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Tobacco Product Use Among Middle and High School Students — United States, 2020

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Tobacco use is the leading cause of preventable disease and death in the United States; nearly all tobacco product use begins during youth and young adulthood (*1*,*2*). CDC and the Food and Drug Administration (FDA) analyzed data from the 2019 and 2020 National Youth Tobacco Surveys (NYTS) to determine changes in the current (past 30-day) use of seven tobacco products among U.S. middle (grades 6–8) and high (grades 9–12) school students. In 2020, current use of any tobacco product was reported by 16.2% (4.47 million) of all students, including 23.6% (3.65 million) of high school and 6.7% (800,000) of middle school students. Electronic cigarettes (e-cigarettes) were the most commonly used tobacco product among high school (19.6%; 3.02 million) and middle school (4.7%; 550,000) students. From 2019 to 2020, decreases in current use of any tobacco product, any combustible tobacco product, multiple tobacco products, e-cigarettes, cigars, and smokeless tobacco occurred among high school and middle school students; these declines resulted in an estimated 1.73 million fewer current youth tobacco product users in 2020 than in 2019 (6.20 million) (*3*). From 2019 to 2020, no significant change occurred in the use of cigarettes, hookahs, pipe tobacco, or heated tobacco products. The comprehensive and sustained implementation of evidence-based tobacco control strategies at the national, state, and local levels, combined with tobacco product regulation by FDA, is warranted to help sustain this progress and to prevent and reduce all forms of tobacco product use among U.S. youths (*1*,*2*).

NYTS is a cross-sectional, voluntary, school-based, self-administered electronic survey of U.S. middle and high school students. A stratified three-stage cluster sampling procedure generated a nationally representative sample of U.S. students attending public and private schools in grades 6–12. Participants complete the survey in classrooms using a tablet computer.* In

*The survey was programmed using an application that did not require Internet access for use. Eligible students who were absent on the day of survey administration could participate in the NYTS using a web-based make-up survey.

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2020, data collection occurred during January 16–March 16, 2020.† In total, 14,531 students (participation rate = 87.4%) from 180 schools (participation rate = 49.9%) participated, yielding an overall response rate of 43.6% in 2020. Detailed information about NYTS is available elsewhere.§

Prevalence, with 95% confidence intervals, of current use of seven tobacco products (e-cigarettes, cigarettes, cigars, smokeless tobacco,¶ hookahs, pipe tobacco,** and heated tobacco products††) was reported; current use was defined as use on one or more days during the past 30 days. Three composite measures of current use (any tobacco product,§§ any combustible tobacco product,¶¶ and multiple tobacco products***) also were reported.

National weighted prevalence estimates and population totals††† in 2020 were reported among all students and separately by school level. Estimates were reported overall and by selected demographic characteristics. Differences between the prevalence

† The data collection timeline was truncated because of widespread school closures during the coronavirus disease 2019 pandemic; data collection was anticipated to occur through May 2020. For comparison, the 2019 NYTS data were collected during February 15–May 24, 2019.

§ https://www.cdc.gov/tobacco/data_statistics/surveys/nyts/index.htm.

¶ Definition of smokeless tobacco includes chewing tobacco, snuff, or dip; snus; and dissolvable tobacco. Use of individual smokeless tobacco products is not reported.

** Use of pipe tobacco was assessed among respondents who reported ever use of one or more "other tobacco product" by the question "In the past 30 days, which of the following products have you used on at least one day? (Select one or more)" Respondents could select tobacco product(s) they had used from the list: roll-your-own cigarettes; pipes filled with tobacco (not hookah or waterpipe); snus; dissolvable tobacco products; bidis. Estimates of current use of roll-your-own cigarettes and bidis are not reported.

†† Respondents were first asked about heated tobacco product use in 2019. Questions assessing awareness, ever use, and current use of heated tobacco products were accompanied by a brief description: "The next section is about heated tobacco products. Some persons refer to these products as "heat-not-burn" tobacco products. Heated tobacco products heat tobacco sticks or capsules to produce a vapor. They are different from e-cigarettes, which heat a liquid to produce a vapor. Some brands of heated tobacco products include iQOS, glo, and Eclipse."

§§ In 2020, any tobacco product use is defined as current use of one or more of the following tobacco products on ≥1 day during the past 30 days: e-cigarettes, cigarettes, cigars, smokeless tobacco, hookahs, pipe tobacco, bidis, or heated tobacco products. In 2019, consistent with previously published estimates, any tobacco product use is defined as current use of one or more of the following tobacco products on ≥1 day during the past 30 days: e-cigarettes, cigarettes, cigars, smokeless tobacco, hookahs, pipe tobacco, or bidis. In 2020, inclusion of heated tobacco products did not significantly change overall estimates of any current tobacco product use among youths.

¶¶ In 2019 and 2020, combustible tobacco product use is defined as current use of one or more of the following tobacco products on ≥1 day during the past 30 days: cigarettes, cigars, hookahs, pipe tobacco, or bidis.

*** In 2020, multiple tobacco product use is defined as current use of two or more of the following tobacco products on ≥1 day during the past 30 days: e-cigarettes, cigarettes, cigars, smokeless tobacco, hookahs, pipe tobacco, bidis, or heated tobacco products. In 2019, consistent with previously published estimates, multiple tobacco product use is defined as current use of two or more of the following tobacco products on ≥1 day during the past 30 days: e-cigarettes, cigarettes, cigars, smokeless tobacco, hookahs, pipe tobacco, or bidis. In 2020, inclusion of heated tobacco products did not change overall estimates of multiple tobacco product use among youth significantly.

††† Data were weighted to account for the complex survey design and to adjust for nonresponse. Population estimates of current use were rounded down to the nearest 10,000 persons.

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of current use in 2020 and that in 2019 (19,018 participants in 2019; student participation rate = 85.8%; school participation rate = 77.2%; overall response rate = 66.3%) were estimated using t-tests; p-values <0.05 were considered statistically significant. Trend analyses during 2011–2020 were not conducted because the mode of administration changed to an electronic survey in 2019 (*3*). The relative percent change (RPC) from 2019 to 2020 was calculated. Unstable estimates with a relative standard error of >30% or an unweighted denominator of <50 were suppressed. Analyses were conducted using SAS-callable SUDAAN (version 11.0.3; RTI International).

In 2020, among all students, 16.2% (an estimated 4.47 million) reported current use of any tobacco product (Table). Among high school students, 23.6% (3.65 million) reported current use of any tobacco product, 9.4% (1.45 million; 39.8% of any tobacco product users) reported current use of any combustible tobacco product, and 8.2% (1.27 million; 34.7% of any tobacco product users) reported current use of multiple tobacco products. By product, current use among high school students was highest for e-cigarettes (19.6%), followed by cigars (5.0%), cigarettes (4.6%), smokeless tobacco (3.1%), hookahs (2.7%), heated tobacco products (1.4%), and pipe tobacco (0.7%). Among high school students, any tobacco product use was reported by 24.7% of males and 22.5% of females; by 25.9% of non-Hispanic White, 23.3% of Hispanic, 18.4% of non-Hispanic Black, and 15.7% of non-Hispanic students of other races; and by 30.9% of those identifying as lesbian, gay, or bisexual, 22.0% of those identifying as heterosexual, and 20.4% of those reporting "not sure" about their sexual identity.

Among middle school students, 6.7% (800,000) reported current use of any tobacco product, 3.4% (400,000; 50.7% of any tobacco product users) reported current use of any combustible tobacco product, and 2.8% (340,000; 41.8% of any tobacco product users) reported current use of multiple tobacco products. By type of product, current use among middle school students was highest for e-cigarettes (4.7%), followed by cigarettes (1.6%), cigars (1.5%), hookahs (1.3%), heated tobacco products (1.3%), smokeless tobacco (1.2%), and pipe tobacco (0.4%). Among middle school students, any tobacco product use was reported by 6.8% of females and 6.6% of males; by 9.4% of Hispanic, 6.7% of non-Hispanic Black, and 5.7% of non-Hispanic White students; and by 16.5% of those identifying as lesbian, gay, or bisexual, 5.5% of those identifying as heterosexual, and 6.4% of those reporting "not sure" about their sexual identity.

From 2019 to 2020, among high school (Figure 1) and middle school students (Figure 2), significant declines (p<0.05) occurred in current use of any tobacco product (high school: 31.2% to 23.6%, RPC = –24.4%; middle school: 12.5% to 6.7%, RPC = –46.4%), any combustible tobacco product (high school: 12.0% to 9.4%, RPC = –21.7%; middle school: 4.8% to 3.4%, RPC = –29.2%), multiple tobacco products (high school: 10.8% to 8.2%, RPC = –24.1%; middle school: 4.0% to 2.8%, RPC = –30.0%), e-cigarettes (high school: 27.5% to 19.6%, RPC = –28.7%; middle school: 10.5% to 4.7%, RPC = –55.2%), cigars (high school: 7.6% to 5.0%, RPC = –34.2%; middle school: 2.3% to 1.5%, RPC = –34.8%), and smokeless tobacco (high school: 4.8% to 3.1%, RPC = –35.4%; middle school: 1.8% to 1.2%, RPC = –33.3%). During 2019–2010, no significant change in current use of cigarettes, hookahs, pipe tobacco, or heated tobacco products occurred among high or middle school students.

Summary

What is already known?

Tobacco use is the leading cause of preventable disease and death in the United States; nearly all tobacco use begins during youth and young adulthood.

What is added by this report?

In 2020, 23.6% (3.65 million) of high school and 6.7% (800,000) of middle school students reported current (past 30-day) use of any tobacco product. From 2019 to 2020, decreases among high school and middle school students occurred in current use of any tobacco product, combustible tobacco products, multiple tobacco products, e-cigarettes, cigars, and smokeless tobacco.

What are the implications for public health?

The comprehensive and sustained implementation of evidence-based tobacco control strategies, combined with tobacco product regulation by the Food and Drug Administration, is warranted to help sustain this progress and prevent and reduce all forms of tobacco product use among U.S. youths.

Discussion

Use of any tobacco product by youths declined by an estimated 1.73 million from 6.20 million in 2019 (*3*) to 4.47 million in 2020. Despite this decline, in 2020 nearly one in four U.S. high school students and approximately one in 15 middle school students still reported current use of any tobacco product. Continued efforts are warranted to sustain this progress and to prevent and reduce all forms of tobacco product use among U.S. youths (*1*,*2*).

Among both middle and high school students, current use of e-cigarettes declined from 2019 to 2020, reversing previous trends and returning current e-cigarette use to levels similar to those observed in 2018 (*4*). Declines in current cigar smoking and smokeless tobacco product use also occurred, as did youths' use of any combustible tobacco products and multiple tobacco products. Together, these changes contributed to an overall reduction in any tobacco product use by youths during 2019–2020. These declines were likely attributable to multiple factors at the national, state, and local level. For example, in December 2019, the federal minimum age of sale of all tobacco

TABLE. Percentage of middle and high school students who reported current (past 30-day) tobacco product use, by product,* school level, sex, race/ethnicity, and sexual identity — National Youth Tobacco Survey, United States, 2020

