibilities to unlicensed personnel with insufficient supervision and training, improper handling of vaccines, and inadequate medical record keeping. KDPH, the Ohio Department of Health, and the Indiana State Department of Health alerted health care providers and provided recommendations for evaluation and care of affected persons. On February 1, 2019, KDPH issued a press release to reach additional persons who received vaccinations from company A. It warned of potential delayed injection-site infections, advised persons experiencing vaccination-associated adverse events to seek medical care, and recommended revaccination. Education concerning proper vaccine storage and handling for health care workers in Indiana, Kentucky, and Ohio is ongoing.

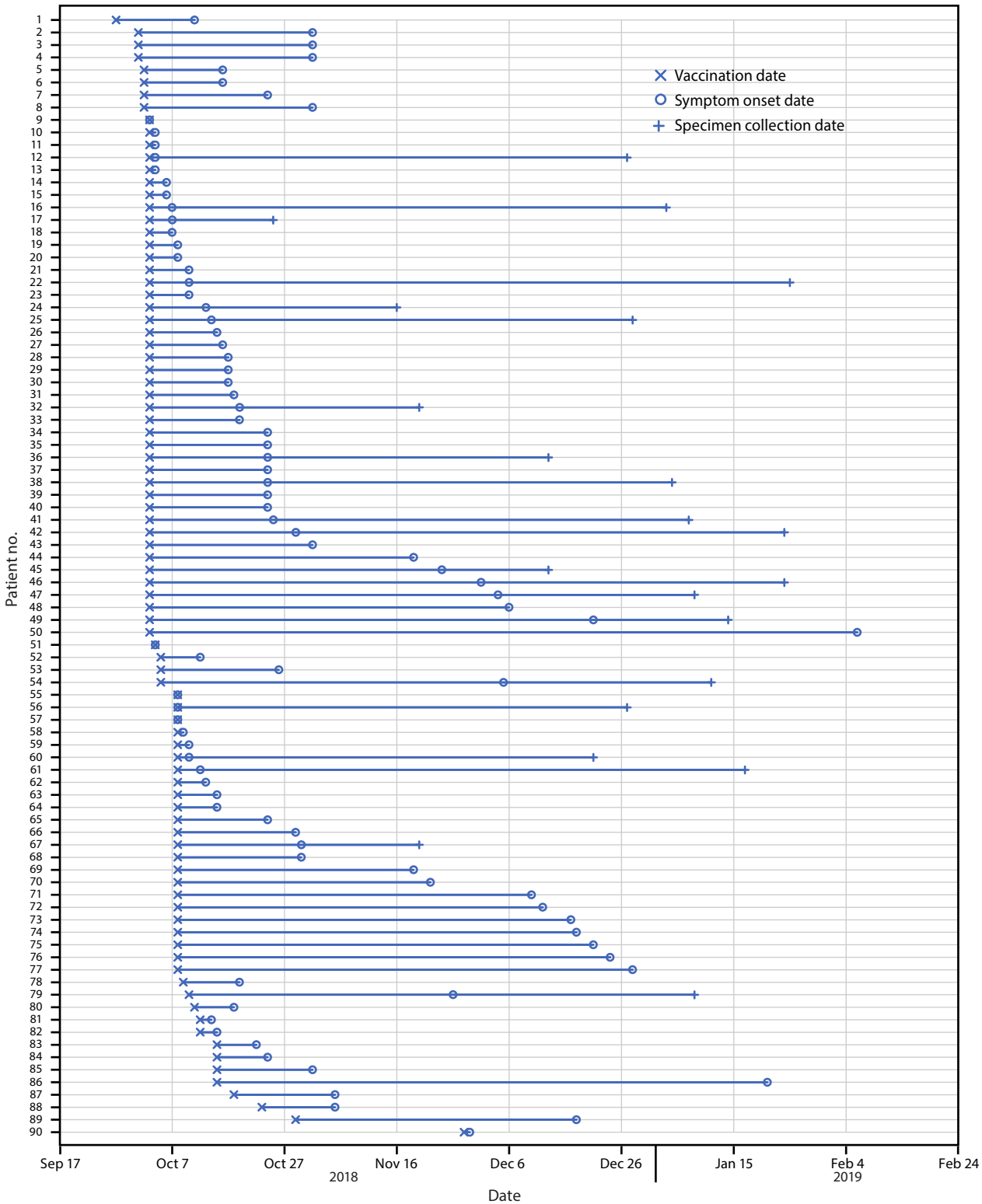
Discussion

Improper storage, handling, and administration of vaccines were linked to an outbreak of skin and soft tissue infections with *M. porcinum* bacteria among persons who received workplace vaccinations from unlicensed staff members of a third-party health care company that was contracted by businesses in three states. The investigation included tracking vaccine manufacturers and lot numbers of the different vaccines stored at company A and administered during workplace vaccination events. Findings from the epidemiologic investigation and molecular typing of samples from predrawn syringes indicated a common source, suggesting that contamination occurred during syringe preparation. Contamination during syringe preparation was likely worsened by inappropriate storage (days to weeks) in predrawn syringes and at temperatures outside of manufacturer guidance. This finding was further supported by the absence of VAERS reports by other providers associated with these manufacturers or lot numbers. Furthermore, low vaccine antigen levels detected in predrawn syringes of influenza and hepatitis A vaccines suggest that administered vaccines might have been impotent and ineffective. Low or undetectable antigen levels in vaccine samples support the theory of a single diluent that might have been introduced during preparation, thereby reducing vaccine antigen levels found in tested predrawn syringes, though none of the four involved vaccines require reconstitution or dilution and company A reported use of a diluent. Low or undetectable antigen levels also support the theory of a contaminant common to all vaccines and might also be the result of vaccine degradation from storage at incorrect temperatures.

This investigation prompted evaluations of vaccine administration training practices and policies in each of the three states. These evaluations placed particular emphasis on assessing the delegation by medical providers of vaccination administration to lay staff members. Vaccine storage and handling errors can result in decreased vaccine potency and reduced effectiveness, limiting immune response and reducing community protection from vaccine-preventable diseases (*1*). Inactivated vaccines require refrigerator storage temperatures of 35°F–46°F (2°C–8°C) to maintain potency. All vaccine storage units must have a temperature monitoring device (e.g., digital data logger), which provides accurate temperature information and details of any temperature excursions outside the recommended storage range (*2*). The compact refrigerators that were used by company A provide inconsistent temperatures and are not recommended for vaccine storage (*1*). CDC guidance specified that vaccines should only be drawn at the time of administration or after arriving at a mass vaccination event, not predrawn and stored in general-use syringes, and remaining vaccines in predrawn syringes should be discarded at the end of each day (*2*).

NTM are opportunistic pathogens naturally found in environmental sources, including soil, dust, drinking water, and water and ice from refrigerators (*3*). Some states adopted reporting of extrapulmonary NTM cases in 2017 (*4*); however, individual extrapulmonary NTM cases are not reportable conditions in Indiana, Kentucky, or Ohio. Vaccination-associated adverse events reporting delays were caused by both lack of regulations requiring reporting of individual extrapulmonary

FIGURE 1. Dates of vaccination, symptom onset, and specimen collection in 90 patients* with vaccination-associated adverse events† after vaccination§ by company A — Indiana, Kentucky, and Ohio, September 2018–February 2019



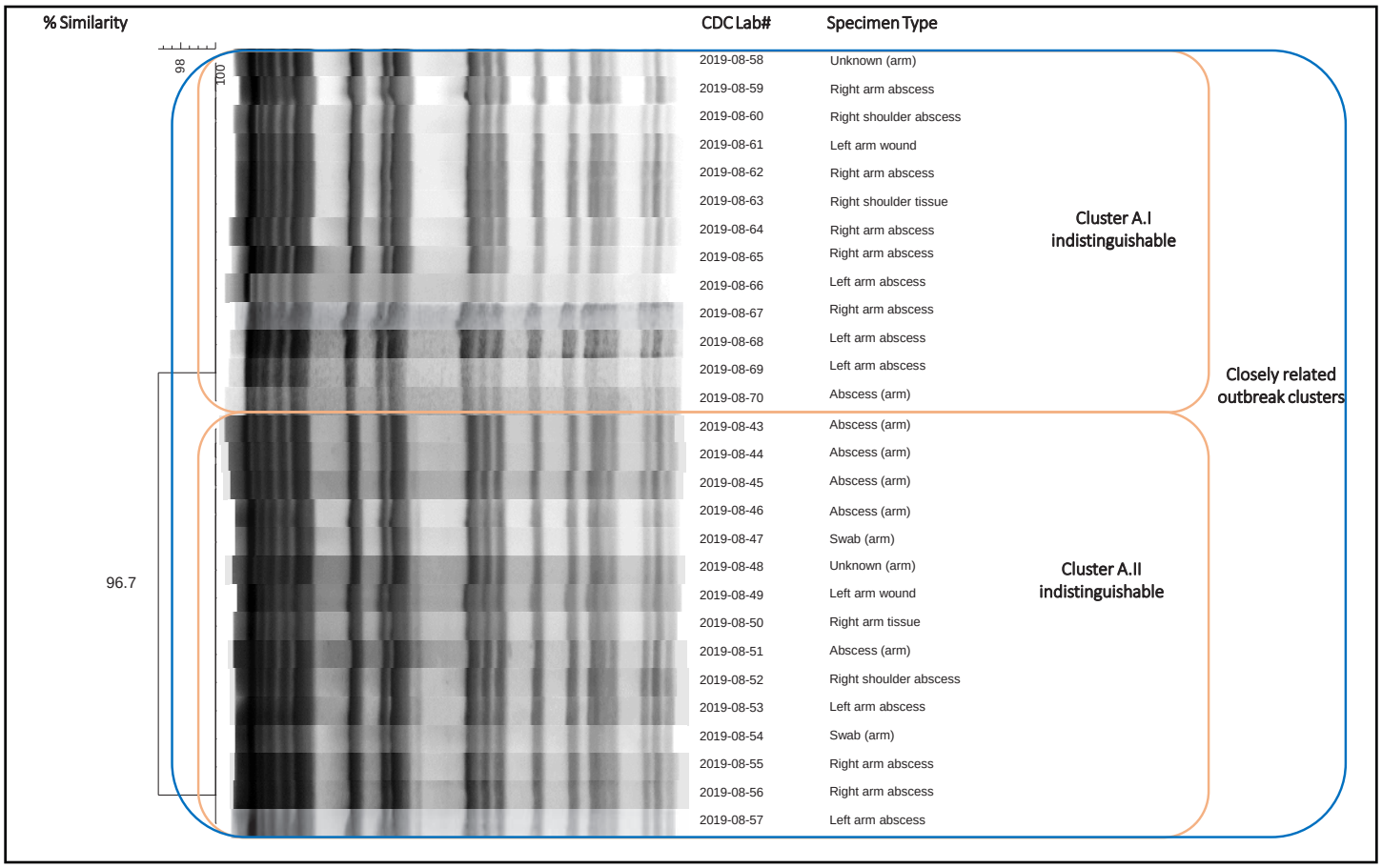
Abbreviation: Tdap = tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccine.

* Of the 101 interviewed patients, 90 reported both vaccination date and symptom onset date. Of these 90 patients, 21 had cultures that yielded *Mycobacterium porcinum* with specimen collection dates reported.

† A case was defined as a vaccination-associated adverse event characterized by severe redness or swelling, nodule, pustule, abscess, or drainage at the injection site in a vaccine recipient within150 days after vaccination by company A, after September 1, 2018.

§ Vaccines administered by company A included influenza, hepatitis A, pneumococcal, and Tdap vaccines.

FIGURE 2. Pulsed-field gel electrophoresis dendrogram* of 28 *Mycobacterium porcinum* specimens isolated from patients vaccinated† by company A — Kentucky and Ohio, September 2018–February 2019



Abbreviations: PFGE = pulsed-field gel electrophoresis; Tdap = tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccine.
* PFGE patterns of the 28 *Mycobacterium porcinum* clinical isolates, 27 from Kentucky and one from Ohio, showed two closely related clusters with one band difference; isolates within each cluster are indistinguishable. *M. porcinum* is a nontuberculous mycobacteria species in the *Mycobacterium fortuitum* group.
† Vaccines administered by company A included influenza, hepatitis A, pneumococcal, and Tdap vaccines.

NTM infections and failure to submit timely reports of adverse events to VAERS by company A. In addition, incomplete record keeping by company A and incomplete reporting of businesses where company A conducted clinics, likely resulted in cases being missed. Earlier detection would have assisted investigators in identifying cases, businesses, and transmission source. Jurisdictions that have added NTM to regulations for reportable diseases have improved their ability to detect and respond to health care–associated outbreaks (*5*,*6*).

This rare outbreak of postvaccination injection site NTM infections highlights the vital role of trained staff members in proper vaccine storage, handling, and administration, and in reporting adverse events to public health authorities. This outbreak was entirely preventable; with proper storage, handing, and administration, vaccines are safe and effective. Persons experiencing postvaccination adverse events should seek medical care, and clinicians caring for persons who experience such adverse events should submit reports through VAERS (https://vaers.hhs.gov, 1-800-822-7967) and contact their local and state health departments.

Acknowledgments

Julie Miracle, Kristy Royalty, Jody Schweitzer, Immunization Branch, Division of Epidemiology and Health Planning, Department for Public Health, Kentucky Cabinet for Health and Family Services; Joseph Hale, James House, Public Health Preparedness Branch, Division of Public Health Protection and Safety, Department for Public Health, Kentucky Cabinet for Health and Family Services; Scott Gibbons, Drug Enforcement and Professional Practices Branch, Office of Inspector General, Kentucky Cabinet for Health and Family Services; Ray Strikas, Immunization Services Division, National Center for Immunization and Respiratory Diseases, CDC; Elaine Miller, Maria Cano, Theresa Harrington, Immunization Safety Office, Division of Healthcare Quality Promotion, National Center for Emerging and Zoonotic Infectious Diseases, CDC; Tracie Williams, National Center for Environmental Health, CDC; Min Z. Levine, National Center for Immunization and Respiratory Diseases,

Summary

What is already known about this topic?

Adherence to vaccine storage, preparation, and administration guidelines is critical to ensure safe, effective vaccination. Improper vaccine handling can increase the risk for adverse events.

What is added by this report?

A multistate investigation identified 101 patients with vaccination-associated adverse events, including 30 with confirmed nontuberculous mycobacteria infection (vaccines received included influenza; hepatitis A; pneumococcal; or tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccines). Improper vaccine storage, handling, and administration by inadequately trained personnel contributed to injection-site infections and other adverse events.

What are the implications for public health practice?

Correctly trained health care workers play a vital role in proper vaccine storage, handling, and administration. Timely reporting to the Vaccine Adverse Event Reporting System and notifying public health authorities of any adverse event clusters are important to detecting vaccination-associated adverse events.

CDC; Jennifer Wright, Suzanne Beavers, Division of Scientific Education and Professional Development, Center for Surveillance, Epidemiology, and Laboratory Services, CDC.

Corresponding author: Erin F. Blau, okl2@cdc.gov.

[1]Epidemic Intelligence Service, CDC; [2]Department for Public Health, Kentucky Cabinet for Health and Family Services; [3]Indiana State Department of Health; [4]Division of Healthcare Quality Promotion, National Center for Emerging Zoonotic and Infectious Diseases, CDC; [5]Montgomery County Health Department, Mount Sterling, Kentucky; [6]Ohio Department of Health; [7]Career Epidemiology Field Officer Program, CDC.

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

References

1. Chojnacky MJ, Miller WW, Ripple DC, Strouse GF. Thermal analysis of refrigeration systems used for vaccine storage. Gaithersburg, MD: US Department of Commerce, National Institute of Standards and Technology; 2009. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.398.4818&rep=rep1&type=pdf
2. Objio T, Morelli V, Trimble S. Storage and handling [Chapter 5]. In: Hamborsky J, Kroger A, Wolfe S, eds. Epidemiology and prevention of vaccine-preventable diseases. 13th ed. Washington D.C.: Public Health Foundation; 2015. https://www.cdc.gov/vaccines/pubs/pinkbook/vac-storage.html
3. Falkinham JO 3rd. Environmental sources of nontuberculous mycobacteria. Clin Chest Med 2015;36:35–41. PMID:25676517 https://doi.org/10.1016/j.ccm.2014.10.003
4. Council of State and Territorial Epidemiologists. Standardized case definition for extrapulmonary nontuberculous mycobacteria infections. Atlanta, GA: Council of State and Territorial Epidemiologists; 2017. https://cdn.ymaws.com/www.cste.org/resource/resmgr/2017PS/2017PSFinal/17-ID-07.pdf
5. Shih DC, Cassidy PM, Perkins KM, Crist MB, Cieslak PR, Leman RL. Extrapulmonary nontuberculous mycobacterial disease surveillance—Oregon, 2014–2016. MMWR Morb Mortal Wkly Rep 2018;67:854–7. PMID:30091968 https://doi.org/10.15585/mmwr.mm6731a3
6. CDC. Healthcare–associated infections, diseases and organisms, nontuberculosis mycobacteria (NTM): health departments. Atlanta, GA: US Department of Health and Human Services, CDC; 2021. https://www.cdc.gov/hai/organisms/ntm/health-departments.html

Temporal Trends in Dietary Sodium Intake Among Adults Aged ≥19 Years — United States, 2003–2016

Lasha S. Clarke, PhD, MPH[1]; Katherine Overwyk, MPH[1,2]; Marlana Bates, MPH[3]; Soyoun Park, PhD[1]; Cathleen Gillespie, MS[1]; Mary E. Cogswell, DrPH[1]

Hypertension, which can be brought on by excess sodium intake, affects nearly one half of U.S. adults and is a major risk factor for heart disease, the leading cause of death in the United States (*1*). In 2019, the National Academies of Sciences, Engineering, and Medicine (NASEM) established the Chronic Disease Risk Reduction (CDRR) intake, a chronic-disease–specific recommendation for dietary sodium of 2,300 mg/day. Reducing daily sodium to CDRR intake is expected to reduce chronic disease risk among healthy persons, primarily by lowering blood pressure (*2*). Although the 2019 sodium CDRR intake is equivalent in number to the 2005 Tolerable Upper Limit (UL) released by NASEM (then known as the Institute of Medicine), the UL was intended to provide guidance on safe intake levels, not to serve as an intake goal (*2*). To describe excess sodium intake in the context of the CDRR intake goal, this report analyzed National Health and Nutrition Examination Survey (NHANES) data from 2003 to 2016 to yield temporal trends in usual sodium intake >2,300 mg/day and in mean sodium intake, unadjusted and adjusted for total energy intake, among U.S. adults aged ≥19 years. The percentage of U.S. adults with sodium intake above CDRR intake was 87.0% during 2003–2004 and 86.7% during 2015–2016. Among U.S. adults overall, no significant linear trend was noted from 2003 to 2016 in unadjusted or energy intake–adjusted mean sodium intake. Small, significant declines were observed in mean usual sodium intake among some groups (adults aged 19–50 years, non-Hispanic White adults, adults experiencing obesity, and adults without hypertension). However, after energy adjustment, only adults aged ≥71 years and Mexican American adults demonstrated significant change in usual sodium intake. Many U.S. adults might be at risk for chronic disease associated with sodium intake above CDRR intake, and efforts to lower sodium intake could improve population cardiovascular health. The results of this report support enhanced efforts to reduce population sodium intake and cardiovascular disease risk, including the Food and Drug Administration's (FDA's) recently released guidance for the reduction of sodium in the commercially processed, packaged, and prepared food supply.*

NHANES, a series of cross-sectional surveys of nationally representative samples of the noninstitutionalized U.S. civilian population, uses a documented multistage design methodology† to release data in 2-year cycles. This investigation used data collected from U.S. adults aged ≥19 years with valid dietary data, as determined by National Center for Health Statistics criteria,§ during seven NHANES cycles from 2003–2004 to 2015–2016. Among 70,059 persons examined during 2003–2016, 40,544 were aged ≥19 years. Among those, 4,312 (11%) participants with incomplete or missing dietary recall data were excluded, yielding an analytic sample of 36,232. Unweighted response rates among adults aged ≥20 years examined during that period range from 53.8% (2015–2016) to 70.9% (2009–2010).¶

Findings were stratified by sex, age group (19–30, 31–50, 51–70, and ≥71 years), race and ethnicity (non-Hispanic White, non-Hispanic Black, and Mexican American), obesity status (has or does not have obesity, defined by body mass index),** and hypertension status (has or does not have hypertension, defined by 2017 hypertension guidelines).†† Race- and ethnicity-specific results are reported for Mexican American persons as opposed to all Hispanic persons because of consistent oversampling among Mexican American persons over time.§§

Details on sodium intake assessment using NHANES have been published elsewhere (*3–5*). To estimate mean usual sodium intake, unadjusted and adjusted for energy intake and excess sodium intake (i.e., >2,300 mg/day) (*2*), this report used the National Cancer Institute method¶¶ for usual intake estimation along with post-stratified adjusted balanced repeated replication weights. Up to two complete and reliable 24-hour dietary recalls*** were used for estimation of the percentage of persons above or below the intake threshold. Energy intake–adjusted sodium intake (i.e., sodium intake adjusted for total calories consumed) was estimated using the residual method (*6,7*) and was calculated as the sum of the expected intake for a participant with mean energy intake and the residual from the linear regression model.

* www.fda.gov/sodiumreduction

† https://wwwn.cdc.gov/nchs/nhanes/continuousnhanes/manuals.aspx?BeginYear=2019
§ https://www.cdc.gov/nchs/nhanes/measuring_guides_dri/measuringguides.htm
¶ https://wwwn.cdc.gov/nchs/nhanes/ResponseRates.aspx#response-rates
** https://www.cdc.gov/obesity/adult/defining.html
†† https://www.acc.org/~/media/Non-Clinical/Files-PDFs-Excel-MS-Word-etc/Guidelines/2017/Guidelines_Made_Simple_2017_HBP.pdf
§§ https://wwwn.cdc.gov/nchs/nhanes/analyticguidelines.aspx
¶¶ https://epi.grants.cancer.gov/diet/usualintakes/method.html
*** https://dietassessmentprimer.cancer.gov/approach/table.html

To assess the statistical significance of temporal trends in sodium consumption above CDRR intake and in mean usual sodium intake, this report treated survey cycle as a continuous variable in linear regression models. The inverse value of the estimated variance from post-stratified weights was used to account for the complex survey design. All statistical analyses were performed using SAS-callable SUDAAN (version 11.0.3; RTI International), and p-values <0.05 were considered statistically significant. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[†††]

During 2003–2016, the percentage of U.S. adults aged ≥19 years whose sodium intake exceeded 2,300 mg/day ranged from 86.7% (2015–2016) to 89.2% (2011–2012) (Table 1). No significant linear trends were found among the overall population or any subgroups. Mean usual sodium intake, unadjusted for energy intake, was 3,521 mg/day during 2003–2004 and 3,468 mg/day during 2015–2016, the 2-year cycle with the lowest intake (Table 2). Temporal declines in mean usual sodium intake (average decline per 2-year cycle) were statistically significant among adults aged 19–30 years (30 mg), 31–50 years (45 mg), non-Hispanic White adults (33 mg), adults experiencing obesity (36 mg), and adults not experiencing hypertension (29 mg). Mean usual energy intake–adjusted sodium intake among U.S. adults aged ≥19 years was lowest (3,333 mg/day) during 2003–2004, and was 3,464 mg/day during 2015–2016 (Table 3). This intake decreased significantly by an average of 33 mg during every 2-year survey cycle among adults aged ≥71 years (p<0.01) and increased significantly by an average of 60 mg per survey cycle among Mexican American adults (p<0.01).