	Sex		Race/Ethnicity				Sexual identity			Total	
Tobacco product	Female	Male	White, non-Hispanic	Black, non-Hispanic	Hispanic†	Other, non-Hispanic	Heterosexual	Lesbian, gay, bisexual	Not sure	% (95% CI)	Estimated weighted no.§
	% (95% CI)										
Middle school and high school combined											
E-cigarettes	12.7 (10.9–14.9)	13.4 (11.5–15.5)	15.5 (13.5–17.8)	6.2 (4.8–8.1)	13.7 (11.0–16.9)	7.7 (5.0–11.8)	12.3 (10.6–14.2)	20.2 (16.7–24.1)	7.5 (5.2–10.7)	**13.1 (11.3–15.0)**	**3,580,000**
Cigars	3.4 (2.7–4.4)	3.7 (3.0–4.5)	2.8 (2.1–3.7)	6.5 (5.2–8.2)	4.0 (2.9–5.4)	—¶	3.1 (2.5–3.7)	6.0 (4.4–8.3)	3.0 (1.9–4.7)	**3.5 (2.9–4.3)**	**960,000**
Cigarettes	3.1 (2.4–4.0)	3.6 (2.7–4.7)	3.7 (2.8–4.8)	2.5 (1.8–3.5)	3.6 (2.6–4.9)	—¶	2.7 (2.1–3.6)	7.0 (5.1–9.4)	3.5 (2.2–5.5)	**3.3 (2.6–4.2)**	**910,000**
Smokeless tobacco	1.3 (0.9–1.7)	3.3 (2.5–4.3)	3.0 (2.3–3.9)	1.2 (0.6–2.1)	1.7 (1.3–2.2)	—¶	2.1 (1.6–2.8)	3.3 (2.2–4.8)	1.9 (1.1–3.3)	**2.3 (1.8–2.9)**	**630,000**
Hookahs	2.3 (1.7–3.0)	2.0 (1.6–2.5)	1.3 (1.0–1.7)	2.9 (2.1–4.0)	3.5 (2.5–5.0)	1.8 (1.0–3.1)	1.7 (1.4–2.1)	4.6 (3.4–6.1)	2.7 (1.5–4.7)	**2.1 (1.7–2.6)**	**580,000**
Heated tobacco products	1.4 (1.1–1.8)	1.3 (1.0–1.8)	1.1 (0.7–1.6)	1.1 (0.7–2.0)	2.1 (1.6–2.7)	—¶	1.0 (0.7–1.3)	3.2 (2.1–4.8)	—¶	**1.4 (1.1–1.7)**	**370,000**
Pipe tobacco	0.4 (0.3–0.6)	0.8 (0.5–1.1)	0.6 (0.4–1.0)	—¶	0.6 (0.4–0.9)	—¶	0.4 (0.3–0.7)	—¶	—¶	**0.6 (0.4–0.8)**	**150,000**
Any tobacco product**	15.8 (13.8–18.1)	16.7 (14.5–19.1)	17.8 (15.4–20.3)	13.2 (11.3–15.4)	17.2 (14.3–20.4)	10.1 (6.9–14.6)	15.1 (13.1–17.3)	25.5 (21.8–29.5)	11.1 (8.3–14.7)	**16.2 (14.3–18.4)**	**4,470,000**
Any combustible tobacco product††	6.6 (5.5–7.9)	7.0 (5.8–8.4)	5.9 (4.7–7.4)	9.2 (7.8–10.7)	8.1 (6.4–10.3)	4.9 (3.2–7.4)	5.7 (4.7–6.8)	13.5 (11.0–16.5)	6.9 (5.0–9.3)	**6.8 (5.8–7.9)**	**1,870,000**
Multiple tobacco products§§	5.3 (4.4–6.6)	6.5 (5.2–8.0)	6.1 (4.9–7.6)	4.9 (3.9–6.0)	6.7 (5.1–8.7)	4.3 (2.8–6.4)	5.0 (4.0–6.1)	11.7 (9.4–14.6)	5.6 (3.7–8.2)	**5.9 (4.9–7.1)**	**1,620,000**
High school											
E-cigarettes	18.7 (16.1–21.7)	20.4 (17.8–23.4)	23.2 (20.6–25.9)	9.1 (6.7–12.2)	18.9 (15.2–23.4)	12.1 (8.8–16.4)	18.5 (16.1–21.1)	25.1 (19.6–31.5)	14.5 (9.2–22.0)	**19.6 (17.2–22.2)**	**3,020,000**
Cigars	4.7 (3.6–6.1)	5.4 (4.3–6.9)	4.2 (3.2–5.5)	9.2 (7.0–12.1)	5.6 (3.8–8.2)	—¶	4.4 (3.6–5.5)	7.2 (4.9–10.4)	6.5 (3.9–10.8)	**5.0 (4.1–6.2)**	**770,000**
Cigarettes	3.9 (2.9–5.2)	5.4 (4.0–7.2)	5.3 (4.0–6.9)	2.8 (1.7–4.6)	4.6 (3.2–6.5)	—¶	3.8 (2.8–5.2)	8.0 (5.7–11.2)	7.5 (4.5–12.3)	**4.6 (3.6–6.0)**	**710,000**
Smokeless tobacco	1.4 (1.0–2.0)	4.8 (3.5–6.6)	4.1 (3.0–5.6)	—¶	2.2 (1.5–3.2)	—¶	3.0 (2.2–4.2)	3.0 (1.8–4.9)	—¶	**3.1 (2.3–4.1)**	**480,000**
Hookahs	2.9 (2.1–3.9)	2.6 (1.9–3.4)	1.8 (1.3–2.3)	3.9 (2.5–6.0)	4.4 (2.8–6.9)	—¶	2.2 (1.7–2.8)	5.4 (3.8–7.7)	—¶	**2.7 (2.1–3.5)**	**420,000**
Heated tobacco products	1.5 (1.1–2.1)	1.3 (0.9–2.0)	1.2 (0.8–1.8)	—¶	2.0 (1.4–2.7)	—¶	1.0 (0.7–1.5)	3.0 (1.8–4.8)	—¶	**1.4 (1.1–1.9)**	**210,000**
Pipe tobacco	0.4 (0.3–0.7)	1.0 (0.6–1.7)	0.9 (0.6–1.5)	—¶	—¶	—¶	—¶	—¶	—¶	**0.7 (0.5–1.1)**	**110,000**
Any tobacco product	22.5 (19.8–25.6)	24.7 (21.6–28.1)	25.9 (23.0–29.2)	18.4 (15.5–21.8)	23.3 (19.4–27.7)	15.7 (12.1–20.2)	22.0 (19.4–24.9)	30.9 (25.3–37.2)	20.4 (14.9–27.2)	**23.6 (21.1–26.4)**	**3,650,000**
Any combustible tobacco product	8.7 (7.1–10.5)	10.2 (8.3–12.3)	8.5 (6.8–10.6)	12.5 (10.3–15.1)	10.7 (8.2–14.0)	6.4 (4.1–9.9)	7.8 (6.5–9.5)	16.2 (12.8–20.2)	13.9 (10.0–19.1)	**9.4 (8.0–11.0)**	**1,450,000**
Multiple tobacco products	7.0 (5.5–8.8)	9.5 (7.5–11.9)	8.9 (7.1–11.0)	6.0 (4.5–8.1)	8.8 (6.4–11.8)	5.9 (3.8–9.0)	7.0 (5.6–8.7)	13.9 (10.6–18.0)	10.8 (6.7–17.0)	**8.2 (6.8–10.0)**	**1,270,000**

See table footnotes on the next page.

product types increased from 18 to 21 years (*5*). Under the authority of the 2009 Family Smoking Prevention and Tobacco Control Act, FDA issued guidance in January 2020 to prioritize enforcement against certain flavored e-cigarette products that appeal to youths, including mint and fruit flavors (*6*). Several states and communities also recently restricted the sale of flavored tobacco products, including e-cigarettes.§§§ In addition, public health efforts to address the multistate outbreak of e-cigarette, or vaping, product use–associated lung injury (EVALI) might have contributed to these declines in youth e-cigarette use (*7*). Furthermore, targeted actions to address the

§§§ https://www.tobaccofreekids.org/assets/factsheets/0398.pdf.

TABLE. (*Continued*) Percentage of middle and high school students who reported current (past 30-day) tobacco product use, by product,* school level, sex, race/ethnicity, and sexual identity — National Youth Tobacco Survey, United States, 2020

	Sex		Race/Ethnicity				Sexual identity			Total	
Tobacco product	Female	Male	White, non-Hispanic	Black, non-Hispanic	Hispanic†	Other, non-Hispanic	Heterosexual	Lesbian, gay, bisexual	Not sure	% (95% CI)	Estimated weighted no.§
	% (95% CI)										
Middle school											
E-cigarettes	4.8 (3.4–6.6)	4.5 (3.5–5.9)	4.3 (3.2–5.6)	2.6 (1.5–4.4)	7.1 (5.2–9.7)	—¶	3.8 (2.8–5.1)	12.1 (9.2–15.7)	—¶	**4.7 (3.6–6.0)**	**550,000**
Cigars	1.6 (1.1–2.3)	1.4 (1.0–1.9)	0.8 (0.5–1.5)	3.1 (2.2–4.4)	1.8 (1.2–2.9)	—¶	1.2 (0.9–1.6)	4.1 (2.4–6.9)	—¶	**1.5 (1.2–2.0)**	**180,000**
Cigarettes	2.0 (1.4–2.9)	1.3 (0.9–1.8)	1.3 (0.7–2.2)	2.1 (1.3–3.4)	2.2 (1.5–3.3)	—¶	1.2 (0.8–1.9)	5.2 (3.0–8.8)	—¶	**1.6 (1.2–2.2)**	**190,000**
Smokeless tobacco	1.0 (0.7–1.5)	1.4 (0.9–2.1)	1.4 (1.0–2.0)	—¶	1.0 (0.6–1.7)	—¶	0.9 (0.7–1.3)	3.8 (2.3–6.3)	—¶	**1.2 (0.9–1.6)**	**140,000**
Hookahs	1.5 (1.0–2.4)	1.2 (0.9–1.7)	0.7 (0.4–1.1)	—¶	2.4 (1.4–4.1)	—¶	1.1 (0.8–1.6)	3.2 (2.0–5.0)	—¶	**1.3 (1.0–1.9)**	**160,000**
Heated tobacco products	1.2 (0.9–1.7)	1.3 (0.8–2.2)	0.9 (0.5–1.4)	—¶	2.2 (1.3–3.5)	—¶	1.0 (0.6–1.5)	3.5 (2.0–6.1)	—¶	**1.3 (0.9–1.8)**	**150,000**
Pipe tobacco	—¶	—¶	—¶	—¶	—¶	—¶	—¶	—¶	—¶	**0.4 (0.2–0.7)**	**40,000**
Any tobacco product	6.8 (5.3–8.8)	6.6 (5.3–8.1)	5.7 (4.6–7.2)	6.7 (5.1–8.8)	9.4 (7.3–12.0)	—¶	5.5 (4.4–6.9)	16.5 (13.0–20.5)	6.4 (4.0–9.9)	**6.7 (5.5–8.2)**	**800,000**
Any combustible tobacco product	3.8 (3.0–5.0)	2.9 (2.2–3.8)	2.1 (1.4–3.2)	5.0 (3.6–6.7)	4.8 (3.4–6.7)	—¶	2.6 (2.0–3.5)	9.0 (6.1–13.0)	3.3 (1.8–5.8)	**3.4 (2.7–4.2)**	**400,000**
Multiple tobacco products	3.1 (2.3–4.1)	2.6 (2.0–3.5)	2.2 (1.5–3.1)	3.3 (2.2–5.0)	4.0 (2.7–5.9)	—¶	2.1 (1.6–2.9)	8.2 (5.8–11.7)	—¶	**2.8 (2.2–3.7)**	**340,000**

Abbreviation: CI = confidence interval.

* Past 30-day use of e-cigarettes was determined by asking "During the past 30 days, on how many days did you use e-cigarettes?" Past 30-day use of cigarettes was determined by asking "During the past 30 days, on how many days did you smoke cigarettes?" Past 30-day use of cigars was determined by asking "During the past 30 days, on how many days did you smoke cigars, cigarillos, or little cigars?" Smokeless tobacco was defined as use of chewing tobacco, snuff, dip, snus, or dissolvable tobacco products. Past 30-day use of smokeless tobacco was determined by asking the following question for use of chewing tobacco, snuff, and dip: "During the past 30 days, on how many days did you use chewing tobacco, snuff, or dip?" and the following question for use of snus and dissolvable tobacco products: "In the past 30 days, which of the following products did you use on at least one day?" Responses from these questions were combined to derive overall smokeless tobacco use. Past 30-day use of hookahs was determined by asking "During the past 30 days, on how many days did you smoke tobacco in a hookah or waterpipe?" Past 30-day use of pipe tobacco (not hookahs) was determined by asking "In the past 30 days, which of the following products have you used on at least one day?" Past 30-day use of heated tobacco products was determined by asking "During the past 30 days, on how many days did you use heated tobacco products?" Because of missing data on the past 30-day use questions, denominators for each tobacco product might be different.

† Hispanic persons could be of any race (White; Black or African American; or other race [i.e., American Indian or Alaska Native; Asian; Hawaiian or other Pacific Islander]).

§ Estimated weighted total number of current tobacco product users was rounded down to the nearest 10,000 persons. Overall estimates were reported among 14,531 U.S. middle and high school students. School level was determined by self-reported grade level: high school (grades 9–12; n = 7,453) and middle school (grades 6–8; n = 7,042). Overall population estimates might not directly total to sums of corresponding subgroup population estimates because of rounding or inclusion of students who did not self-report sex, race/ethnicity, sexual identity, or grade level.

¶ Data were statistically unreliable because of unweighted denominator <50 or a relative standard error >30%.

** In 2020, any tobacco product use was defined as use of any tobacco product (e-cigarettes, cigarettes, cigars, smokeless tobacco, hookahs, pipe tobacco, bidis [small brown cigarettes wrapped in a leaf], or heated tobacco products) on ≥1 day during the past 30 days.

†† Any combustible tobacco product use was defined as use of cigarettes, cigars, hookahs, pipe tobacco, or bidis on ≥1 day during the past 30 days.

§§ In 2020, multiple tobacco product use was defined as use of two or more tobacco products (e-cigarettes, cigarettes, cigars, smokeless tobacco, hookahs, pipe tobacco, bidis, or heated tobacco products) on ≥1 day during the past 30 days.