[†††] 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.

Discussion

Most U.S. adults consume dietary sodium above CDRR intake and could benefit from sodium reduction to lower their chronic disease risk. Among U.S. adults overall and in most subgroups evaluated, sodium intake remained similar from 2003 to 2016, with approximately 95% of men and 77% of women at increased cardiovascular disease risk because of excess intake during 2015-2016. Although total sodium intake gives a measure of the health risk, adjusting for energy intake allows better understanding of whether temporal changes in intake are associated with the amount of food consumed versus the amount of sodium in those foods. Slight but significant linear

TABLE 1. Percentage of adults with usual sodium intake >2,300 mg/day, by survey years and selected characteristics — National Health and Nutrition Estimation Survey, United States, 2003–2016

Characteristic	Survey yrs, % (SE)							Percentage point change every 2 yrs	p-value for linear trend*
	2003–2004	2005–2006	2007–2008	2009–2010	2011–2012	2013–2014	2015–2016		
Overall	**87.0 (0.6)**	**88.6 (0.4)**	**87.8 (0.6)**	**89.0 (0.5)**	**89.2 (0.6)**	**87.7 (0.5)**	**86.7 (0.5)**	**−0.13**	**0.52**
Sex									
Women	77.4 (1.1)	80.6 (0.7)	80.2 (1.0)	82.8 (0.9)	82.6 (0.7)	78.9 (0.6)	77.8 (0.8)	−0.22	0.63
Men	96.6 (0.3)	97.6 (0.3)	96.7 (0.3)	97.1 (0.3)	97.3 (0.4)	96.8 (0.4)	95.8 (0.3)	−0.14	0.23
Age group, yrs									
19–30	94.1 (1.1)	90.2 (1.4)	91.0 (1.4)	91.9 (0.7)	94.5 (1.1)	93.4 (1.0)	87.7 (0.9)	−0.50	0.34
31–50	89.5 (1.1)	91.5 (0.5)	89.4 (0.9)	91.0 (0.8)	92.2 (0.8)	89.4 (0.8)	90.7 (0.9)	−0.08	0.74
51–70	84.9 (1.3)	88.5 (0.8)	88.4 (1.1)	89.5 (0.8)	85.9 (1.1)	85.0 (1.0)	86.2 (0.6)	−0.42	0.25
≥71	68.5 (1.2)	78.3 (1.5)	77.3 (1.3)	75.5 (0.9)	77.1 (1.6)	76.4 (1.6)	74.2 (1.8)	0.92	0.26
Race/Ethnicity†									
NH, Black	83.2 (1.3)	83.9 (1.8)	85.5 (1.2)	85.5 (1.5)	87.3 (0.7)	81.4 (1.2)	83.6 (1.3)	0.05	0.93
NH, White	88.3 (0.8)	90.9 (0.4)	88.9 (0.6)	90.6 (0.6)	89.1 (0.8)	88.4 (0.4)	86.7 (0.8)	−0.43	0.13
Mexican American	83.8 (1.7)	80.6 (1.3)	84.0 (1.2)	81.6 (1.1)	96.0 (0.8)	90.6 (1.4)	88.1 (1.3)	1.85	0.16
Has obesity§									
Yes	90.0 (0.9)	89.6 (0.5)	88.7 (1.2)	89.5 (0.5)	90.4 (1.1)	86.5 (0.8)	87.1 (0.9)	−0.51	0.06
No	85.9 (0.7)	88.6 (0.6)	88.1 (0.8)	89.0 (0.7)	88.8 (0.6)	88.8 (0.4)	86.4 (0.7)	0.14	0.57
Has hypertension¶									
Yes	85.1 (0.9)	88.4 (0.4)	86.5 (0.7)	88.4 (0.6)	87.2 (0.7)	84.4 (0.6)	87.3 (0.9)	−0.34	0.37
No	89.7 (0.6)	89.3 (0.6)	89.4 (0.9)	89.6 (0.7)	90.9 (0.7)	90.4 (0.6)	86.3 (0.6)	−0.25	0.42

Abbreviations: BMI = body mass index; NH = non-Hispanic; SE = standard error.

* Based on the F-value; post-stratified balanced repeated replication weights were used to account for the complex survey design.

† Persons of of other or multiple races not reported; percentages will not sum to 100.

§ Obesity status is categorized based on clinical guidelines (https://www.cdc.gov/obesity/adult/defining.html) for categorizing BMI (kg/m^2), such that "Not having obesity" corresponds with a BMI <30, and "Having obesity" corresponds with a BMI ≥30.

¶ Hypertension status is based on mean blood pressure and self-reported use of antihypertensive medications and is defined using the 2017 Hypertension Guidelines (https://www.acc.org/~/media/Non-Clinical/Files-PDFs-Excel-MS-Word-etc/Guidelines/2017/Guidelines_Made_Simple_2017_HBP.pdf), where "Having hypertension" is defined as mean systolic blood pressure ≥130 mmHg, mean diastolic blood pressure ≥80 mmHg, or self-reported use of antihypertensive medication. For the purpose of this analysis, participants who did not meet the 2017 Hypertension Guidelines definition for hypertension were defined as "Not having hypertension."

TABLE 2. Mean usual sodium intake among adults, by survey years and selected characteristics — National Health and Nutrition Estimation Survey, United States, 2003–2016

Characteristic	Survey yrs, mg/day (SE)							Avg. change in sodium (mg) every 2 yrs	p-value for linear trend*
	2003–2004	2005–2006	2007–2008	2009–2010	2011–2012	2013–2014	2015–2016		
Overall	**3,521 (17)**	**3,650 (20)**	**3,567 (28)**	**3,567 (20)**	**3,523 (12)**	**3,477 (16)**	**3,468 (22)**	**−17**	**0.13**
Sex									
Women	2,992 (20)	3,057 (26)	3,014 (19)	2,978 (16)	2,961 (14)	2,966 (13)	2,974 (18)	−9	0.10
Men	4,093 (28)	4,311 (31)	4,186 (43)	4,205 (32)	4,131 (22)	4,035 (25)	3,996 (37)	−31	0.15
Age group, yrs									
19–30	3,888 (52)	3,850 (43)	3,769 (47)	3,769 (48)	3,760 (42)	3,740 (34)	3,666 (53)	−30	<0.01
31–50	3,731 (34)	3,898 (19)	3,775 (36)	3,729 (27)	3,741 (28)	3,636 (21)	3,617 (27)	−45	0.01
51–70	3,257 (34)	3,464 (24)	3,419 (38)	3,474 (32)	3,346 (37)	3,310 (29)	3,409 (30)	−4	0.81
≥71	2,722 (23)	2,924 (25)	2,866 (35)	2,872 (31)	2,904 (22)	2,973 (30)	2,917 (35)	31	0.06
Race/Ethnicity†									
NH, Black	3,268 (37)	3,430 (48)	3,373 (31)	3,312 (32)	3,415 (26)	3,420 (38)	3,240 (36)	0.3	0.99
NH, White	3,581 (21)	3,715 (21)	3,623 (31)	3,622 (22)	3,520 (18)	3,468 (18)	3,466 (29)	−33	0.05§
Mexican American	3,474 (37)	3,348 (48)	3,351 (30)	3,316 (62)	3,762 (49)	3,613 (76)	3,633 (28)	44	0.08
Has obesity¶									
Yes	3,579 (42)	3,741 (35)	3,598 (39)	3,589 (29)	3,533 (31)	3,438 (33)	3,507 (36)	−36	0.04
No	3,507 (26)	3,629 (19)	3,566 (28)	3,561 (25)	3,536 (15)	3,511 (16)	3,447 (27)	−18	0.10
Has hypertension**									
Yes	3,379 (29)	3,617 (35)	3,507 (33)	3,451 (22)	3,472 (22)	3,393 (22)	3,448 (29)	−8	0.59
No	3,656 (26)	3,692 (25)	3,596 (26)	3,664 (25)	3,574 (24)	3,548 (18)	3,490 (25)	−29	0.01

Abbreviations: BMI = body mass index; NH = non-Hispanic; SE = standard error.

* Based on the F-value; post-stratified balanced repeated replication weights were used to account for the complex survey design.

† Persons of other or multiple races not reported; percentages will not sum to 100.

§ P-value = 0.048.

¶ Obesity status is categorized based on clinical guidelines (https://www.cdc.gov/obesity/adult/defining.html) for categorizing BMI (kg/m^2), such that "Not having obesity" corresponds to a BMI <30, and "Having obesity" corresponds to a BMI ≥30.

** Hypertension status is based on mean blood pressure and self-reported use of antihypertensive medications and is defined using the 2017 Hypertension Guidelines (https://www.acc.org/~/media/Non-Clinical/Files-PDFs-Excel-MS-Word-etc/Guidelines/2017/Guidelines_Made_Simple_2017_HBP.pdf), where "Having hypertension" is defined as mean systolic blood pressure ≥130 mmHg, mean diastolic blood pressure ≥80 mmHg, or self-reported use of antihypertensive medication. For the purpose of this analysis, participants who did not meet the 2017 Hypertension Guidelines definition for hypertension were defined as "Not having hypertension."

temporal declines in mean usual sodium intake among some subgroups were not significant after adjusting for energy intake, suggesting that decreases in the calories consumed over time might explain the trend, as opposed to decreases in the amount of sodium within foods. After energy intake adjustment, which avoids the confounding effect of energy intake (*8*), the amount of sodium consumed over time declined among adults aged ≥71 years and increased among Mexican American adults.

Data from What We Eat in America[§§§] support shifts in energy intake. Total mean energy intake among adults decreased from 2,216 kcal/day during 2003–2004 to 2,105 kcal/day during 2015–2016. During the same period, average daily energy intake increased among men (by 146 kcal) and women aged ≥70 years (by 50 kcal). During 2003–2004, mean energy intake among Mexican American persons was 2,386 kcal/day. During 2015–2016, the data are presented for all Hispanic persons (because of sampling methodology implemented in NHANES 2009–2010)[¶¶¶]; Hispanic persons (consumed 2,179 kcal/day on average. Additional reports suggest significant nonlinear declines in energy intake from 2003–2004 to 2009–2010 among U.S. adults aged 20–74 years, and among several subgroups (*9*). Thus, temporal changes in sodium intake observed in this study could be attributable to some changes in the amounts of sodium added by manufacturers to some foods, or the types and amounts of sodium-dense foods consumed from 2003–2004 to 2015–2016, which warrants further investigation. Recent FDA guidance, supported by evidence that most dietary sodium comes from processed and packaged and prepared foods, provides voluntary sodium reduction targets for manufactured foods, and foods prepared by commercial establishments, such as restaurants, to achieve in the next 2.5 years.

The findings from this study update previous reports on temporal trends in sodium intake and provide additional information relative to CDRR intake and temporal trends in sodium consumption accounting for energy intake (*3*,*4*,*6*,*10*). Differences in subgroup categorization and analytic methods preclude direct comparison; however, the results here are consistent with previous reports which used the sodium UL to illustrate that most U.S. adults consume >2,300 mg of sodium per day (*2*–*4*,*7*).

§§§ https://www.ars.usda.gov/northeast-area/beltsville-md-bhnrc/beltsville-human-nutrition-research-center/food-surveys-research-group/docs/wweia-data-tables/

¶¶¶ https://www.ars.usda.gov/ARSUserFiles/80400530/pdf/0910/Table_2_NIN_RAC_09.pdf

TABLE 3. Mean usual energy intake–adjusted sodium intake among adults, by survey years and selected characteristics — National Health and Nutrition Estimation Survey, United States, 2003–2016

Characteristic	Survey years, mg/day (SE)							Avg. change in sodium (mg) every 2 yrs	p-value for linear trend*
	2003–2004	2005–2006	2007–2008	2009–2010	2011–2012	2013–2014	2015–2016		
Overall	**3,333 (13)**	**3,524 (14)**	**3,524 (9)**	**3,480 (10)**	**3,432 (6)**	**3,427 (13)**	**3,464 (18)**	**−3**	**0.86**
Sex									
Women	3,299 (19)	3,477 (16)	3,444 (13)	3,381 (12)	3,339 (13)	3,341 (12)	3,395 (13)	−9	0.51
Men	3,371 (15)	3,582 (24)	3,616 (18)	3,588 (15)	3,531 (12)	3,527 (20)	3,535 (31)	21	0.31
Age group, yrs									
19–30	3,308 (31)	3,470 (23)	3,540 (23)	3,477 (21)	3,451 (26)	3,476 (19)	3,525 (39)	13	0.36
31–50	3,327 (24)	3,585 (16)	3,538 (17)	3,493 (14)	3,478 (16)	3,472 (22)	3,504 (17)	−2	0.89
51–70	3,394 (19)	3,536 (23)	3,526 (21)	3,505 (20)	3,401 (11)	3,380 (17)	3,441 (27)	−15	0.34
≥71	3,258 (22)	3,425 (21)	3,455 (19)	3,386 (22)	3,336 (26)	3,353 (21)	3,317 (26)	−33	<0.01
Race/Ethnicity†									
NH, Black	3,366 (13)	3,556 (16)	3,540 (13)	3,492 (11)	3,398 (8)	3,421 (13)	3,431 (23)	−7	0.70
NH, White	3,202 (31)	3,397 (20)	3,423 (12)	3,310 (22)	3,361 (12)	3,344 (16)	3,387 (24)	−4	0.77
Mexican American	3,154 (39)	3,192 (32)	3,282 (16)	3,288 (25)	3,468 (29)	3,407 (38)	3,516 (29)	60	<0.01
Has obesity§									
Yes	3,410 (22)	3,668 (23)	3,593 (25)	3,556 (10)	3,483 (14)	3,462 (20)	3,526 (26)	−11	0.59
No	3,300 (17)	3,460 (14)	3,494 (11)	3,439 (16)	3,404 (9)	3,411 (15)	3,424 (20)	−1	0.96
Has hypertension¶									
Yes	3,340 (13)	3,560 (17)	3,556 (15)	3,463 (10)	3,449 (13)	3,431 (18)	3,457 (20)	6	0.74
No	3,318 (18)	3,500 (19)	3,486 (10)	3,494 (14)	3,409 (12)	3,431 (19)	3,469 (20)	2	0.88

Abbreviations: BMI = body mass index; NH = non-Hispanic; SE = standard error.

* Based on the F-value; post-stratified balanced repeated replication weights were used to account for the complex survey design.

† Persons of of other or multiple races not reported; percentages will not sum to 100.

§ Obesity status is categorized based on clinical guidelines (https://www.cdc.gov/obesity/adult/defining.html) for categorizing BMI (kg/m^2), such that "Not having obesity" corresponds with a BMI <30, and "Having obesity" corresponds with a BMI ≥30.

¶ Hypertension status is based on mean blood pressure and self-reported use of antihypertensive medications and is defined using the 2017 Hypertension Guidelines (https://www.acc.org/~/media/Non-Clinical/Files-PDFs-Excel-MS-Word-etc/Guidelines/2017/Guidelines_Made_Simple_2017_HBP.pdf), where "Having hypertension" is defined as mean systolic blood pressure ≥130 mmHg, mean diastolic blood pressure ≥80 mmHg, or self-reported use of antihypertensive medication. For the purpose of this analysis, participants who did not meet the 2017 Hypertension Guidelines definition for hypertension were defined as "Not having hypertension."

Summary

What is already known about this topic?

U.S. adults' usual sodium intake consistently exceeds national guidelines. Given associations between excess sodium intake and hypertension risk, the Chronic Disease Risk Reduction (CDRR) intake of 2,300 mg/day was recently established. Sodium consumption below this level is expected to reduce chronic disease risk.

What is added by this report?

During 2003–2016, ≥86% of U.S. adults consumed sodium above CDRR intake. Significant changes in unadjusted mean usual sodium intake were seen among some groups; other groups demonstrated significant changes only after energy intake adjustment.

What are the implications for public health practice?

Many U.S. adults might be at risk for chronic disease associated with sodium intake above CDRR intake. Efforts to lower sodium intake could improve population cardiovascular health.

Given that higher sodium intake is positively correlated with higher total energy intake,**** assessment of energy intake–adjusted sodium intake is recommended to account for differences in energy intake across groups and over time (*6*,*8*). This report used the residual method to adjust for energy intake, consistent with a previous report (*6*). In addition, a large, nationally representative sample of U.S. adults with two complete dietary recalls was analyzed with measurement error methods to account for within-person day-to-day variability in all analyses. This analysis also considered changes in NHANES methodology for estimating sodium intake (i.e., the discontinuation of adjusting for optional salt added to eligible foods), allowing for more accurate description of trends from 2003 to 2016 (*3*–*5*). Previous research supports that excluding the salt adjustment step when using 24-hour dietary recall yields sodium intake estimates that are similar to estimates based on urinary sodium (*5*).

The findings in this report are subject to at least two limitations. First, the use of self-reported dietary information is subject to random error and social desirability biases. However, use of two 24-hour recalls and inclusion of energy intake adjustment account for some types of measurement error, including that attributable to day-to-day variability in sodium consumption (*6*). Further, given the prevalence of excess sodium consumption among U.S. adults, it is unlikely that time trends in the underreporting of sodium intake have

**** https://www.who.int/elena/titles/guidance_summaries/sodium_intake/en/

meaningfully changed the conclusions drawn. Second, because the 2017 guideline (which was not released when data were collected during 2003–2016) was used to define hypertension and includes persons with undiagnosed hypertension, some persons categorized as having hypertension might have been unaware of their status.

Overall, this report provides updated information on temporal trends in sodium intake among U.S. adults. These data can update and support national strategies, including Healthy People 2030 objectives,[††††] and recent FDA guidance to decrease sodium intake, lower hypertension risk, and improve population cardiovascular health.

[††††] https://health.gov/healthypeople/objectives-and-data/browse-objectives/nutrition-and-healthy-eating/reduce-consumption-sodium-people-aged-2-years-and-over-nws-12

Corresponding author: Lasha S. Clarke, ksg4@cdc.gov, 770-488-6657.

[1]Division for Heart Disease and Stroke Prevention, National Center for Chronic Disease Prevention and Health Promotion, CDC; [2]IHRC, Inc., Atlanta, Georgia; [3]Panum Group LLC, Bethesda, Maryland.

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. No potential conflicts of interest were disclosed.

References

1. CDC. Hypertension cascade: hypertension prevalence, treatment and control estimates among US adults aged 18 years and older applying the criteria from the American college of cardiology and American Heart Association's 2017 hypertension guideline—NHANES 2013–2016. Atlanta, GA: US Department of Health and Human Services; 2019.
2. National Academies of Sciences Engineering and Medicine. Dietary reference intakes for sodium and potassium. Washington, DC: The National Academies Press; 2019.
3. Cogswell ME, Zhang Z, Carriquiry AL, et al. Sodium and potassium intakes among US adults: NHANES 2003–2008. Am J Clin Nutr 2012;96:647–57. PMID:22854410 https://doi.org/10.3945/ajcn.112.034413
4. CDC. Trends in the prevalence of excess dietary sodium intake—United States, 2003–2010. MMWR Morb Mortal Wkly Rep 2013;62:1021–5. PMID:24352065
5. Sebastian RS, Wilkinson Enns C, Steinfeldt LC, Goldman JD, Moshfegh AJ. Monitoring sodium intake of the US population: impact and implications of a change in what we eat in America, National Health and Nutrition Examination Survey dietary data processing. J Acad Nutr Diet 2013;113:942–9. PMID:23567248 https://doi.org/10.1016/j.jand.2013.02.009
6. Rehm CD, Peñalvo JL, Afshin A, Mozaffarian D. Dietary intake among US adults, 1999–2012. JAMA 2016;315:2542–53. PMID:27327801 https://doi.org/10.1001/jama.2016.7491
7. Jackson SL, King SM, Zhao L, Cogswell ME. Prevalence of excess sodium intake in the United States—NHANES, 2009–2012. MMWR Morb Mortal Wkly Rep 2016;64:1393–7. PMID:26741238 https://doi.org/10.15585/mmwr.mm6452a1
8. Willett W. Nutritional epidemiology. 3rd ed. New York, NY: Oxford University Press; 2013.
9. Ford ES, Dietz WH. Trends in energy intake among adults in the United States: findings from NHANES. Am J Clin Nutr 2013;97:848–53. PMID:23426032 https://doi.org/10.3945/ajcn.112.052662
10. Wall HK, Ritchey MD, Gillespie C, Omura JD, Jamal A, George MG. Vital signs: prevalence of key cardiovascular disease risk factors for million hearts 2022—United States, 2011–2016. MMWR Morb Mortal Wkly Rep 2018;67:983–91. PMID:30188885 https://doi.org/10.15585/mmwr.mm6735a4

Effectiveness of Pfizer-BioNTech mRNA Vaccination Against COVID-19 Hospitalization Among Persons Aged 12–18 Years — United States, June–September 2021

Samantha M. Olson, MPH[1,*]; Margaret M. Newhams, MPH[2,*]; Natasha B. Halasa, MD[3]; Ashley M. Price, MPH[1]; Julie A. Boom, MD[4]; Leila C. Sahni, PhD[4]; Katherine Irby, MD[5]; Tracie C. Walker, MD[6]; Stephanie P. Schwartz, MD[6]; Pia S. Pannaraj, MD[7]; Aline B. Maddux, MD[8]; Tamara T. Bradford, MD[9]; Ryan A. Nofziger, MD[10]; Benjamin J. Boutselis[2]; Melissa L. Cullimore, MD[11]; Elizabeth H. Mack, MD[12]; Jennifer E. Schuster, MD[13]; Shira J. Gertz, MD[14]; Natalie Z. Cvijanovich, MD[15]; Michele Kong, MD[16]; Melissa A. Cameron, MD[17]; Mary A. Staat, MD[18]; Emily R. Levy, MD[19]; Brandon M. Chatani, MD[20]; Kathleen Chiotos, MD[21]; Laura D. Zambrano, PhD[1]; Angela P. Campbell, MD[1]; Manish M. Patel, MD[1,*]; Adrienne G. Randolph, MD[2,22,*]; Overcoming COVID-19 Investigators