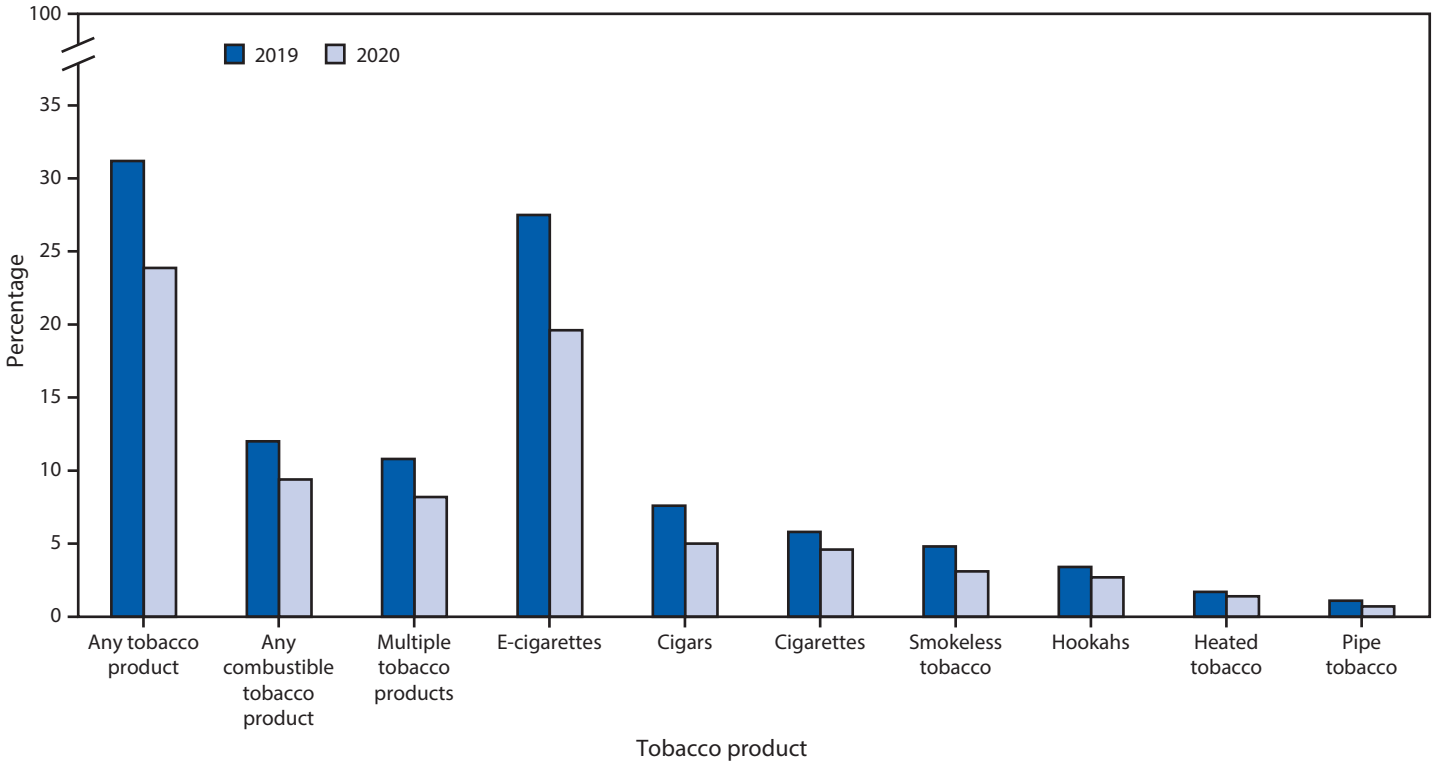
youth e-cigarette epidemic occurred, including FDA's public education campaign to reduce youth e-cigarette, smokeless tobacco, and cigarette use.¶¶¶

Despite declines in youths' use of combustible tobacco products since 2011 (*4*), no change in current cigarette smoking occurred during 2019–2020. Among all students who currently used any tobacco product, approximately 42% (1.87 million) reported smoking combustible tobacco products in 2020. However, a decline in current cigar smoking did occur during 2019–2020. Continued actions are warranted to help ensure sustained progress in preventing and reducing youths' use of all forms of tobacco products, including those that are combustible, noncombustible, and electronic.

The findings in this report are subject to at least three limitations. First, the data collection period was truncated because

¶¶¶ https://www.fda.gov/tobacco-products/public-health-education/youth-and-tobacco.

FIGURE 1. Percentage of current use of selected tobacco products,* any tobacco product,† any combustible tobacco product,§ and multiple tobacco products¶ among high school students — National Youth Tobacco Survey, United States, 2019 and 2020**



* Current use is defined as use on ≥1 day during the past 30 days for each product.

† In 2020, any tobacco product use was defined as use of any tobacco product (e-cigarettes, cigarettes, cigars, smokeless tobacco, hookahs, pipe tobacco, bidis [small brown cigarettes wrapped in a leaf], or heated tobacco products) on ≥1 day during the past 30 days. In 2019, consistent with previously published estimates, any tobacco product use was defined as use of any tobacco product (e-cigarettes, cigarettes, cigars, smokeless tobacco, hookahs, pipe tobacco, or bidis) on ≥1 day during the past 30 days.

§ Any combustible tobacco product use was defined as use of cigarettes, cigars, hookahs, pipe tobacco, or bidis on ≥1 day during the past 30 days.

¶ In 2020, multiple tobacco product use was defined as use of two or more tobacco products (e-cigarettes, cigarettes, cigars, smokeless tobacco, hookahs, pipe tobacco, bidis, or heated tobacco products) on ≥1 day during the past 30 days. In 2019, consistent with previously published estimates, multiple tobacco product use was defined as use of two or more tobacco products (e-cigarettes, cigarettes, cigars, smokeless tobacco, hookahs, pipe tobacco, or bidis) on ≥1 day during the past 30 days.

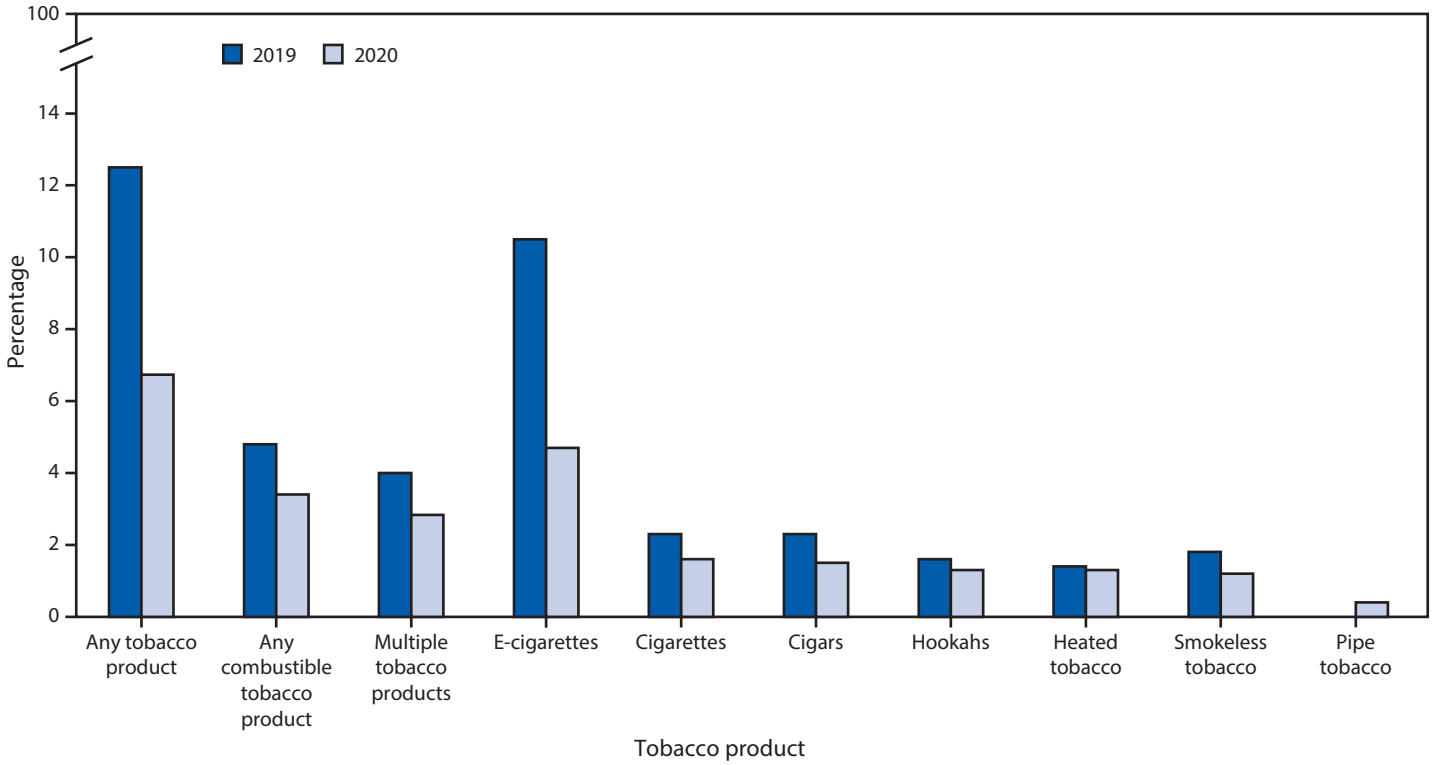
** During 2019–2020, significant declines in the use of any tobacco product ($p<0.001$), any combustible tobacco product ($p = 0.018$), multiple tobacco products ($p = 0.020$), e-cigarettes ($p<0.001$), cigars ($p<0.001$), and smokeless tobacco ($p = 0.031$) were observed. No significant change in use of cigarettes, hookahs, heated tobacco products, or pipe tobacco occurred.

of the coronavirus disease 2019 pandemic, resulting in a lower school participation rate (49.9%) compared with recent NYTS cycles (average across 2011–2019 NYTS cycles = 78.2%). However, the 2020 NYTS student participation rate (87.4%) was high, and the weighted sample yielded nationally representative estimates.**** Second, these data were self-reported and might be subject to recall and response biases. Finally, these findings might not be generalizable to youths who are homeschooled, have dropped out of school, are in detention centers, or are enrolled in alternative schools.

In 2020, approximately one in six U.S. middle and high school students, or approximately 4.47 million youths overall, reported current use of any tobacco product. The comprehensive and sustained implementation of evidence-based tobacco control strategies at the national, state, and local levels, combined with tobacco product regulation by FDA, is warranted for continuing progress toward reducing and preventing all forms of tobacco product use among U.S. youths. Such strategies include increasing prices of tobacco products, protecting persons from exposure to secondhand smoke and e-cigarette aerosol, sustaining hard-hitting media campaigns that warn about the dangers of tobacco product use, restricting youth access to tobacco

**** In addition to standard nonresponse bias analysis assessing differences in responding and nonresponding schools, for the 2020 cycle, extended nonresponse analyses were conducted to examine differences between participating schools (180) and schools that were recruited, but did not participate (74) because of widespread school closures during the coronavirus disease 2019 pandemic. These groups of schools did not differ by U.S. Census region. School participation was significantly higher among nonurban schools and those with a lower proportion of the student population that was non-Hispanic Black. However, both of these indicators were used in the creation of survey weight adjustments to mitigate potential biases.

FIGURE 2. Percentage of current use of selected tobacco products,*,† any tobacco product,§ any combustible tobacco product,¶ and multiple tobacco products among middle school students — National Youth Tobacco Survey, United States, 2019 and 2020††**



* Current use is defined as use on ≥1 day during the past 30 days for each product.
† Estimate for "pipe tobacco, 2019" is suppressed because of relative standard error >30% or unweighted denominator <50.
§ In 2020, any tobacco product use was defined as use of any tobacco product (e-cigarettes, cigarettes, cigars, smokeless tobacco, hookahs, pipe tobacco, bidis [small brown cigarettes wrapped in a leaf], or heated tobacco products) on ≥1 day during the past 30 days. In 2019, consistent with previously published estimates, any tobacco product use was defined as use of any tobacco product (e-cigarettes, cigarettes, cigars, smokeless tobacco, hookahs, pipe tobacco, or bidis) on ≥1 day during the past 30 days.
¶ Any combustible tobacco product use was defined as use of cigarettes, cigars, hookahs, pipe tobacco, or bidis on ≥1 day during the past 30 days.
** In 2020, multiple tobacco product use was defined as use of two or more tobacco products (e-cigarettes, cigarettes, cigars, smokeless tobacco, hookahs, pipe tobacco, bidis, or heated tobacco products) on ≥1 day during the past 30 days. In 2019, consistent with previously published estimates, multiple tobacco product use was defined as use of two or more tobacco products (e-cigarettes, cigarettes, cigars, smokeless tobacco, hookahs, pipe tobacco, or bidis) on ≥1 day during the past 30 days.
†† During 2019–2020, significant declines in the use of any tobacco product ($p<0.001$), any combustible tobacco product ($p = 0.013$), multiple tobacco products ($p = 0.025$), e-cigarettes ($p<0.001$), cigars ($p = 0.012$), and smokeless tobacco ($p = 0.038$) were observed. No significant change in use of cigarettes, hookahs, or heated tobacco products occurred. Because of the suppression of the pipe tobacco estimate in 2019, no comparison was made during 2019–2020.

products, prohibiting the sale of all flavored tobacco products, and development of regulations to reduce youth appeal and addictiveness of tobacco products (*1–3*,*8–10*). In addition, as the tobacco product landscape continues to diversify, surveillance for all forms of tobacco product use, including novel products, by youths is important to inform public health policy and practice at the local, state, and national levels.

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References

1. US Department of Health and Human Services. The health consequences of smoking—50 years of progress. Atlanta, GA: US Department of Health and Human Services, CDC; 2014. https://www.ncbi.nlm.nih.gov/books/NBK179276/pdf/Bookshelf_NBK179276.pdf
2. US Department of Health and Human Services. Preventing tobacco use among youth and young adults. Atlanta, GA: US Department of Health and Human Services, CDC; 2012. https://www.cdc.gov/tobacco/data_statistics/sgr/2012/index.htm
3. Wang TW, Gentzke AS, Creamer MR, et al. Tobacco product use and associated factors among middle and high school students—United States, 2019. MMWR Surveill Summ 2019;68(No. SS-12). PMID:31805035 https://doi.org/10.15585/mmwr.ss6812a1
4. Gentzke AS, Creamer M, Cullen KA, et al. Vital signs: tobacco product use among middle and high school students—United States, 2011–2018. MMWR Morb Mortal Wkly Rep 2019;68:157–64. PMID:30763302 https://doi.org/10.15585/mmwr.mm6806e1

5. Food and Drug Administration. newly signed legislation raises federal minimum age of sale of tobacco products to 21. Silver Spring, MD: US Department of Health and Human Services, Food and Drug Administration; 2019. https://www.fda.gov/tobacco-products/ctp-newsroom/newly-signed-legislation-raises-federal-minimum-age-sale-tobacco-products-21
6. Center for Tobacco Products. Enforcement priorities for Electronic Nicotine Delivery Systems (ENDS) and other deemed products on the market without premarket authorization (revised). Silver Spring, MD: US Department of Health and Human Services, Food and Drug Administration; 2020. https://www.fda.gov/media/133880/download
7. King BA, Jones CM, Baldwin GT, Briss PA. The EVALI and youth vaping epidemics—implications for public health. N Engl J Med 2020;382:689–91. PMID:31951683 https://doi.org/10.1056/NEJMp1916171
8. US Department of Health and Human Services. E-cigarette use among youth and young adults: a report of the Surgeon General. Atlanta, GA: US Department of Health and Human Services, CDC; 2016. https://www.cdc.gov/tobacco/data_statistics/sgr/e-cigarettes/pdfs/2016_sgr_entire_report_508.pdf
9. US Department of Health and Human Services. Surgeon General's advisory on e-cigarette use among youth. Rockville, MD: US Department of Health and Human Services, Office of the Surgeon General; 2018. https://e-cigarettes.surgeongeneral.gov/documents/surgeon-generals-advisory-on-e-cigarette-use-among-youth-2018.pdf
10. CDC. Best practices for comprehensive tobacco control programs—2014. Atlanta, GA: US Department of Health and Human Services, CDC; 2014. https://www.cdc.gov/tobacco/stateandcommunity/best_practices/index.htm

Surveillance for Harmful Algal Bloom Events and Associated Human and Animal Illnesses — One Health Harmful Algal Bloom System, United States, 2016–2018

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Harmful algal bloom events can result from the rapid growth, or bloom, of photosynthesizing organisms in natural bodies of fresh, brackish, and salt water. These events can be exacerbated by nutrient pollution (e.g., phosphorus) and warming waters and other climate change effects (*1*); have a negative impact on the health of humans, animals, and the environment; and damage local economies (*2*,*3*). U.S. harmful algal bloom events of public health concern are centered on a subset of phytoplankton: diatoms, dinoflagellates, and cyanobacteria (also called blue-green algae). CDC launched the One Health Harmful Algal Bloom System (OHHABS) in 2016 to inform efforts to prevent human and animal illnesses associated with harmful algal bloom events. A total of 18 states reported 421 harmful algal bloom events, 389 cases of human illness, and 413 cases of animal illness that occurred during 2016–2018. The majority of harmful algal bloom events occurred during May–October (413; 98%) and in freshwater bodies (377; 90%). Human and animal illnesses primarily occurred during June–September (378; 98%) and May–September (410; 100%). Gastrointestinal or generalized illness signs or symptoms were the most frequently reported (>40% of human cases and >50% of animal cases); however, multiple other signs and symptoms were reported. Surveillance data from harmful algal bloom events, exposures, and health effects provide a systematic description of these occurrences and can be used to inform control and prevention of harmful algal bloom–associated illnesses.

Harmful algal bloom events occur in salt, brackish, and fresh water. In bodies of water such as oceans and estuaries, diatoms or dinoflagellates form "tides" that produce toxins associated with seafood poisoning, including paralytic shellfish poisoning, or respiratory distress from inhalation of aerosolized toxins. Cyanobacteria predominantly bloom in fresh water such as lakes and rivers; they can produce microcystins, cylindrospermopsin, and other toxins that humans or animals might be exposed to through water contact, inhalation, or ingestion (*2*,*4*). Animals that become ill or die can be sentinels for harmful algal bloom events. Behavioral and biological factors might increase the likelihood or magnitude of their exposures to toxins compared with human exposures (*5*).

CDC, in consultation with state and federal partners, designed and launched* OHHABS using a One Health† approach. Integrating technical expertise from a 2007–2011 harmful algal bloom surveillance project (*2*) and national waterborne and foodborne outbreak surveillance (https://www.cdc.gov/nors/about.html), the reporting system links harmful algal bloom event data with human or animal illness data and uses standard definitions to classify harmful algal bloom events as suspected or confirmed and cases of human or animal illness as suspected, probable, or confirmed.§ Animal illnesses or deaths are reported as single cases or in groups, such as flocks of birds. This summary describes data from OHHABS for January 1, 2016–December 31, 2018, in reports that were submitted¶ by state health departments by March 18, 2020. SAS (version 9.4; SAS Institute) was used

* OHHABS partners and system development are described in more detail at https://www.cdc.gov/habs/ohhabs_tables_and_figures.html.

† One Health is defined by CDC as "a collaborative, multisectoral, and transdisciplinary approach — working at the local, regional, national, and global levels — with the goal of achieving optimal health outcomes recognizing the interconnection between persons, animals, plants, and their shared environment." https://www.cdc.gov/onehealth/index.html.

§ Harmful algal bloom events and cases reported to OHHABS are classified based on standard definitions. Suspected harmful algal bloom events are required to have observational/environmental data or associated illnesses as supporting evidence. Confirmed harmful algal bloom events are required to have either laboratory-based harmful algal bloom data or both observational/environmental data and at least one associated case of illness as supporting evidence. Harmful algal bloom–associated illness data are subject to a public health assessment process. Suspected human or animal cases must have experienced a harmful algal bloom exposure and signs/symptoms. Probable human or animal case classifications must be supported by one of the following: observational/environmental data, laboratory-based harmful algal bloom data, or a professional medical diagnosis. Confirmed human or animal cases must be supported by one of the following: 1) clinical data confirming the exposure plus a professional medical diagnosis or other causes ruled out or 2) laboratory-based harmful algal bloom data plus a professional medical diagnosis and other causes ruled out. More detailed information is available at: https://www.cdc.gov/habs/pdf/ohhabs-case-and-event-definitions-table-508.pdf.

¶ OHHABS is available for voluntary reporting by public health agencies and their designated environmental health or animal health partners in the United States, District of Columbia, Federated States of Micronesia, Guam, Marshall Islands, Northern Mariana Islands, Palau, Puerto Rico, and U.S. Virgin Islands.

to conduct descriptive analyses to characterize environmental conditions during harmful algal bloom events, harmful algal bloom–associated cases of human or animal illness, and results of environmental and clinical toxin testing.

A total of 18 states** voluntarily reported 421 harmful algal bloom events that occurred during 2016–2018, with the majority (88%) classified as confirmed (Table 1). These events occurred predominantly during May–October (98%), peaking in July (27%). The majority (90%) of the reported harmful algal bloom events occurred in freshwater bodies. Fewer than half of all reports (39%) indicated that a visible scum had been observed. Laboratory testing for 372 (88%) harmful algal bloom events was performed on water samples (98%), algae or cyanobacteria (7%), or food samples (1%). Reasons for testing included environmental monitoring activities (79%), citizen complaints (17%), or health events involving animals (5%) or humans (5%). Toxin results reported for 308 harmful algal bloom events (83%) frequently identified microcystins (94%); 35 (11%) reports identified more than one type of toxin.

A total of 389 human cases of illness were reported, with 341 (88%) classified as probable (Table 2). Approximately one half of cases (199; 51%) resulted from a single, freshwater harmful algal bloom event that occurred in a large lake in July; extended to connected waterways, such as rivers, canals, and reservoirs; and spanned more than 3 months. At least 153 (39%) of the 389 persons with cases were aged <18 years. Almost all (98%) reported illnesses occurred during June–September. Signs and symptoms reported for 380 (98%) cases indicated that affected persons most frequently experienced gastrointestinal (67%); generalized (e.g., headache, fever, or lethargy) (43%); dermatologic (27%); or ear, nose, or throat-related (16%) signs or symptoms. No deaths were reported. Time to onset of initial signs or symptoms was available for 124 persons who had a one-time exposure and ranged from 1 minute to 8 days.

** Alaska, Arizona, California, Connecticut, Florida, Kansas, Maryland, Michigan, Minnesota, Nevada, New York, North Carolina, Ohio, Oregon, Pennsylvania, Utah, Virginia, and Wisconsin.

TABLE 1. Characteristics of harmful algal bloom events (n = 421) — One Health Harmful Algal Bloom System (OHHABS),* United States, 2016–2018

Characteristic	No. (%)
Classification†	
Confirmed	370 (88)
Suspected	51 (12)
Water source type	
Fresh	377 (90)
Brackish	14 (3)
Salt	12 (3)
Unknown	18 (4)
Month§,¶	
February	1 (—)
March	2 (—)
April	3 (1)
May	31 (7)
June	65 (15)
July	115 (27)
August	99 (24)
September	75 (18)
October	28 (7)
Unknown	2 (—)
Scum observed	**166 (39)**
Laboratory testing performed	**372 (88)**
Sample type tested**	
Raw or ambient water	363 (98)
Algae or cyanobacteria	27 (7)
Food	4 (1)
Finished drinking water	1 (—)
Reason for testing**	
Monitoring	295 (79)
Citizen complaint	64 (17)
Animal health event response	17 (5)
Human health event response	17 (5)
Fish illness or kill	4 (1)
Other	3 (1)
Odor	1 (—)
Unknown	7 (2)

See table footnotes on the next column.

TABLE 1. (*Continued*) Characteristics of harmful algal bloom events (n = 421) — One Health Harmful Algal Bloom System (OHHABS),* United States, 2016–2018

Characteristic	No. (%)
Testing results,††**	
Toxins§§	**308 (83)**
Microcystins	291 (94)
Anatoxin-A	30 (10)
Saxitoxin	19 (6)
Cylindrospermopsin	4 (1)
Nodularin	3 (1)
Ciguatoxin	1 (—)
Other	1 (—)
Cyanobacteria	65 (17)
Dinoflagellates	8 (2)
Gonyaulacales	2 (25)
Gymnodiniales	3 (38)
Peridiniales	1 (13)
Prorocentrales	1 (13)
Unknown	2 (25)
Raphidophyceans	**3 (1)**
Diatoms	**2 (1)**
Unknown¶¶	**23 (7)**

* A total of 18 states adopted OHHABS and voluntarily reported 421 harmful algal bloom events: Alaska, Arizona, California, Connecticut, Florida, Kansas, Maryland, Michigan, Minnesota, Nevada, New York, North Carolina, Ohio, Oregon, Pennsylvania, Utah, Virginia, and Wisconsin.
† Event classification criteria are located at https://www.cdc.gov/habs/pdf/ohhabs-case-and-event-definitions-table-508.pdf.
§ Percentages do not sum to 100% as a result of rounding.
¶ Month was assigned based on data availability, using the following hierarchy: 1) bloom observation date, 2) month of bloom notification, and 3) earliest date of an associated human or animal case.
** Percentages might exceed 100% because multiple options could be selected.
†† Data collection was restricted to positive results from environmental testing.
§§ Multiple toxins were reported for 35 events, with microcystins as one of the toxin classifications detected in 33 events. Other toxins detected included anatoxin-a, cylindrospermopsin, nodularin, saxitoxin, or other unspecified toxins.
¶¶ Twenty-three reports did not include results from environmental testing.