On October 19, 2021, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

Pfizer-BioNTech COVID-19 vaccine is authorized for use in children and adolescents aged 12–15 years and is licensed by the Food and Drug Administration (FDA) for persons aged ≥16 (*1*). A randomized placebo-controlled trial demonstrated an efficacy of 100% (95% confidence interval [CI] = 75.3%–100%) in preventing outpatient COVID-19 in persons aged 12–15 years (*2*); however, data among adolescents on vaccine effectiveness (VE) against COVID-19 in real-world settings are limited, especially among hospitalized patients. In early September 2021, U.S. pediatric COVID-19 hospitalizations reached the highest level during the pandemic (*3*,*4*). In a test-negative, case-control study at 19 pediatric hospitals in 16 states during June 1–September 30, 2021, the effectiveness of 2 doses of Pfizer-BioNTech vaccine against COVID-19 hospitalization was assessed among children and adolescents aged 12–18 years. Among 464 hospitalized persons aged 12–18 years (179 case-patients and 285 controls), the median age was 15 years, 72% had at least one underlying condition, including obesity, and 68% attended in-person school. Effectiveness of 2 doses of Pfizer-BioNTech vaccine against COVID-19 hospitalization was 93% (95% CI = 83%–97%), during the period when B.1.617.2 (Delta) was the predominant variant. This evaluation demonstrated that 2 doses of Pfizer-BioNTech vaccine are highly effective at preventing COVID-19 hospitalization among persons aged 12–18 years and reinforces the importance of vaccination to protect U.S. youths against severe COVID-19.

This study used a test-negative design, similar to other post-authorization VE evaluations, in which vaccine performance is assessed by comparing the odds of antecedent vaccination among laboratory-confirmed case-patients hospitalized with COVID-19 and hospitalized controls without COVID-19 (*5*). Participants were aged 12–18 years and were admitted to 19 pediatric hospitals in the CDC-funded Overcoming COVID-19 Network during June 1–September 30, 2021 (*6*). Case-patients[†] were hospitalized with symptomatic COVID-19–like illness and a positive SARS-CoV-2 reverse transcription–polymerase chain reaction (RT-PCR) or antigen test result; no case-patients received a diagnosis of multisystem inflammatory syndrome in children (MIS-C) during their enrolling hospitalization. Two hospitalized control groups were enrolled: 1) patients with symptoms compatible with COVID-19 with negative SARS-CoV-2 RT-PCR or antigen test results (test-negative) and 2) patients without COVID-19–associated symptoms who might or might not have received SARS-CoV-2 testing (syndrome-negative).[§] Baseline demographic characteristics, clinical information about the current illness, and SARS-CoV-2 testing history were obtained through parent or guardian interviews performed by trained study personnel and review of electronic medical records. Parents or guardians were asked about COVID-19 vaccination history, including number of doses and whether the most recent dose occurred in the last 14 days, location where vaccination occurred, vaccine manufacturer, and availability of a COVID-19 vaccination card. Study personnel searched sources, including state vaccination registries, electronic medical records, or other sources (including documentation from pediatricians) to verify reported or unknown vaccination status.

Patients were considered to have received COVID-19 vaccination based on source documentation or by plausible self-report (vaccination dates and location were provided).

* These authors contributed equally to this report.

† Symptomatic COVID-19–like illness was defined as one or more of the following: fever, cough, shortness of breath, loss of taste, loss of smell, gastrointestinal symptoms (e.g., diarrhea, vomiting, or stomachache), use of respiratory support (e.g., high flow oxygen by nasal cannula, new invasive or noninvasive ventilation) for the acute illness, or new pulmonary findings on chest imaging consistent with pneumonia. Patients with COVID-19 as the primary reason for admission were categorized as symptomatic COVID-19 patients. Seventeen case-patients had some missing data on positive testing and were not retested at the hospital: 15 patients had positive test results with a date and unconfirmed test type, and two patients had positive test results but were missing the date of testing.

§ Syndrome-negative controls had no signs or symptoms of COVID-19 (including fever, cough, shortness of breath, loss of taste, loss of smell, gastrointestinal symptoms, use of respiratory support for the acute illness, or new pulmonary findings on chest imaging consistent with pneumonia) and were not clinically suspected to have COVID-19. Among 163 syndrome-negative controls, 10 (6%) did not receive SARS-CoV-2 testing.

Because vaccination with Moderna or Janssen vaccine were not authorized for persons aged <18 years at the time of this evaluation, only receipt of Pfizer-BioNTech vaccine was assessed in this analysis. The study included fully vaccinated persons aged 12–18 years with COVID-19 vaccination status categorized as 1) unvaccinated (no receipt of any COVID-19 vaccine before illness onset[¶]) or 2) fully vaccinated (receipt of 2 doses of Pfizer-BioNTech vaccine, with the second dose administered ≥14 days before illness onset). Patients who were partially vaccinated (i.e., received only 1 dose or received a second dose <14 days before illness onset) were excluded from the analysis. Descriptive statistics were used to compare characteristics of case-patients and controls. Pearson chi-square tests (categorical outcomes) or Wilcoxon rank-sum test for medians (continuous outcomes) were used to make comparisons between groups; statistical significance was defined as $p<0.05$. VE against COVID-19 hospitalization was calculated by comparing the odds of full COVID-19 vaccination among case-patients and controls using the equation VE = 100 × (1 − adjusted odds ratio), determined from logistic regression models. Firth penalized regression was used for models with six or fewer vaccinated case-patients. Models were adjusted for U.S. Census region, calendar month of admission, age, sex, and race/ethnicity (*5*). Other factors were assessed (underlying health conditions and social vulnerability index) but were not included in the final model because they did not change the odds ratio of vaccination by >5% (*5*). Sensitivity analyses were performed to evaluate whether VE differed by control group. VE was also stratified by age groups (12–15 and 16–18 years). Statistical analyses were conducted using SAS (version 9.4; SAS Institute). This activity was reviewed by CDC and the other participating institutions and was conducted consistent with applicable federal law and CDC policy.[**]

During June 1–September 30, 2021, among 572 eligible patients, 108 were excluded, including 56 who were partially vaccinated or who completed vaccination 0–13 days before illness onset, 20 who were hospitalized >14 days after illness onset, 14 case-patients who received a positive SARS-CoV-2 test result but were admitted for non–COVID-19 reasons, and 18 who were excluded for other reasons.[††] The 464 patients in the final analysis comprised 179 case-patients and 285 controls (122 [43%] test-negative and 163 [57%] syndrome-negative). Among case-patients and all controls, the median age was 15 years, 72% had at least one underlying condition, including obesity, and 68% attended in-person school (Table 1). Vaccination coverage was 3% among case-patients and 33% among controls. Case-patients more frequently resided in areas with higher social vulnerability index scores[§§] (median = 0.67) than did controls (median = 0.58) ($p = 0.02$). The distribution of most underlying conditions was not significantly different between case-patients and controls; however, diabetes was more prevalent among case-patients (12%) than among controls (5%) ($p = 0.01$), and neurologic or neuromuscular disorders were more prevalent among controls (28%) than among case-patients (12%) ($p<0.01$).

Among 179 COVID-19 case-patients, six (3%) were vaccinated and 173 (97%) were unvaccinated (Table 2). Overall, 77 (43%) case-patients were admitted to an intensive care unit, and 29 (16%) critically ill case-patients received life support during hospitalization, including invasive mechanical ventilation, vasoactive infusions, or extracorporeal membrane oxygenation; two of these 29 critically ill patients (7%) died. All 77 case-patients admitted to the intensive care unit, all 29 critically ill case-patients, and both deaths occurred among unvaccinated case-patients. Among 169 case-patients with available hospital discharge data, the median length of hospital stay was 5 days (interquartile range [IQR] = 2–9 days) for unvaccinated case-patients and 3 days (IQR = 2–4 days) for vaccinated case-patients.

VE against COVID-19 hospitalization was 93% (95% CI = 83%–97%) (Table 3), during the period when B.1.617.2 (Delta) was the predominant variant. Among all 99 patients classified as fully vaccinated, 96 (97%) had documentation of vaccination status. In a sensitivity analysis, VE was similar for each control group assessed independently (test-negative VE = 94%, 95% CI = 85%–98%; syndrome-negative VE = 92%, 95% CI = 80%–97%). In addition, VE was similar among 106 case-patients aged 12–15 years (VE = 91%) and 73 case-patients aged 16–18 years (VE = 94%).

Discussion

During June–September 2021, receipt of 2 doses of Pfizer-BioNTech vaccine provided a high level of protection against COVID-19 hospitalization among children and adolescents aged 12–18 years in a real-world evaluation at 19 U.S. pediatric hospitals. This evaluation demonstrated that nearly all (97%) persons aged 12–18 years hospitalized with

¶ The date of illness onset was used for case-patients and controls with COVID-19–like illness with median value imputed if missing. For controls without COVID-19–like illness, the date of admission was used for a date of illness onset, also referred to as illness onset for this report.

** 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.

†† Other reasons for excluding patients from the analysis included SARS-CoV-2 testing >10 days after illness onset or >3 days from hospitalization (three), onset of COVID-19–like illness after admission (14), and documentation of full vaccination with Moderna COVID-19 vaccine (one).

§§ Documentation for CDC/ATSDR social vulnerability index (SVI) is available at https://www.atsdr.cdc.gov/placeandhealth/svi/index.html. Median SVI for case-patients and controls are based on US 2018 SVI data.