TABLE 2. Characteristics of human exposure and illness (n = 389*) associated with harmful algal bloom events (n = 73) — One Health Harmful Algal Bloom System (OHHABS),† 2016–2018

Human case characteristic	No. (%)
Classification§	
Confirmed	14 (4)
Probable	341 (87)
Suspected	34 (9)
Water source type¶	
Fresh	366 (94)
Brackish	1 (—)
Salt	0 (—)
Unknown	22 (6)
Age group, yrs**	
0–1	3 (1)
2–4	39 (10)
5–11	50 (13)
12–17	61 (16)
18–45	137 (35)
46–64	42 (11)
≥65	18 (5)
Unknown	39 (10)
Sex**	
Male	200 (51)
Female	184 (47)
Unknown	5 (1)
Month of illness onset	
February	1 (—)
May	5 (1)
June	34 (9)
July	260 (67)
August	57 (15)
September	27 (7)
October	4 (1)
Unknown	1 (—)
Setting of exposure††,§§	
Public outdoor area	235 (60)
Beach	63 (16)
Private residence	53 (14)
Other	57 (15)
Park	27 (7)
Unknown	22 (6)
Health care seeking behavior††	
Call to a poison control center	297 (76)
Health care provider	68 (17)
Emergency department	36 (9)
First aid care	3 (1)
Clinical testing¶¶	**30 (8)**
Signs and symptoms††,*,†††	
Gastrointestinal	262 (67)
Generalized	169 (43)
Dermatologic	104 (27)
Ear, nose, or throat	62 (16)
Neurologic	56 (14)
Cardiopulmonary	41 (11)
Ophthalmologic	30 (8)
Other	30 (8)
Musculoskeletal	13 (3)
Genitourinary	6 (2)
Unknown	9 (2)
Median time to illness onset—one-time exposure, hours (min, max) (n = 124 cases)	**13.5 (0.02–192)**
Foodborne illness**	**22 (6)**
Paralytic shellfish poisoning (PSP)	11 (50)
Ciguatera fish poisoning (CFP)	5 (23)
Other	4 (18)
Unknown	2 (10)

* A total of 199 (51%) cases were the result of a single freshwater harmful algal bloom event.
† Of 18 states that adopted the One Health Harmful Algal Bloom System (OHHABS), 10 states voluntarily reported 389 cases of human illness: Alaska, California, Kansas, Minnesota, New York, Ohio, Oregon, Pennsylvania, Utah, Wisconsin.
§ Case classification criteria are available at https://www.cdc.gov/habs/pdf/ohhabs-case-and-event-definitions-table-508.pdf.
¶ Water source type is the water body type from the linked harmful algal bloom event.
** Percentages do not add up to 100% as a result of rounding.
†† Percentages might exceed 100% because multiple options could be selected.
§§ Other setting category includes ship, outdoor place of work, camp or cabin setting, farm or agricultural setting, resort, National Forest, school, college, or university, subdivision or neighborhood, apartment or condo, hotel, motel, lodge, or inn, and other unspecified settings.
¶¶ Specimens for five cases of foodborne illness that were tested at CDC; urinalysis confirmed exposures to saxitoxin or multiple toxins for four of five patients.
*** Signs and symptoms were classified primarily based on the biological system that was affected. "Generalized" refers to constitutional signs and symptoms such as headache, fever, or lethargy. Some signs and symptoms that have been classified as neurologic might present in other systems (e.g., ophthalmologic). Classifications are available at https://www.cdc.gov/habs/ohhabs_tables_and_figures.html.
††† 67% of cases were still experiencing symptoms at the time of interview.

Patients consulted poison control centers (76%), health care providers (17%), or emergency departments (9%). Clinical specimens were tested for 30 (8%) patients; CDC performed urinalysis for five of these persons and confirmed that four had exposures to saxitoxin or multiple toxins.

Based on 64 animal case reports, at least 413 animals†† became ill, and 369 (89%) died (Table 3). The majority (81%) of animal cases of illness were classified as suspected. The majority (89%) of the exposures involved fresh water, including one large bird die-off of 300 (73%) cases that occurred at a lake in May 2018. Almost all (99%) illnesses§§ occurred during May–September. Within animal categories of domestic pets (52), livestock (42), and wildlife (319), the most frequently affected animals were dogs (96%), cattle (86%), and birds (97%). Signs of illness were available for 92 cases and included generalized (e.g., weakness, lethargy, or anorexia) (64%), gastrointestinal (54%), and neurologic (14%) symptoms. Time to onset of initial signs was available

†† If no total case count was reported for a group of animals, data were extrapolated, with a value of two animal cases assigned as a conservative estimate.

§§ Animal cases were assigned months based on data availability, using the following hierarchy: 1) illness onset date, 2) discovery date, and 3) death date.

TABLE 3. Characteristics of animal exposure and illness (n = 413) associated with harmful algal bloom events (n = 42) — One Health Harmful Algal Bloom System (OHHABS),* 2016–2018

Animal case characteristic	No. (%)
Single or group case report (n = 64)†	
Single	55 (86)
Group§	9 (14)
Deaths	369 (89)
Classification¶	
Confirmed	13 (3)
Probable	67 (16)
Suspected	333 (81)
Water source type**	
Fresh	366 (89)
Brackish	11 (3)
Salt	2 (—)
Unknown	34 (8)
Category	
Domestic pet	52 (13)
Dog	50 (96)
Cat	2 (4)
Livestock††	**42 (10)**
Cattle	36 (86)
Bird	4 (10)
Horse or donkey	2 (5)
Wildlife††	**319 (77)**
Bird	310 (97)
Fish	6 (2)
Other mammal	1 (—)
Month of illness§§	
May	304 (74)
June	36 (9)
July	28 (7)
August	32 (8)
September	10 (2)
October	1 (—)
December	2 (—)
Setting of exposure¶¶,*,§§§**	**112 (27)**
Private residence	29 (26)
Public outdoor area	22 (20)
Other	18 (16)
Beach	13 (12)
Unknown	37 (33)
Veterinary medical care or treatment received†††	**25 (6)**
Signs ¶¶,§§§,¶¶¶	**92 (22)**
Generalized	59 (64)
Gastrointestinal	50 (54)
Neurologic	13 (14)
Cardiopulmonary	7 (8)
Ophthalmologic	5 (5)
Other	3 (3)
Dermatologic	2 (2)
Ear, nose, or throat	1 (1)
Hematologic	1 (1)
Median time to illness onset – one-time exposure, hours (min, max) (n = 21)	**6 (0.25–96)**

See table footnotes on the next column.

* Of 18 states that adopted the One Health Harmful Algal Bloom System (OHHABS), 10 states voluntarily reported 413 cases of animal illness: California, Florida, Kansas, Michigan, Minnesota, New York, Oregon, Utah, Virginia, Wisconsin.

† Animals could be reported as single cases or in groups on a single form. If no total case count was reported for a group of animals, a value of two animal cases was assigned. Data provided in aggregate for groups of animals were extrapolated to describe exposures, case attributes, and health effects.

§ Birds (n = 3), cattle (n = 2), fish (n = 2), dogs (n = 1), and horses (n = 1). These groups included a large bird die-off (n = 300 animals).

¶ Case classification criteria are available at https://www.cdc.gov/habs/pdf/ohhabs-case-and-event-definitions-table-508.pdf.

** Water source is the water body type from the linked harmful algal bloom event.

†† Percentages do not add up to 100% as a result of rounding.

§§ Animal cases were assigned months based on data availability, using the following hierarchy: 1) illness onset date, 2) discovery date, and 3) death date.

¶¶ Summarized for the subset of reports with data available.

*** Other setting category includes park, community or municipality, resort, or ship.

††† Animal group reports were manually reviewed. If multiple animals were reported as receiving care but no total case count could be confirmed, a value of two animal cases was assigned.

§§§ Percentages might exceed 100% because multiple options could be selected.

¶¶¶ Signs were available for 49 dogs, 36 cattle, four birds, two horses and one cat. Signs were classified primarily based the biological system that was affected. "Generalized" refers to constitutional signs such as weakness, lethargy, or anorexia. Some signs that have been classified as neurologic might present in other system (e.g., ophthalmologic). Classifications are available at https://www.cdc.gov/habs/ohhabs_tables_and_figures.html.

for 21 animals that had a one-time exposure and ranged from 15 minutes to 4 days. Veterinary medical care or treatment was provided to 25 (6%) animals.

Discussion

Data reported to OHHABS by 18 states for 2016–2018 included 421 harmful algal bloom events, 389 cases of human illness, and 413 cases of animal illness. While the majority of harmful algal bloom events were classified as confirmed, the majority of human illnesses were classified as probable, and animal illnesses as suspected. These data reflect the launch of national public health surveillance for harmful algal bloom events and associated illnesses in the United States.

Epidemiologists, environmental health practitioners, public health laboratorians, and health communicators work together to increase awareness and understanding of public health risks of harmful algal bloom events. In addition, animal health professionals, environmental health professionals, and other stakeholders, such as academics, parks and recreation professionals, and citizen scientists, have knowledge and networks that strengthen the public health system's ability to detect, investigate, and report harmful algal bloom events and associated illnesses (*2*,*6*). Poison control centers also can support case detection and investigation by sharing data with health departments. Illustrative of this approach, the Utah Poison Control Center shared data with the Utah Department of Health and entered data into OHHABS, including during a cyanobacterial bloom event in 2016 that resulted in one half of the total human cases reported for 2016–2018.

Diagnostic testing for harmful algal bloom toxins is under development but is not currently available in routine clinical settings (*7*). Fewer than 5% of human or animal cases of illness were classified as confirmed on the basis of current OHHABS criteria, which require supporting evidence such as a medical diagnosis or clinical confirmation of a harmful algal bloom exposure. Health care providers can play a critical role by notifying health departments when they suspect harmful algal bloom–associated illnesses, considering harmful algal bloom–associated illness as a differential diagnosis, and assigning relevant *International Classification of Diseases* (ICD) codes (*8*). More access to confirmatory testing is needed to support public health surveillance.

Laboratory testing occurred in approximately 90% of harmful algal bloom events, most often related to environmental monitoring activities, citizen complaints, or health event responses. Many U.S. jurisdictions have developed programs to monitor harmful algal blooms and related tools that help communicate health risks from exposure to harmful algal bloom events.[¶¶] Remote sensing (e.g., satellite imagery) and citizen scientist opportunities can supplement such efforts and might help to increase early detection of harmful algal bloom events.[***,†††,§§§] Recently, the U.S. Environmental Protection Agency released risk-based guidance for microcystins and cylindrospermopsin to assist with management of drinking water systems and recreational bodies of water (*9*,*10*). This guidance, paired with water monitoring activities, notification systems, and community engagement, might be used to increase the completeness and accuracy of public health surveillance data reported in OHHABS, thereby increasing the data available for public health decision-making.

The findings in this report are subject to at least four limitations. First, these data are for the initial OHHABS data collection period; participation, data completeness, and data quality are anticipated to improve over time. Second, the number of reported events or illnesses underrepresents the total that occurred within or across states. Surveillance capacity and scope (e.g., inclusion of animal case reports) vary across jurisdictions and within this reporting period. Third, case and event definitions are not toxin-specific and do not yet have thresholds for test results from clinical specimen or environmental samples that correspond to acute health outcomes or public health action levels for toxins. Finally, harmful algal bloom events can exhibit geospatial, temporal, and toxin production variability, which makes environmental data more difficult to collect, interpret, and report.

¶¶ https://www.epa.gov/cyanohabs/state-habs-monitoring-programs-and-resources.
*** https://oceanservice.noaa.gov/hazards/hab.
††† https://www.epa.gov/water-research/cyanobacteria-assessment-network-cyan.
§§§ https://cyanos.org/#programs.

Summary

What is already known on this topic?

Harmful algal blooms occur in fresh, brackish, and salt water throughout the United States. They can affect human and animal health and have ecological and economic impacts.

What is added by this report?

Eighteen states adopted use of the One Health Harmful Algal Bloom System and entered 421 reports during 2016–2018, including information about 389 human illnesses and at least 413 animal illnesses associated with harmful algal bloom events.

What are the implications for public health practice?

Information about harmful algal bloom exposures and health effects support efforts to detect these events and mitigate and prevent associated illnesses. Human, animal, and environmental health partners can work together to document the occurrence and impacts of harmful algal bloom events and characterize associated illnesses.

OHHABS is informed by local, state, and federal One Health partnerships. Data about harmful algal bloom exposures and health effects can be used to support prevention of harmful algal bloom–associated illnesses, which might increase because of warming waters or other climate change impacts (https://www.epa.gov/nutrientpollution/climate-change-and-harmful-algal-blooms). OHHABS data can inform educational resources and outreach efforts by identifying factors that contribute to illnesses and informing targeted messages to populations at risk. More in-depth analyses to further characterize the data should support additional public health policy and prevention efforts. A continued One Health approach to surveillance, paired with scientific research (e.g., environmental science and human and animal health studies) findings and increased access to specimen testing, will add to the robustness and utility of the system.