TABLE 1. Characteristics of hospitalized COVID-19 case-patients and controls aged 12–18 years — 19 pediatric hospitals, 16 states,* June–September 2021

Characteristic (no. unknown)	Case status, no. (column %)			
	Total (N = 464)	Case-patients (n = 179)	Controls (n = 285)	P-value†
Median age, yrs (IQR)	15 (14–17)	16 (14–17)	15 (14–17)	0.07
Age group, yrs				
12–15	285 (61.4)	106 (59.2)	179 (62.8)	0.44
16–18	179 (38.6)	73 (40.8)	106 (37.2)	
Sex				
Female	210 (45.3)	90 (50.3)	120 (42.1)	0.09
Race/Ethnicity				
White, non-Hispanic	193 (41.6)	68 (38.0)	125 (43.9)	0.27
Black, non-Hispanic	96 (20.7)	37 (20.7)	59 (20.7)	
Hispanic, any race	125 (26.9)	57 (31.8)	68 (23.9)	
Other, non-Hispanic	33 (7.1)	13 (7.3)	20 (7.0)	
Unknown	17 (3.7)	4 (2.2)	13 (4.6)	
Social vulnerability index,§ median (IQR) (1)	0.60 (0.34–0.82)	0.67 (0.37–0.85)	0.58 (0.32–0.80)	0.02
U.S. Census region*				
Northeast	21 (4.5)	5 (2.8)	16 (5.6)	0.28
Midwest	60 (12.9)	28 (15.6)	32 (11.2)	
South	283 (61.0)	106 (59.2)	177 (62.1)	
West	100 (21.6)	40 (22.4)	60 (21.1)	
Month of admission				
June	21 (4.5)	7 (3.9)	14 (4.9)	0.03
July	50 (10.8)	29 (16.2)	21 (7.4)	
August	159 (34.3)	58 (32.4)	101 (35.4)	
September	234 (50.4)	85 (47.5)	149 (52.3)	
Underlying health condition				
At least one underlying condition (2)	333 (72.1)	131 (73.2)	202 (71.4)	0.67
Respiratory system disorder (4)	120 (26.1)	55 (30.9)	65 (23.1)	0.06
Asthma (6)	88 (19.2)	42 (23.7)	46 (16.4)	0.05
Cardiovascular system disorder (5)	29 (6.3)	7 (3.9)	22 (7.8)	0.09
Neurologic/Neuromuscular disorder (3)	100 (21.7)	21 (11.8)	79 (27.9)	<0.01
Active or prior oncologic disorder (3)	25 (5.4)	6 (3.4)	19 (6.7)	0.12
Nononcologic immunosuppressive disorder (5)	9 (2.0)	2 (1.1)	7 (2.5)	0.31
Endocrine disorder (3)	63 (13.7)	30 (16.8)	33 (11.7)	0.12
Diabetes (4)	35 (7.6)	21 (11.8)	14 (5.0)	0.01
Other chronic conditions¶ (2)	226 (48.9)	100 (55.9)	126 (44.5)	0.02
Other characteristic				
In-person school attendance (161)	205 (67.7)	80 (68.4)	125 (67.2)	0.83
Fully vaccinated**	99 (21.3)	6 (3.4)	93 (32.6)	<0.01
If fully vaccinated, median days from second vaccine to illness onset (IQR)††	72 (45–97)	55 (47–106)	73 (43–97)	0.68

Abbreviations: IQR = interquartile range; SVI = social vulnerability index.

* Patients were enrolled from 19 pediatric hospitals in 16 states. *Northeast*: Boston Children's Hospital (Massachusetts), Saint Barnabas Medical Center (New Jersey), *Midwest*: Akron Children's Hospital (Ohio), Children's Mercy Kansas City (Missouri), Children's Hospital and Medical Center: Nebraska (Nebraska), Cincinnati Children's Hospital Medical Center (Ohio), Mayo Clinic (Minnesota), *South*: Arkansas Children's Hospital (Arkansas), University of North Carolina at Chapel Hill Children's Hospital (North Carolina), Children's of Alabama (Alabama), Monroe Carell Jr. Children's Hospital at Vanderbilt (Tennessee), Medical University of South Carolina Children's Health (South Carolina), Texas Children's Hospital (Texas), Holtz Children's Hospital (Florida), Children's Hospital of New Orleans (Louisiana), *West*: University of California San Francisco Benioff Children's Hospital Oakland (California), Children's Hospital Colorado (Colorado), Children's Hospital Los Angeles (California), University of California San Diego-Rady Children's Hospital (California).

† Testing for statistical significance was conducted using the Pearson chi-square test to compare categorical variables or Wilcoxon rank-sum test for medians to compare continuous data.

§ CDC/ATSDR SVI documentation is available at https://www.atsdr.cdc.gov/placeandhealth/svi/index.html. Median SVI for case-patients and controls are based on US 2018 SVI data.

¶ Other chronic conditions included rheumatologic/autoimmune disorder, hematologic disorder, renal or urologic dysfunction, gastrointestinal/hepatic disorder, metabolic or confirmed or suspected genetic disorder (including obesity), or atopic or allergic condition.

** COVID-19 vaccination status included the following two categories: 1) unvaccinated, defined as no receipt of any SARS-CoV-2 vaccine before illness onset and 2) fully vaccinated, defined as receipt of both doses of a 2-dose Pfizer-BioNTech vaccination ≥14 days before illness onset.

†† Dates are based on those with documented vaccination, not plausible self-report. The date of illness onset was used for case-patients and controls with COVID-19–like illness with median value imputed if missing. For controls without COVID-19–like illness, the date of admission was used for a date of illness onset, also referred to as illness onset for this report.

TABLE 2. Clinical outcomes and severity among hospitalized COVID-19 case-patients aged 12–18 years, by vaccination status* — 19 pediatric hospitals, 16 states,† June–September 2021

Characteristic (no. unknown)	Case-patients hospitalized with COVID-19, no. (%)		
	Total (N = 179)	Unvaccinated (n = 173)	Fully vaccinated (n = 6)
ICU admission	**77 (43.0)**	**77 (44.5)**	**0 (—)**
Critically ill patients on life support	**29 (16.2)**	**29 (16.8)**	**0 (—)**
Invasive mechanical ventilation	21 (11.7)	21 (12.1)	0 (—)
Vasoactive infusions (1)	20 (11.2)	20 (11.6)	0 (—)
Extracorporeal membrane oxygenation (2)	7 (4.0)	7 (4.1)	0 (—)
Patients with discharge data, no./total no (%)	**172/179 (96.1)**	**166/173 (96.0)**	**6/6 (100)**
Hospital length of stay, median (IQR) (10)	5 (2–9)	5 (2–9)	3 (2–4)
Died before discharge (7)	2 (1.2)	2 (1.2)	0 (—)

Abbreviations: ICU = intensive care unit; IQR = interquartile range.

* COVID-19 vaccination status included the following two categories: 1) unvaccinated, defined as no receipt of any SARS-CoV-2 vaccine before illness onset and 2) fully vaccinated, defined as receipt of both doses of a 2-dose Pfizer-BioNTech vaccination ≥14 days before illness onset.

† Patients were vaccinated and unvaccinated persons aged 12–18 years enrolled from 19 pediatric hospitals in 16 states. *Northeast*: Boston Children's Hospital (Massachusetts), Saint Barnabas Medical Center (New Jersey), *Midwest*: Akron Children's Hospital (Ohio), Children's Mercy Kansas City (Missouri), Children's Hospital and Medical Center: Nebraska (Nebraska), Cincinnati Children's Hospital Medical Center (Ohio), Mayo Clinic (Minnesota), *South*: Arkansas Children's Hospital (Arkansas), University of North Carolina at Chapel Hill Children's Hospital (North Carolina), Children's of Alabama (Alabama), Monroe Carell Jr. Children's Hospital at Vanderbilt (Tennessee), Medical University of South Carolina Children's Health (South Carolina), Texas Children's Hospital (Texas), Holtz Children's Hospital (Florida), Children's Hospital of New Orleans (Louisiana), *West*: University of California San Francisco Benioff Children's Hospital Oakland (California), Children's Hospital Colorado (Colorado), Children's Hospital Los Angeles (California), University of California San Diego-Rady Children's Hospital (California).

TABLE 3. Vaccine effectiveness* against COVID-19 among hospitalized patients aged 12–18 years, by vaccination status† — 19 pediatric hospitals, 16 states,§ July–September 2021

Age group, yrs	No. vaccinated/Total (%)		Vaccine effectiveness, % (95% CI)
	Case-patients	Controls	
All	**6/179 (3.4)**	**93/285 (32.6)**	**93 (83–97)**
12–15	4/106 (3.8)	53/179 (29.6)	91 (74–97)
16–18	2/73 (2.7)	40/106 (37.7)	94 (78–99)

Abbreviation: CI = confidence interval.

* Vaccine effectiveness estimates were based on odds of antecedent vaccination in case-patients vs controls adjusted for U.S. Census region, calendar month of admission, continuous age in years, sex, race/ethnicity (non-Hispanic White, non-Hispanic Black, non-Hispanic other, Hispanic of any race, or unknown). Firth penalized regression was used for models with six or fewer vaccinated cases.

† COVID-19 vaccination status included the following two categories: 1) unvaccinated, defined as no receipt of any SARS-CoV-2 vaccine before illness onset and 2) fully vaccinated, defined as receipt of both doses of a 2-dose Pfizer-BioNTech vaccination ≥14 days before illness onset.

§ Patients were enrolled from 19 pediatric hospitals in 16 states. *Northeast*: Boston Children's Hospital (Massachusetts), Saint Barnabas Medical Center (New Jersey), *Midwest*: Akron Children's Hospital (Ohio), Children's Mercy Kansas City (Missouri), Children's Hospital and Medical Center: Nebraska (Nebraska), Cincinnati Children's Hospital Medical Center (Ohio), Mayo Clinic (Minnesota), *South*: Arkansas Children's Hospital (Arkansas), University of North Carolina at Chapel Hill Children's Hospital (North Carolina), Children's of Alabama (Alabama), Monroe Carell Jr. Children's Hospital at Vanderbilt (Tennessee), Medical University of South Carolina Children's Health (South Carolina), Texas Children's Hospital (Texas), Holtz Children's Hospital (Florida), Children's Hospital of New Orleans (Louisiana), *West*: University of California San Francisco Benioff Children's Hospital Oakland (California), Children's Hospital Colorado (Colorado), Children's Hospital Los Angeles (California), University of California San Diego-Rady Children's Hospital (California).

COVID-19 were unvaccinated (versus fully vaccinated) and reinforces the importance of vaccination to protect U.S. youths against severe COVID-19.

These findings are consistent with efficacy data from the Pfizer-BioNTech clinical trial among persons aged 12–15 years, which found an observed vaccine efficacy of 100% (95% CI = 75.3%–100%) (*2*). However, that trial was not powered to assess efficacy against hospitalized COVID-19. Another study reported VE against COVID-19 hospitalization of 81% for fully vaccinated patients aged 12–15 years; however, that study assessed only 45 cases and thus had wide CIs (–55% to 98%) (*7*). One other evaluation from Israel evaluated Pfizer-BioNTech VE against SARS-CoV-2 infection in patients aged 12–15 years and found similarly high VE (91.5%; 95% CI = 88.2%–93.9%), but the study did not include enough cases to examine VE against hospitalized COVID-19 (*8*). In this real-world analysis, in which all case-patients were hospitalized, vaccination reduced the risk for COVID-19 hospitalization in persons aged 12–18 years by 93%. Moreover, 16% of patients hospitalized with COVID-19 had critical illness requiring life support; all were unvaccinated. Taken together, these findings contribute to the growing knowledge regarding VE against pediatric COVID-19, as updated FDA Emergency Use Authorizations to expand COVID-19 vaccine eligibility to younger ages are considered.

The findings in this report are subject to at least six limitations. First, VE could not be assessed directly against specific variants; the predominant variant during the evaluation period was B.1.617.2 (Delta) (*9*). Second, the sample was too small to assess VE by underlying conditions or by other subgroups of interest, including against critical illness. Third, because this analysis included self-reported data from some participants, vaccination status might have been misclassified in a few case-patients or controls, or there might have been imperfect recollection of illness onset dates. Fourth, because of high levels of COVID-19 transmission in southern states during this period, the majority of patients in this analysis (61%) were from the

Summary

What is already known about this topic?

Persons aged 12–18 years are eligible to receive COVID-19 vaccine. Currently, data are lacking on real-world vaccine effectiveness against COVID-19 hospitalization in adolescents.

What is added by this report?

Among hospitalized U.S. patients aged 12–18 years, vaccine effectiveness of 2 doses of Pfizer-BioNTech vaccine against COVID-19 hospitalization during June–September 2021, was 93% (95% confidence interval = 83%–97%).

What are the implications for public health practice?