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References

1. Wells ML, Karlson B, Wulff A, et al. Future HAB science: directions and challenges in a changing climate. Harmful Algae 2020;91:101632. https://doi.org/10.1016/j.hal.2019.101632
2. Backer LC, Manassaram-Baptiste D, LePrell R, Bolton B. Cyanobacteria and algae blooms: review of health and environmental data from the Harmful Algal Bloom-Related Illness Surveillance System (HABISS) 2007–2011. Toxins (Basel) 2015;7:1048–64. PMID:25826054 https://doi.org/10.3390/toxins7041048
3. Adams CM, Larkin SL, Hoagland P, Sancewich B. Assessing the economic consequences of harmful algal blooms: A summary of existing literature, research methods, data, and information gaps. In: Shumway SE, Burkholder JM, Morton SL, eds. Harmful algal blooms: a compendium desk reference. 1st ed. Hoboken, NJ: John Wiley and Sons Ltd; 2018:337–54. https://doi.org/10.1002/9781118994672.ch8
4. Backer LC, McNeel SV, Barber T, et al. Recreational exposure to microcystins during algal blooms in two California lakes. Toxicon 2010;55:909–21. PMID:19615396 https://doi.org/10.1016/j.toxicon.2009.07.006
5. Backer LC, Miller M. Sentinel animals in a One Health approach to harmful cyanobacterial and algal blooms. Vet Sci 2016;3:1–18. PMID:27152315 https://doi.org/10.3390/vetsci3020008
6. Nierenberg K, Hollenbeck J, Fleming LE, et al. Frontiers in outreach and education: the Florida red tide experience. Harmful Algae 2011;10:374–80. PMID:21532966 https://doi.org/10.1016/j.hal.2011.01.004
7. Wharton RE, Cunningham BR, Schaefer AM, Guldberg SM, Hamelin EI, Johnson RC. Measurement of microcystin and nodularin activity in human urine by immunocapture-protein phosphatase 2A assay. Toxins 2019;11:729. PMID: 31847123 https://doi.org/10.3390/toxins11120729
8. Figgatt M, Muscatiello N, Wilson L, Dziewulski D. Harmful algal bloom–associated illness surveillance: lessons from reported hospital visits in New York, 2008–2014. Am J Public Health 2016;106:440–2. PMID:26794161 https://doi.org/10.2105/AJPH.2015.302988
9. US Environmental Protection Agency. Recommended human health recreational ambient water quality criteria or swimming advisories for microcystins and cylindrospermopsin. Washington, DC: US Environmental Protection Agency; 2019. https://www.epa.gov/wqc/recommended-human-health-recreational-ambient-water-quality-criteria-or-swimming-advisories
10. US Environmental Protection Agency. 2015 drinking water health advisories for two cyanobacterial toxins. Washington, DC: US Environmental Protection Agency; 2015. https://www.epa.gov/sites/production/files/2017-06/documents/cyanotoxins-fact_sheet-2015.pdf

Health Center Testing for SARS-CoV-2 During the COVID-19 Pandemic — United States, June 5–October 2, 2020

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Long-standing social inequities and health disparities have resulted in increased risk for coronavirus disease 2019 (COVID-19) infection, severe illness, and death among racial and ethnic minority populations. The Health Resources and Services Administration (HRSA) Health Center Program supports nearly 1,400 health centers that provide comprehensive primary health care* to approximately 30 million patients in 13,000 service sites across the United States.† In 2019, 63% of HRSA health center patients who reported race and ethnicity identified as members of racial ethnic minority populations (*1*). Historically underserved communities and populations served by health centers have a need for access to important information and resources for preventing exposure to SARS-CoV-2, the virus that causes COVID-19, to testing for those at risk, and to follow-up services for those with positive test results.§ During the COVID-19 public health emergency, health centers¶ have provided and continue to provide testing and follow-up care to medically underserved populations**; these centers are capable of reaching areas disproportionately affected by the pandemic.†† HRSA administers a weekly, voluntary Health Center COVID-19 Survey§§ to track health center COVID-19 testing capacity and the impact of COVID-19 on operations, patients, and personnel. Potential respondents can include up to 1,382 HRSA-funded health centers.¶¶ To assess health centers' capacity to reach racial and ethnic minority groups at increased risk for COVID-19 and to provide access to testing, CDC and HRSA analyzed survey data for the weeks June 5–October 2, 2020*** to describe all patients tested (3,194,838) and those who received positive SARS-CoV-2 test results (308,780) by race/ethnicity and state of residence. Among persons with known race/ethnicity who received testing (2,506,935), 36% were Hispanic/Latino (Hispanic), 38% were non-Hispanic White (White), and 20% were non-Hispanic Black (Black); among those with known race/ethnicity with positive test results, 56% were Hispanic, 24% were White, and 15% were Black. Improving health centers' ability to reach groups at increased risk for COVID-19 might reduce transmission by identifying cases and supporting contact tracing and isolation. Efforts to improve coordination of COVID-19 response-related activities between state and local public health departments and HRSA-funded health centers can increase access to testing and follow-up care for populations at increased risk for COVID-19.

HRSA administers a weekly voluntary Health Center COVID-19 Survey to track health center COVID-19 testing capacity and the impact of COVID-19 on operations, patients, and staff members. The 1,382 health centers asked to complete the survey are located in all 50 states, the District of Columbia (DC), and five territories and freely associated states.††† This analysis used survey data from the weeks ending June 5–October 2, 2020, to describe the patient population and, among all patients who received testing for SARS-CoV-2 with viral tests (i.e., polymerase chain reaction and antigen tests), the numbers and proportions of persons with tests and positive results by race/ethnicity and state of residence. State survey response rates ranged from 68% to 80% among health centers. Proportions of patients receiving SARS-CoV-2 tests and positive test results included unreported race/ethnicity as a separate category.

As reported in the HRSA Uniform Data System in 2019, HRSA-funded health centers reported that 35% of their

* Based on community needs, health centers offer medical, dental, vision, behavioral health, and enabling services.

† https://bphc.hrsa.gov/sites/default/files/bphc/about/healthcenterfactsheet.pdf.

§ Follow up services could include support for public health contact tracing, case investigation, case management, reporting, and isolation/quarantine.

¶ The term "health center" is used to include both Federally Qualified Health Centers (FQHCs) and Health Center Program Look-Alikes (i.e., a health center that meets all Health Center Program requirements but does not receive federal award funding). During COVID-19, HRSA provided one-time COVID-19 funding to FQHCs and Health Center Look-Alikes to purchase, administer, and expand capacity for testing to monitor and support COVID-19 testing and response related activities. Data from FQHCs are included for this analysis.

** https://data.hrsa.gov/tools/shortage-area/mua-find.

†† Areas where economic, geographic, or cultural barriers limit access to affordable health care services.

§§ https://bphc.hrsa.gov/emergency-response/coronavirus-health-center-data/.

¶¶ In June 2020, there were 1,382 HRSA-funded health centers; by September 2020, there were 1,376.

*** In April 2020, HRSA began administering the voluntary weekly Health Center COVID-19 Survey. On June 5, 2020, survey questions related to testing were modified to disaggregate between virus detection (polymerase chain reaction, antigen) and antibody detection (serology). Before June 5, 2020, data from survey questions related to testing might be reflective of COVID-19 tests for both virus and antibody detection.

††† HRSA funds health centers in DC and the following U.S. territories and freely associated states: American Samoa, Federated States of Micronesia, Guam, Northern Mariana Islands, Marshall Islands, Puerto Rico, and U.S. Virgin Islands.

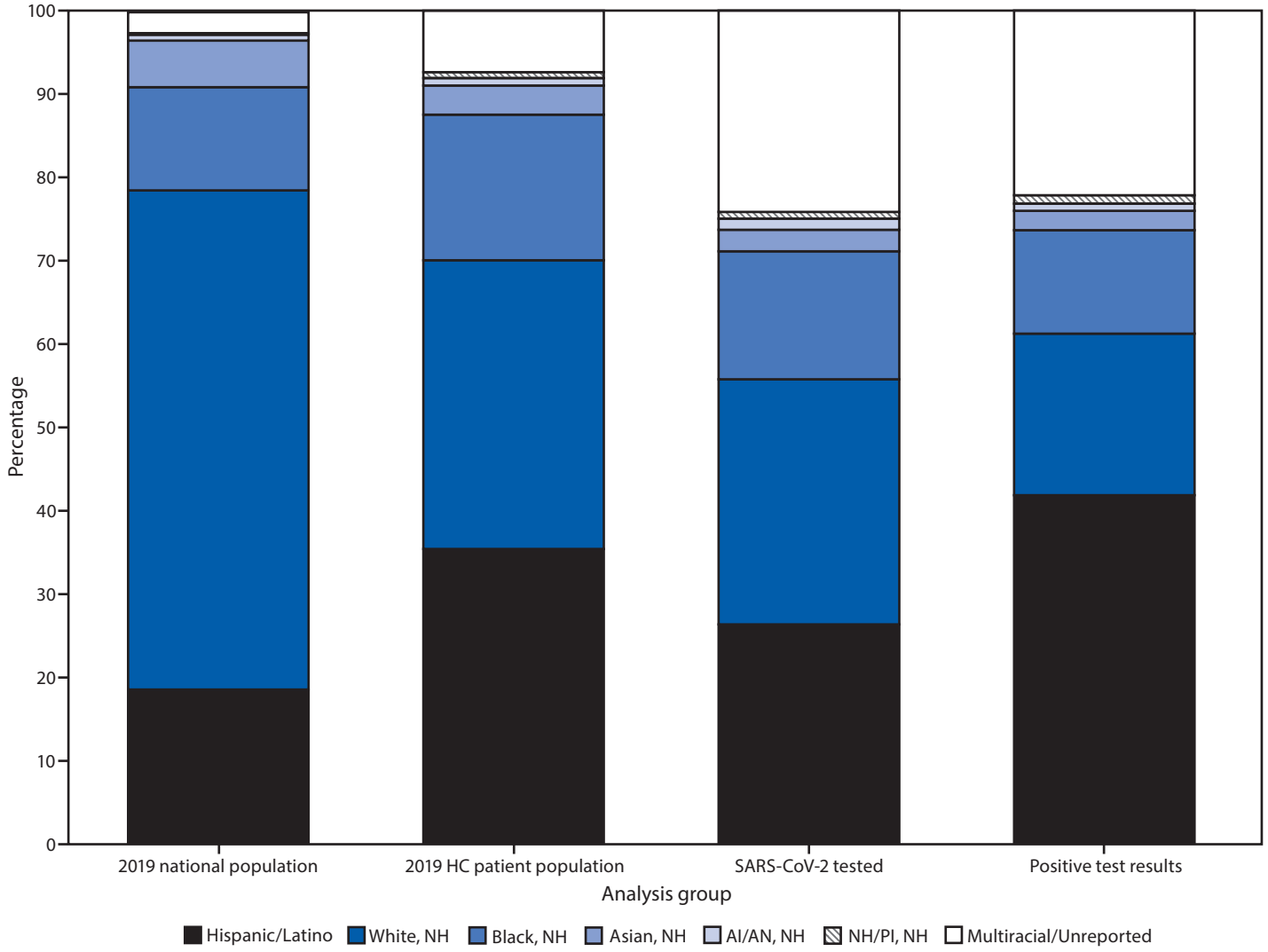
national patient population was White, 35% Hispanic,[§§§] 18% Black, 4% Asian, 1% American Indian/Alaska Native (AI/AN), 1% Native Hawaiian/Other Pacific Islander, and 1.3% multiracial persons; race/ethnicity was not reported for 6% of the patient population (Figure) (*1*). By comparison, the 2019 American Community Survey[¶¶¶] estimated that the U.S. population comprises 60% White, 18% Hispanic, 12% Black, 6% Asian, 1% AI/AN, 0.2% Native Hawaiian/Other Pacific Islander, and 3% multiracial persons.

During June 5–October 2, 2020, health centers responding to the survey reported that 3,194,838 patients received testing

[§§§] Patients who reported Hispanic/Latino ethnicity were classified as Hispanic/Latino, regardless of race.

[¶¶¶] https://data.census.gov/cedsci/profile?g=0100000US.

FIGURE. Racial/ethnic distribution of 2019 national* and Health Resources and Services Administration (HRSA)–funded health center† patient populations§ and persons who received testing and had positive SARS-CoV-2 test results¶ — Health Center COVID-19 Survey, United States, June 5–October 2, 2020



Abbreviations: AI/AN = American Indian/Alaska Native; COVID-19 = coronavirus disease 2019; HC = health center; NH/PI = Native Hawaiian/Other Pacific Islander; NH = non-Hispanic.

* Data from the 2019 American Community Survey (https://data.census.gov/cedsci/table?d=ACS%201-Year%20Estimates%20Data%20Profiles&tid=ACSDP1Y2019.DP05&hidePreview=false). Data include non-Hispanic NH/PI (0.2%), not visible in figure and do not include other race (0.3%). Persons with multiracial or unreported race/ethnicity have an unreported or non-Hispanic ethnicity.

† HRSA–funded health centers include both Federally Qualified Health Centers (FQHCs) and Health Center Program Look-Alikes (i.e, meets all Health Care Center Program requirements but does not receive federal funding). During the COVID-19 pandemic, HRSA provided one-time COVID-19 funding to FQHCs and Health Center Look-Alikes to purchase, administer, and expand capacity for testing to monitor and suppress COVID-19 testing and response-related activities.

§ HRSA 2019 Uniform Data System. https://data.hrsa.gov/tools/data-reporting/program-data/national.

¶ HRSA COVID-19 Survey, June 5–October 2, 2020. Data for the number tested or the number tested positive are aggregated by health centers before submission and cannot be deduplicated, which might inflate or misrepresent the number of patients tested or who had positive test results.

TABLE 1. Viral testing for SARS-CoV-2,* by race/ethnicity and jurisdiction† — Health Center COVID-19 Survey, United States, June 5–October 2, 2020

Jurisdiction	No.§ of FQHCs¶	Response range** (%)	Total no. patients tested††	Race/Ethnicity, no. tested (row %)							
				Hispanic/ Latino	White, NH	Black, NH	Asian, NH	AI/AN, NH	NH/PI, NH	Multiracial	Unreported
United States	1,382–1,376	68–80	3,194,838	913,718 (29)	941,017 (29)	491,311 (15)	77,528 (2)	36,837 (1)	5,161 (—)	26,386 (1)	687,903 (22)
Alabama	17	59–94	46,146	3,393 (7)	16,089 (35)	21,262 (46)	183 (—)	139 (—)	4 (—)	241 (1)	4,800 (10)
Alaska	27	44–74	57,147	1,788 (3)	11,510 (20)	528 (1)	967 (2)	20,785 (36)	83 (—)	362 (1)	21,080 (37)
American Samoa	1	0–100	1,567	104 (7)	46 (3)	0 (—)	55 (4)	12 (1)	0 (—)	2 (—)	8 (1)
Arizona	23	65–83	53,455	27,220 (51)	15,584 (29)	1,509 (3)	335 (1)	1,741 (3)	50 (—)	392 (1)	6,573 (12)
Arkansas	12	50–100	51,488	7,855 (15)	24,988 (49)	13,061 (25)	243 (—)	152 (—)	21 (—)	189 (—)	4,169 (8)
California	175–178	59–74	336,454	186,034 (55)	51,114 (15)	26,371 (8)	20,103 (6)	949 (—)	634 (—)	4,891 (1)	45,217 (13)
Colorado	19	68–95	59,401	24,702 (42)	19,064 (32)	5,165 (9)	1,166 (2)	324 (1)	31 (—)	791 (1)	8,123 (14)
Connecticut	16	56–94	83,507	27,872 (33)	15,803 (19)	8,258 (10)	1,190 (1)	218 (—)	20 (—)	349 (—)	29,613 (35)
Delaware	3	33–100	2,356	894 (38)	466 (20)	850 (36)	31 (1)	9 (—)	4 (—)	14 (1)	88 (4)
District of Columbia	8	63–100	18,438	5,632 (31)	1,628 (9)	8,554 (46)	274 (1)	30 (—)	2 (—)	89 (—)	2,215 (12)
Federated States of Micronesia	4	25–100	198	0 (—)	0 (—)	0 (—)	54 (27)	0 (—)	0 (—)	0 (—)	0 (—)
Florida	47	62–87	257,119	97,542 (38)	51,704 (20)	38,483 (15)	1,868 (1)	189 (—)	44 (—)	2,431 (1)	64,665 (25)
Georgia	35	60–91	100,909	15,410 (15)	32,664 (32)	42,889 (43)	1,119 (1)	67 (—)	11 (—)	862 (1)	7,861 (8)
Guam	1	0–100	8,574	31 (—)	199 (2)	38 (—)	2,572 (30)	9 (—)	4 (—)	432 (5)	268 (3)
Hawaii	14	36–86	8,894	850 (10)	911 (10)	91 (1)	1,325 (15)	13 (—)	2,833 (32)	286 (3)	1,081 (12)
Idaho	14	71–100	12,111	3,014 (25)	6,281 (52)	168 (1)	100 (1)	1,028 (8)	25 (—)	26 (—)	1,460 (12)
Illinois	45	64–82	162,663	51,534 (32)	37,781 (23)	22,276 (14)	3,097 (2)	217 (—)	44 (—)	676 (—)	46,966 (29)
Indiana	27	48–78	20,639	6,031 (29)	5,570 (27)	2,035 (10)	967 (5)	34 (—)	3 (—)	112 (1)	5,876 (28)
Iowa	14	64–93	30,891	5,292 (17)	14,786 (48)	1,511 (5)	447 (1)	222 (1)	16 (—)	235 (1)	8,357 (27)
Kansas	19	53–100	25,472	6,582 (26)	13,631 (54)	1,972 (8)	326 (1)	336 (1)	93 (—)	212 (1)	2,264 (9)
Kentucky	25	76–96	64,494	3,453 (5)	51,839 (80)	4,141 (6)	446 (1)	36 (—)	15 (—)	506 (1)	4,017 (6)
Louisiana	36	61–81	48,007	5,297 (11)	16,396 (34)	21,333 (44)	487 (1)	143 (—)	39 (—)	323 (1)	3,968 (8)
Maine	18	50–89	9,049	600 (7)	6,614 (73)	515 (6)	40 (—)	40 (—)	7 (—)	43 (—)	1,189 (13)
Marshall Islands	1	0–100	121	0 (—)	0 (—)	0 (—)	1 (1)	0 (—)	0 (—)	0 (—)	0 (—)
Maryland	17	47–82	8,898	2,696 (30)	1,824 (20)	2,629 (30)	117 (1)	248 (3)	3 (—)	135 (2)	1,242 (14)
Massachusetts	37–38	59–89	153,411	51,639 (34)	52,813 (34)	16,444 (11)	5,326 (3)	181 (—)	61 (—)	817 (1)	25,712 (17)
Michigan	39	51–79	99,960	12,870 (13)	53,804 (54)	13,622 (14)	1,799 (2)	305 (—)	46 (—)	1,040 (1)	16,412 (16)
Minnesota	16	56–81	16,645	2,828 (17)	5,093 (31)	3,627 (22)	1,178 (7)	794 (5)	5 (—)	32 (—)	3,077 (18)
Mississippi	20	65–95	38,843	3,411 (9)	8,300 (21)	25,850 (67)	218 (1)	59 (—)	9 (—)	326 (1)	605 (2)
Missouri	28–29	66–90	78,075	7,414 (9)	36,275 (46)	16,802 (22)	677 (1)	207 (—)	57 (—)	567 (1)	15,895 (20)
Montana	14	43–86	18,377	368 (2)	7,522 (41)	31 (—)	18 (—)	441 (2)	7 (—)	60 (—)	9,928 (54)
Nebraska	7	57–86	9,224	3,585 (39)	2,167 (23)	2,008 (22)	896 (10)	40 (—)	6 (—)	97 (1)	422 (5)
Nevada	8	38–88	17,827	9,990 (56)	4,102 (23)	938 (5)	1,145 (6)	47 (—)	157 (1)	94 (1)	1,322 (7)

See table footnotes on the next page.

and 308,780 had positive SARS-CoV-2 test results. Compared to other jurisdictions, Texas reported the highest number of patients who received testing (353,081; 11%), and California reported the highest number of patients who had positive test results (46,113; 15%). Based on data reported to the Health Center COVID-19 Survey, White and Hispanic patients each accounted for 29% of patients who received testing for SARS-CoV-2 (Table 1) and, among patients who received positive test results, 19% were White and 45% were Hispanic (Table 2). Overall, race was not reported for 22% (687,903) of patients tested and 19% of patients with positive test results (57,208); 1% (26,386) of patients receiving testing and 1% (2,378) of patients with positive test results were multiracial. In Puerto Rico, 96% of patients receiving testing were Hispanic; among other jurisdictions, the highest proportions of patients receiving testing who were Hispanic were in Nevada (9,990; 56%) and New Mexico (11,705; 56%). Compared with all other jurisdictions, California reported the most Hispanic patients who received testing (186,034) and the most positive test results among Hispanic patients (33,310; 18%). Among those with positive test results, Puerto Rico reported the largest proportion of Hispanic patients (2,095; 98%) and New Mexico the second highest proportion (531; 73%). Nationally, Black patients accounted for 15% of patients receiving testing and 12% of those who received positive test results. Mississippi reported the highest proportion of patients who received testing who were Black (25,850; 67%) and the highest proportion of those who had positive test results who were Black (2,348; 69%). Georgia reported the largest number of tests conducted (42,889; 43%) and positive test results (4,204; 32%) among Black patients.

Discussion

Health centers' efforts to increase testing for SARS-CoV-2 are an important mitigation strategy to reach racial and ethnic minority groups at increased risk for COVID-19. Published state and national data indicate that racial and ethnic

TABLE 1. (*Continued*) Viral testing for SARS-CoV-2,* by race/ethnicity and jurisdiction† — Health Center COVID-19 Survey, United States, June 5–October 2, 2020

Jurisdiction	No.§ of FQHCs¶	Response range** (%)	Total no. patients tested††	Race/Ethnicity, no. tested (row %)							
				Hispanic/ Latino	White, NH	Black, NH	Asian, NH	AI/AN, NH	NH/PI, NH	Multiracial	Unreported
New Hampshire	10	70–100	3,535	936 (26)	2,140 (61)	88 (2)	80 (2)	6 (—)	3 (—)	10 (—)	272 (8)
New Jersey	23–24	33–67	51,393	26,433 (51)	9,698 (19)	7,173 (14)	603 (1)	62 (—)	43 (—)	398 (1)	6,887 (13)
New Mexico	16	75–100	20,857	11,705 (56)	4,115 (20)	295 (1)	98 (—)	1,427 (7)	12 (—)	208 (1)	2,985 (14)
New York	63	48–67	204,075	31,877 (16)	32,798 (16)	24,734 (12)	5,972 (3)	194 (—)	30 (—)	1,606 (1)	106,749 (52)
North Carolina	39	46–69	65,685	14,505 (22)	18,118 (28)	22,130 (34)	661 (1)	524 (1)	66 (—)	334 (1)	9,326 (14)
North Dakota	4	75–100	5,003	199 (4)	2,425 (48)	385 (8)	170 (3)	300 (6)	9 (—)	35 (1)	1,476 (30)
Northern Mariana Islands	1	0–100	0	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)
Ohio	51	67–82	72,400	7,604 (11)	37,561 (52)	13,461 (19)	1,216 (2)	443 (1)	39 (—)	550 (1)	11,418 (16)
Oklahoma	21	52–95	13,147	2,833 (22)	5,284 (40)	1,151 (9)	86 (1)	480 (4)	16 (—)	145 (1)	3,117 (24)
Oregon	30	73–90	17,782	6,771 (38)	7,471 (42)	474 (3)	400 (2)	686 (4)	40 (—)	145 (1)	1,697 (10)
Palau	1	0–100	1,612	0 (—)	254 (16)	4 (—)	334 (21)	0 (—)	0 (—)	0 (—)	0 (—)
Pennsylvania	43	67–91	54,143	9,563 (18)	22,464 (41)	13,911 (26)	2,549 (5)	118 (—)	13 (—)	651 (1)	4,745 (9)
Puerto Rico	21–22	73–91	28,909	27,709 (96)	134 (—)	5 (—)	0 (—)	3 (—)	0 (—)	260 (1)	798 (3)
Rhode Island	8	63–100	22,637	10,653 (47)	4,907 (22)	2,120 (9)	388 (2)	55 (—)	9 (—)	241 (1)	4,228 (19)
South Carolina	23	70–91	63,976	4,705 (7)	15,311 (24)	36,609 (57)	686 (1)	124 (—)	12 (—)	321 (1)	6,097 (10)
South Dakota	4	50–100	5,966	1,194 (20)	3,536 (59)	67 (1)	223 (4)	283 (5)	14 (—)	16 (—)	631 (11)
Tennessee	29	59–83	85,712	8,496 (10)	53,673 (63)	8,411 (10)	430 (1)	63 (—)	53 (—)	1,018 (1)	13,549 (16)
Texas	72	69–85	353,081	109,844 (31)	55,515 (16)	42,531 (12)	10,324 (3)	766 (—)	170 (—)	1,510 (—)	132,353 (37)
U.S. Virgin Islands	2	0–50	365	100 (27)	45 (12)	200 (55)	0 (—)	0 (—)	0 (—)	20 (5)	0 (—)
Utah	13	62–92	13,870	5,451 (39)	4,663 (34)	209 (2)	65 (—)	622 (4)	26 (—)	125 (1)	2,671 (19)
Vermont	11	64–100	5,017	143 (3)	4,415 (88)	42 (1)	41 (1)	16 (—)	0 (—)	10 (—)	348 (7)
Virginia	26	65–88	35,346	8,234 (23)	15,027 (43)	6,979 (20)	381 (1)	140 (—)	4 (—)	211 (1)	4,350 (12)
Washington	27	70–89	98,481	34,877 (35)	30,972 (31)	3,647 (4)	3,844 (4)	1,317 (1)	240 (—)	1,664 (2)	20,566 (21)
West Virginia	28	61–89	47,084	2,864 (6)	39,019 (83)	1,748 (4)	48 (—)	18 (—)	12 (—)	221 (—)	3,153 (7)
Wisconsin	16	69–100	23,098	10,532 (46)	4,309 (19)	1,962 (8)	153 (1)	150 (1)	15 (—)	33 (—)	5,932 (26)
Wyoming	6	33–83	1,304	559 (43)	595 (46)	14 (1)	6 (—)	25 (2)	1 (—)	22 (2)	82 (6)

Abbreviations: AI/AN = American Indian/Alaska Native; COVID-19 = coronavirus disease 2019; FQHC = Federally Qualified Health Center; NH/PI = Native Hawaiian/Other Pacific Islander; NH = non-Hispanic.