This evaluation demonstrated that 2 doses of Pfizer-BioNTech vaccine were highly effective in preventing COVID-19 hospitalization among persons aged 12–18 years. Findings reinforce the importance of vaccination to protect U.S. youths against severe COVID-19.

South; this might limit the representativeness of the sample. Fifth, this report only assessed VE for the Pfizer-BioNTech vaccine. Finally, because vaccination of persons aged 12–15 years commenced only recently, evaluation of duration of protection was not possible.

As of October 18, 2021, 46% of U.S. children and adolescents aged 12–15 years and 54% of those aged 16–17 years were fully vaccinated against COVID-19 (*10*). In a multistate network of U.S. pediatric hospitals, this study found that receipt of 2 doses of Pfizer-BioNTech vaccine was highly effective in preventing COVID-19 hospitalization among persons aged 12–18 years. These data suggest that increasing vaccination coverage among this group could reduce the incidence of severe COVID-19 in the United States. Further, as in-person school attendance increases, multicomponent preventive measures to reduce the incidence of severe COVID-19 among adolescents, including vaccination, are imperative.¶¶

¶¶ Guidance for COVID-19 prevention in kindergarten through grade 12 schools is available at https://www.cdc.gov/coronavirus/2019-ncov/community/schools-childcare/k-12-guidance.html.

Overcoming COVID-19 Investigators

Meghan Murdock, Children's of Alabama, Birmingham, Alabama; Mary Glas Gaspers, University of Arizona, Tucson, Arizona; Katri V. Typpo, University of Arizona, Tucson, Arizona; Connor P. Kelley, University of Arizona, Tucson, Arizona; Ronald C. Sanders, Arkansas Children's Hospital, Little Rock, Arkansas; Masson Yates, Arkansas Children's Hospital, Little Rock, Arkansas; Chelsea Smith, Arkansas Children's Hospital, Little Rock, Arkansas; Katheryn Crane, Rady Children's Hospital, San Diego, California; Geraldina Lionetti, University of California, San Francisco Benioff Children's Hospital Oakland, Oakland, California; Juliana Murcia-Montoya, University of California, San Francisco Benioff Children's Hospital Oakland, Oakland, California; Matt S. Zinter, University of California, San Francisco Benioff Children's Hospital, San Francisco, California; Denise Villarreal-Chico, University of California, San Francisco Benioff Children's Hospital, San Francisco, California; Adam L. Skura, Children's Hospital Los Angeles, Los Angeles, California; Daniel Hakimi, Children's Hospital Los Angeles, Los Angeles, California; Harvey Peralta, Children's Hospital Los Angeles, Los Angeles, California; Emily Port, Children's Hospital Colorado, Aurora, Colorado; Imogene A. Carson, Children's Hospital Colorado, Aurora, Colorado; Justin M. Lockwood, Children's Hospital Colorado, Aurora, Colorado; Satoshi Kamidani, Emory University School of Medicine, Children's Healthcare of Atlanta, Atlanta, Georgia; Keiko M. Tarquinio, Emory University School of Medicine, Children's Healthcare of Atlanta, Atlanta, Georgia; Caitlen E. Taylor, Emory University School of Medicine, Children's Healthcare of Atlanta, Atlanta, Georgia; Kelly N. Michelson, Ann & Robert H. Lurie Children's Hospital of Chicago, Chicago, Illinois; Bria M. Coates, Ann & Robert H. Lurie Children's Hospital of Chicago, Chicago, Illinois; Marla S. Johnston, Children's Hospital of New Orleans, New Orleans, Louisiana; Suden Kucukak, Boston Children's Hospital, Boston, Massachusetts; Sabrina R. Chen, Boston Children's Hospital, Boston, Massachusetts; Amber O. Orzel, Boston Children's Hospital, Boston, Massachusetts; Edie Weller, Boston Children's Hospital, Boston, Massachusetts; Laura Berbert, Boston Children's Hospital, Boston, Massachusetts; Jie He, Boston Children's Hospital, Boston, Massachusetts; Sabrina M. Heidemann, Children's Hospital of Michigan, Detroit, Michigan; Janet R. Hume, University of Minnesota Masonic Children's Hospital, Minneapolis, Minnesota; Ellen R. Bruno, University of Minnesota Masonic Children's Hospital, Minneapolis, Minnesota; Lexie A. Goertzen, University of Minnesota Masonic Children's Hospital, Minneapolis, Minnesota; Supriya Behl, Mayo Clinic, Rochester, Minnesota; Noelle M. Drapeau, Mayo Clinic, Rochester, Minnesota; Shannon M. Hill, Children's Mercy Hospital, Kansas City, Missouri; Abigail Kietzman, Children's Mercy Hospital, Kansas City, Missouri; Valerie Rinehart, Children's Hospital & Medical Center, Omaha, Nebraska; Lauren A. Hoody, Children's Hospital & Medical Center, Omaha, Nebraska; Angelo G. Navas, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina; Paris C. Bennett, University of North Carolina at Chapel Hill, Chapel Hill, North Carolina; Nicole A. Twinem, Rebecca D. Considine Research Institute, Akron Children's Hospital, Akron, Ohio; Merry L. Tomcany, Rebecca D. Considine Research Institute, Akron Children's Hospital, Akron, Ohio; Chelsea C. Rohlfs, Cincinnati Children's Hospital, Cincinnati, Ohio; Rebecca L. Douglas, Children's Hospital of Philadelphia, Philadelphia, Pennsylvania; Megan M. Bickford, Medical University of South Carolina Children's Health, Charleston, South Carolina; Lauren E. Wakefield, Medical University of South Carolina Children's Health, Charleston, South Carolina; Janet B. Nicotera, Monroe Carell Jr. Children's Hospital at Vanderbilt, Nashville, Tennessee; Meenakshi Golchha, Monroe Carell Jr. Children's Hospital at Vanderbilt, Nashville, Tennessee; Jennifer N. Oates, Texas Children's Hospital, Houston, Texas.

Corresponding author: Samantha M. Olson, ylz8@cdc.gov.

[1]CDC COVID-19 Response Team; [2]Department of Anesthesiology, Critical Care, and Pain Medicine, Boston Children's Hospital, Boston, Massachusetts; [3]Division of Pediatric Infectious Diseases, Department of Pediatrics, Vanderbilt University Medical Center, Nashville, Tennessee; [4]Department of Pediatrics, Baylor College of Medicine, Immunization Project, Texas Children's Hospital, Houston, Texas; [5]Section of Pediatric Critical Care, Department of Pediatrics, Arkansas Children's Hospital, Little Rock, Arkansas; [6]Department of Pediatrics, University of North Carolina at Chapel Hill Children's Hospital, Chapel Hill, North Carolina; [7]Division of Infectious Diseases, Children's Hospital Los Angeles and Departments of Pediatrics and Molecular Microbiology and Immunology, University of Southern California, Los Angeles, California; [8]Department of Pediatrics, Section of Critical Care Medicine, University of Colorado School of Medicine and Children's Hospital Colorado, Aurora, Colorado; [9]Department of Pediatrics, Division of Cardiology, Louisiana State University Health Sciences Center and Children's Hospital of New Orleans, New Orleans, Louisiana; [10]Division of Critical Care Medicine, Department of Pediatrics, Akron Children's Hospital, Akron, Ohio; [11]Division of Pediatric Critical Care, Department of Pediatrics, Children's Hospital and Medical Center, Omaha, Nebraska; [12]Division of Pediatric Critical Care Medicine, Medical University of South Carolina, Charleston, South Carolina; [13]Division of Pediatric Infectious Diseases, Department of Pediatrics, Children's Mercy Kansas City, Kansas City, Missouri; [14]Division of Pediatric Critical Care, Department of Pediatrics, Saint Barnabas Medical Center, Livingston, New Jersey; [15]Division of Critical Care Medicine, University of California, San Francisco Benioff Children's Hospital Oakland, Oakland, California; [16]Division of Pediatric Critical Care Medicine, Department of Pediatrics, University of Alabama at Birmingham, Birmingham, Alabama; [17]Division of Pediatric Hospital Medicine, University of California San Diego-Rady Children's Hospital, San Diego, California; [18]Department of Pediatrics, University of Cincinnati College of Medicine, Cincinnati Children's Hospital Medical Center, Cincinnati, Ohio; [19]Divisions of Pediatric Infectious Diseases and Pediatric Critical Care Medicine, Department of Pediatric and Adolescent Medicine, Mayo Clinic, Rochester, Minnesota; [20]Division of Pediatric Infectious Diseases, Department of Pediatrics, UHealth/Holtz Children's Hospital, Miami, Florida; [21]Division of Critical Care Medicine, Department of Anesthesiology and Critical Care, Children's Hospital of Philadelphia, Philadelphia, Pennsylvania; [22]Departments of Anesthesia and Pediatrics, Harvard Medical School, Boston, Massachusetts.

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. Natasha B. Halasa reports grants from Sanofi and Quidel outside of the submitted work. Jennifer E. Schuster reports grants from Merck outside of the submitted work. Pia S. Pannaraj reports grants from AstraZeneca and Pfizer outside of the submitted work, and personal fees from Seqirus and Nestle outside of the submitted work. No other potential conflicts of interest were disclosed.

References

1. Food and Drug Administration. FDA approves first COVID-19 vaccine. Silver Spring, MD: US Department of Health and Human Services, Food and Drug Administration; 2021. https://www.fda.gov/news-events/press-announcements/fda-approves-first-covid-19-vaccine
2. Frenck RW Jr, Klein NP, Kitchin N, et al.; C4591001 Clinical Trial Group. Safety, immunogenicity, and efficacy of the BNT162b2 Covid-19 vaccine in adolescents. N Engl J Med 2021;385:239–50. PMID:34043894 https://doi.org/10.1056/NEJMoa2107456
3. CDC. COVID-NET: laboratory-confirmed COVID-19–associated hospitalizations. Atlanta, GA: US Department of Health and Human Services, CDC; 2021. Accessed October 15, 2021. https://gis.cdc.gov/grasp/covidnet/COVID19_5.html
4. Delahoy MJ, Ujamaa D, Whitaker M, et al.; COVID-NET Surveillance Team. Hospitalizations associated with COVID-19 among children and adolescents—COVID-NET, 14 states, March 1, 2020–August 14, 2021. MMWR Morb Mortal Wkly Rep 2021;70:1255–60. PMID:34499627 https://doi.org/10.15585/mmwr.mm7036e2
5. Tenforde MW, Patel MM, Ginde AA, et al.; Influenza and Other Viruses in the Acutely Ill (IVY) Network. Effectiveness of SARS-CoV-2 mRNA vaccines for preventing Covid-19 hospitalizations in the United States. Clin Infect Dis 2021. Epub August 6, 2021. PMID:34358310 https://doi.org/10.1093/cid/ciab687
6. Son MBF, Murray N, Friedman K, et al.; Overcoming COVID-19 Investigators. Multisystem inflammatory syndrome in children—initial therapy and outcomes. N Engl J Med 2021;385:23–34. PMID:34133855 https://doi.org/10.1056/NEJMoa2102605
7. Tartof SY, Slezak JM, Fischer H, et al. Effectiveness of mRNA BNT162b2 COVID-19 vaccine up to 6 months in a large integrated health system in the USA: a retrospective cohort study. Lancet 2021. Epub October 4, 2021. PMID:34619098
8. Glatman-Freedman A, Hershkovitz Y, Kaufman Z, Dichtiar R, Keinan-Boker L, Bromberg M. Effectiveness of BNT162b2 vaccine in adolescents during outbreak of SARS-CoV-2 Delta variant infection, Israel, 2021. Emerg Infect Dis 2021. Epub September 27, 2021. PMID:34570694
9. CDC. COVID data tracker: variant proportions. Atlanta, GA: US Department of Health and Human Services, CDC; 2021. Accessed October 15, 2021. https://covid.cdc.gov/covid-data-tracker/#variant-proportions
10. CDC. COVID data tracker: percent of people receiving COVID-19 vaccine by age and date reported to CDC, United States. Atlanta, GA: US Department of Health and Human Services, CDC; 2021. Accessed October 18, 2021. https://covid.cdc.gov/covid-data-tracker/#vaccination-demographics-trends

Notes from the Field

Pediatric HIV Outbreak in Ratodero, Pakistan — April 2019–April 2020

Elizabeth M. Rabold, MD[1,2]; Saqib Ali Shaikh, MSc[3]; Karl Schenkel, MD[4]; Mirza Amir Baig, MPH, MHM[5]; Rana Jawad Asghar, MD[6]; Ahmed Liban, MPA[7]; Oliver Morgan, PhD[4]; Hammad Ali, PhD[2]

In April 2019, local media reports alerted the Sindh AIDS Control Program (SACP) in Pakistan of 14 children aged <10 years with new diagnoses of HIV infection in Ratodero, a rural subdistrict of Larkana District in Sindh province* (*1*). The report of pediatric cases of HIV infection in these children, whose parents all had received negative HIV test results, was concerning given the low number of children living with HIV in Pakistan (4,200 in a population of 79 million children) and the low (<0.1%) HIV prevalence estimate in the general population.†,§ Within 2 weeks, SACP, with assistance from the Pakistan Field Epidemiology and Laboratory Training Program (FELTP), established 18 health care and community testing sites throughout Larkana District to identify additional cases. Testing was limited to specimens from persons who visited these voluntary testing sites, regardless of symptoms, and did not include contact tracing of clients with positive test results for HIV infection or implementation of HIV testing at high-risk clinical entry points (e.g., emergency departments or infectious disease clinics).

By May 18, 2019, among 16,856 persons tested, health officials identified 571 (3.4%) new cases of HIV infection, 463 (81%) of which were in children and adolescents aged ≤15 years, including 355 (62%) aged ≤5 years.¶ In late May 2019, Pakistan's Federal Health Ministry requested assistance from the World Health Organization (WHO). International partners including other United Nations agencies and CDC joined WHO to support SACP, FELTP, and other local partners in the outbreak investigation and response. Preliminary investigations (including patient interviews, site visits to clinics, hospitals, and blood banks, and review of surveillance data) identified unsafe injection practices at health care facilities, unsafe practices at blood banks, inadequate infection control measures, and improper management of medical waste as possible risk factors. The Expanded Programme on Immunization services in Pakistan, which includes immunizations against hepatitis B, tuberculosis, polio, and other childhood diseases, uses single-use, auto-disable syringes, and thus routine childhood vaccinations were not deemed to be associated with the outbreak. Because most of the children's mothers were HIV-negative, mother-to-child transmission could not have occurred in most cases. The response team recommended improving infection prevention and control and blood safety, including educating health care workers about safe injection practices, convening task forces with critical stakeholders, and enforcing policy changes and regulations.

After the initial outbreak investigation, dedicated testing sites continued to identify more persons living with HIV. During April 2019–April 2020, a total of 1,353 persons (3.2%) received positive HIV test results in Ratodero. Approximately 75% of newly identified HIV infections occurred in children and adolescents aged <15 years, of which 633 (61%) were boys and 405 (39%) girls.** Consistent with preliminary outbreak investigation findings, a case-control study identified iatrogenic transmission as the predominant mode of HIV transmission, likely related to poor infection prevention and blood safety practices (*2*). Prevalence of hepatitis B surface antigen (18%) and hepatitis C antibodies (6.5%) among persons with a newly received diagnosis of HIV infection was higher than that in controls (5% and 1%, respectively) and that of the pediatric population in the same province (1.8% and 1.6%, respectively) (*3*,*4*). A pending phylogenetic analysis might provide additional information about potential routes of HIV transmission.

Iatrogenic transmission of HIV has been associated with at least four other HIV outbreaks in Pakistan during the past 20 years (*5*); the high prevalence of hepatitis B and C in the country raises concern for iatrogenic transmission of other bloodborne pathogens. Improvements at the local and national levels in health care practices, community education, and health care provider training with an emphasis on infection prevention and control measures, could help prevent future outbreaks of HIV and other bloodborne infections in Pakistan.

* https://www.nytimes.com/2021/03/31/magazine/pakistan-hiv.html
† https://aidsinfo.unaids.org/
§ https://dhsprogram.com/pubs/pdf/FR354/FR354.pdf
¶ https://www.nih.org.pk/field-epidemiology-laboratory-training-program-feltp-2/
** https://nacp.gov.pk. Accessed April 30, 2020.

Acknowledgments

Yetmgeta Eyayou Abdella, Serena Brusamento, Fahmida Iqbal Khan, Lisa Hedman, Joumana Hermez, Palitha Gunarathna Mahipala, Muhammed Safdar Pasha, Musa Rahim, Muhammad Tayyab, Lara Vojnov, Walter Zingg, World Health Organization; Fareed Larik, Naveed Masood Memon, Muhammad Asif Syed, Pakistan Field Epidemiology and Laboratory Training Program.

Corresponding author: Elizabeth M. Rabold, nqo6@cdc.gov, 404-498-5703.

[1]Epidemic Intelligence Service, CDC; [2]Division of Global HIV & TB, Center for Global Health, CDC; [3]Sindh AIDS Control Programme, Ministry of Health, Karachi, Pakistan; [4]World Health Organization, Geneva, Switzerland; [5]Pakistan Field Epidemiology and Laboratory Training Program, Islamabad, Pakistan; [6]Global Health Strategists & Implementers, Islamabad, Pakistan; [7]Division of Global Health Protection, Center for Global Health, CDC.

All authors have completed and submitted the International Committee of Medical Journal Editors form for disclosure of potential conflicts of interest. Karl Schenkel serves on the scientific advisory board for SORMAS, a surveillance tool from the Helmholtz Centre for Infectious Disease Research, funded by the German government. No other potential conflicts of interest were disclosed.

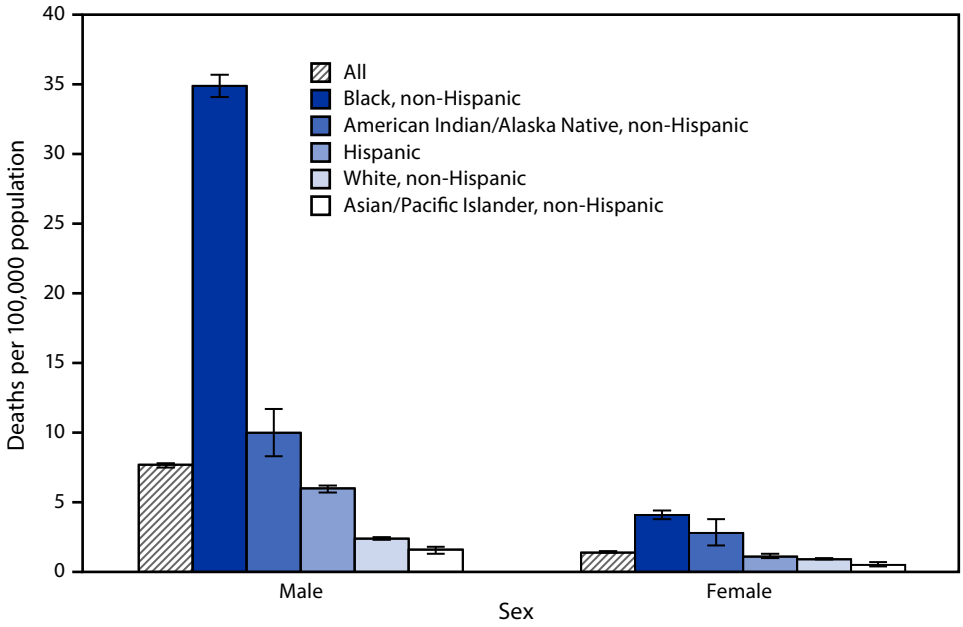
References

1. Mir F, Mahmood F, Siddiqui AR, et al. HIV infection predominantly affecting children in Sindh, Pakistan, 2019: a cross-sectional study of an outbreak. Lancet Infect Dis 2020;20:362–70. PMID:31866326 https://doi.org/10.1016/S1473-3099(19)30743-1
2. Mir F, Nathwani AA, Simms V, et al. Factors associated with HIV infection among children in Larkana District, Pakistan: a matched case-control study. Lancet HIV 2021;8:e342–52. PMID:34087096 https://doi.org/10.1016/S2352-3018(21)00049-7
3. Ali M, Idrees M, Ali L, et al. Hepatitis B virus in Pakistan: a systematic review of prevalence, risk factors, awareness status and genotypes. Virol J 2011;8:102. PMID:21375760 https://doi.org/10.1186/1743-422X-8-102
4. Jafri W, Jafri N, Yakoob J, et al. Hepatitis B and C: prevalence and risk factors associated with seropositivity among children in Karachi, Pakistan. BMC Infect Dis 2006;6:101. PMID:16792819 https://doi.org/10.1186/1471-2334-6-101
5. Rabold EM, Ali H, Fernandez D, et al. Systematic review of reported HIV outbreaks, Pakistan, 2000–2019. Emerg Infect Dis 2021;27:1039–47. PMID:33755545 https://doi.org/10.3201/eid2704.204205

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Age-Adjusted Rates* of Firearm-Related Homicide,† by Race, Hispanic Origin, and Sex — National Vital Statistics System, United States, 2019



* Deaths per 100,000 population are age-adjusted to the 2000 U.S. standard population, with 95% confidence intervals indicated by error bars. In 2019, the age-adjusted rate of firearm-related homicide was 7.7 per 100,000 population for males and 1.4 for females.

† Firearm-related homicide deaths were identified using *International Classification of Diseases, Tenth Revision* underlying cause-of-death codes U01.4 and X93–X95.

In 2019, among males, non-Hispanic Black males had the highest age-adjusted rate of firearm-related homicide at 34.9 per 100,000 population and non-Hispanic Asian/Pacific Islander males had the lowest rate (1.6). Among females, non-Hispanic Black females had the highest rate (4.1) and non-Hispanic Asian/Pacific Islander females had the lowest rate (0.5). Males had higher rates than females across all race and Hispanic origin groups.

Source: National Vital Statistics System, Mortality Data, 2019. https://www.cdc.gov/nchs/nvss/deaths.htm

Reported by: Matthew F. Garnett, MPH, Mgarnett@cdc.gov, 301-458-4077; Merianne R. Spencer, MPH; Holly Hedegaard, MD.

For more information on these topics, CDC recommends the following link: https://www.cdc.gov/violenceprevention/firearms

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

Readers who have difficulty accessing this PDF file may access the HTML file at https://www.cdc.gov/mmwr/index2021.html. Address all inquiries about the *MMWR* Series to Editor-in-Chief, *MMWR* Series, Mailstop V25-5, CDC, 1600 Clifton Rd., N.E., Atlanta, GA 30329-4027 or to mmwrq@cdc.gov.

ISSN: 0149-2195 (Print)