* SARS-CoV-2 viral tests include polymerase chain reaction and antigen tests.

† The Health Resources Services Administration (HRSA) funds health centers in all 50 states, the District of Columbia, and the following U.S. territories and freely associated states: American Samoa, Federated States of Micronesia, Guam, Northern Mariana Islands, Marshall Islands, Puerto Rico, and U.S. Virgin Islands.

§ In June 2020, the number of HRSA-fund health centers was 1,382. By September, the number of HRSA-funded centers decreased to 1,376, by three in California and by one each in Massachusetts, Missouri, New Jersey, and Puerto Rico. By October, the number of Puerto Rico's HRSA-funded health centers increased by one.

¶ FQHCs receive HRSA Health Center Program federal grant funding to improve the health of underserved populations

** The weekly response rate was calculated using the number of health centers that responded to the survey as the numerator and number of current HRSA-funded health centers as the denominator. The response range represents the lowest response rate and the highest response rate nationally and by state during June 5–October 2, 2020.

†† Data for the number of persons receiving testing or who had positive test results are aggregated by health center before submission and cannot be deduplicated, which might inflate or misrepresent the number of patients who received testing or who had positive test results.

minority groups might be more likely to become infected with SARS-CoV-2, experience more severe COVID-19–associated illness, and have higher risk for death from COVID-19 (*2*–*7*). This study contributes to understanding current health center testing patterns and areas for improvement. Long-standing social inequalities and health disparities among racial and ethnic minority groups likely result from a multitude of factors that lead to increased risk for getting ill and dying of COVID-19, including discrimination,**** limited health care access and utilization, occupation, housing, and educational and income gaps.†††† Further, these factors might contribute to other risk factors for severe disease and death, including limited health care access, underlying medical conditions, and higher levels of environmental exposure. The factors contributing to disparities likely vary widely within and among groups, depending on geographic location and other contextual factors.

Health centers have a long-standing commitment to meeting the primary care needs of their communities (*8*). HRSA has awarded funding§§§§ to support health centers to purchase, administer, and expand capacity for COVID-19 testing and

**** Discrimination, which includes racism, can lead to chronic and toxic stress and shapes social and economic factors that put some people from racial and ethnic minority groups at increased risk for COVID-19.

†††† https://www.cdc.gov/coronavirus/2019-ncov/community/health-equity/race-ethnicity.html.

§§§§ To date, in 2020, HRSA has awarded approximately $2 billion through three rounds of funding to health centers: 1) March 24: $100 million (https://www.hhs.gov/about/news/2020/03/24/hhs-awards-100-million-to-health-centers-for-covid-19-response.html); 2) April 8:$1.3 billion (https://www.hhs.gov/about/news/2020/04/08/hhs-awards-billion-to-health-centers-in-historic-covid19-response.html); and 3) May 7: $583 million (https://www.hhs.gov/about/news/2020/05/07/hhs-awards-more-than-half-billion-across-the-nation-to-expand-covid19-testing.html).

TABLE 2. Positive viral tests for SARS-CoV-2,* by race/ethnicity and jurisdiction† — Health Center COVID-19 Survey, United States, June 5–October 2, 2020

Jurisdiction	Total positive§	Race/Ethnicity, no. positive (row %)							
		Hispanic/Latino	White, NH	Black, NH	Asian, NH	AI/AN, NH	NH/PI, NH	Multiracial	Unreported
United States	308,780	140,462 (45)	59,959 (19)	38,385 (12)	6,792 (2)	1,262 (—)	473 (—)	2,378 (1)	57,208 (19)
Alabama	5,097	710 (14)	1,469 (29)	2,296 (45)	23 (—)	14 (—)	0 (—)	32 (1)	542 (11)
Alaska	961	81 (8)	167 (17)	31 (3)	18 (2)	253 (26)	0 (—)	7 (1)	399 (42)
American Samoa	0	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)
Arizona	8,297	4,719 (57)	1,857 (22)	243 (3)	25 (—)	178 (2)	9 (—)	70 (1)	1,190 (14)
Arkansas	5,946	1,808 (30)	1,738 (29)	883 (15)	14 (—)	13 (—)	7 (—)	10 (—)	886 (15)
California	46,113	33,310 (72)	4,075 (9)	2,458 (5)	997 (2)	76 (—)	63 (—)	572 (1)	4,470 (10)
Colorado	4,656	3,234 (69)	721 (15)	142 (3)	49 (1)	14 (—)	3 (—)	10 (—)	480 (10)
Connecticut	3,904	2,032 (52)	221 (6)	229 (6)	33 (1)	2 (—)	1 (—)	3 (—)	1,379 (35)
Delaware	244	144 (59)	19 (8)	71 (29)	4 (2)	2 (1)	0 (—)	0 (—)	4 (2)
District of Columbia	1,697	737 (43)	82 (5)	696 (41)	16 (1)	4 (—)	0 (—)	6 (—)	154 (9)
Federated States of Micronesia	0	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)
Florida	43,859	17,913 (41)	3,500 (8)	3,347 (8)	131 (—)	9 (—)	2 (—)	142 (—)	18,802 (43)
Georgia	13,130	2,984 (23)	4,213 (32)	4,204 (32)	69 (1)	6 (—)	2 (—)	48 (—)	1,597 (12)
Guam	633	2 (—)	5 (1)	0 (—)	222 (35)	0 (—)	0 (—)	35 (6)	2 (—)
Hawaii	907	63 (7)	27 (3)	3 (—)	144 (16)	1 (—)	234 (26)	20 (2)	78 (9)
Idaho	2,938	1,185 (40)	991 (34)	119 (4)	55 (2)	94 (3)	18 (1)	9 (—)	467 (16)
Illinois	16,752	6,993 (42)	3,571 (21)	2,074 (12)	151 (1)	16 (—)	1 (—)	55 (—)	3,874 (23)
Indiana	3,274	1,372 (42)	600 (18)	238 (7)	152 (5)	2 (—)	0 (—)	12 (—)	897 (27)
Iowa	3,634	1,011 (28)	1,550 (43)	141 (4)	68 (2)	14 (—)	1 (—)	25 (1)	821 (23)
Kansas	2,810	1,345 (48)	986 (35)	177 (6)	27 (1)	30 (1)	5 (—)	3 (—)	226 (8)
Kentucky	4,191	579 (14)	2,884 (69)	306 (7)	35 (1)	0 (—)	2 (—)	22 (1)	361 (9)
Louisiana	4,922	734 (15)	1,826 (37)	2,088 (42)	29 (1)	11 (—)	0 (—)	37 (1)	191 (4)
Maine	119	28 (24)	42 (35)	43 (36)	0 (—)	0 (—)	0 (—)	1 (1)	5 (4)
Marshall Islands	0	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)
Maryland	1,472	763 (52)	148 (10)	410 (28)	24 (2)	13 (1)	1 (—)	19 (1)	93 (6)
Massachusetts	10,029	6,755 (67)	1,167 (12)	696 (7)	312 (3)	1 (—)	1 (—)	50 (—)	1,031 (10)
Michigan	3,931	1,060 (27)	1,455 (37)	460 (12)	65 (2)	9 (—)	2 (—)	48 (1)	828 (21)
Minnesota	2,194	991 (45)	219 (10)	527 (24)	190 (9)	22 (1)	1 (—)	2 (—)	241 (11)
Mississippi	3,412	255 (7)	686 (20)	2,348 (69)	23 (1)	7 (—)	1 (—)	29 (1)	54 (2)
Missouri	5,770	1,319 (23)	2,310 (40)	1,090 (19)	48 (1)	8 (—)	0 (—)	23 (—)	916 (16)
Montana	865	26 (3)	323 (37)	2 (—)	1 (—)	30 (3)	1 (—)	2 (—)	480 (55)
Nebraska	1,749	1,171 (67)	160 (9)	138 (8)	131 (7)	2 (—)	0 (—)	6 (—)	140 (8)
Nevada	2,893	2,029 (70)	325 (11)	121 (4)	127 (4)	7 (—)	21 (1)	14 (—)	245 (8)

See table footnotes on the next page.

response-related activities, which has enabled health centers to maintain or increase their staffing levels, conduct training, purchase personal protective equipment, and administer tests. Health center services, including testing, contact tracing, isolation, providing health care, and aiding recovery from the impact of unintended negative consequences¶¶¶¶ of mitigation strategies, have increased the capacity of health centers to reach populations at increased risk for COVID-19 as well as access to testing and care.*****

A recent analysis of SARS-CoV-2 testing in a multistate network of health centers during the first weeks of the COVID-19 pandemic reported small racial differences in testing and positivity rates; however, larger differences were identified by ethnicity, preferred language, and insurance status, underscoring health centers' unique position for serving racial and ethnic minority groups and addressing the ongoing need for targeted, language-concordant testing strategies (*9*). The results of this analysis indicate that health centers have afforded racial and ethnic minority populations access to SARS-CoV-2 testing during the COVID-19 pandemic and that these populations were at increased risk for COVID-19, given the large percentage of positive test results. White and Hispanic patients each accounted for 29% of tests performed; however, only 19% of positive test results were among White persons who received testing, whereas 61% were among racial and ethnic minority groups, with the largest percentage of positive test results (45%) among Hispanic patients. Twenty-six states and Puerto Rico reported >40% of positive tests among persons of Hispanic ethnicity with 1.5% of all Hispanic patients receiving testing at Puerto Rican health centers.

¶¶¶¶ Potential unintended negative consequences include loss of health insurance; food, housing, and income insecurity; mental health concerns; substance use; and violence resulting from social isolation, financial stress, and anxiety.

***** https://www.cdc.gov/coronavirus/2019-ncov/community/health-equity/cdc-strategy.html.

TABLE 2. (*Continued*) Positive viral tests for SARS-CoV-2,* by race/ethnicity and jurisdiction† — Health Center COVID-19 Survey, United States, June 5–October 2, 2020

Jurisdiction	Total positive§	Race/Ethnicity, no. positive (row %)							
		Hispanic/Latino	White, NH	Black, NH	Asian, NH	AI/AN, NH	NH/PI, NH	Multiracial	Unreported
New Hampshire	139	91 (65)	32 (23)	8 (6)	4 (3)	0 (—)	0 (—)	0 (—)	4 (3)
New Jersey	3,275	1,080 (33)	266 (8)	287 (9)	40 (1)	0 (—)	0 (—)	16 (—)	1,584 (48)
New Mexico	729	531 (73)	89 (12)	8 (1)	2 (—)	23 (3)	0 (—)	7 (1)	66 (9)
New York	10,697	1,404 (13)	1,382 (13)	1,507 (14)	1,775 (17)	6 (—)	3 (—)	75 (1)	4,528 (42)
North Carolina	8,467	3,922 (46)	1,846 (22)	1,623 (19)	63 (1)	53 (1)	8 (—)	40 (—)	908 (11)
North Dakota	402	13 (3)	173 (43)	49 (12)	17 (4)	8 (2)	0 (—)	0 (—)	142 (35)
Northern Mariana Islands	0	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)
Ohio	4,794	1,014 (21)	1,881 (39)	1,197 (25)	88 (2)	2 (—)	21 (—)	33 (1)	556 (12)
Oklahoma	1,264	500 (40)	419 (33)	70 (6)	14 (1)	46 (4)	1 (—)	10 (1)	197 (16)
Oregon	1,785	1,011 (57)	266 (15)	79 (4)	346 (19)	14 (1)	1 (—)	3 (—)	62 (3)
Palau	0	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)
Pennsylvania	3,573	1,105 (31)	954 (27)	719 (20)	357 (10)	7 (—)	1 (—)	87 (2)	333 (9)
Puerto Rico	2,137	2,095 (98)	5 (—)	5 (—)	0 (—)	0 (—)	0 (—)	0 (—)	32 (1)
Rhode Island	2,808	1,943 (69)	250 (9)	196 (7)	35 (1)	0 (—)	2 (—)	19 (1)	360 (13)
South Carolina	5,399	1,087 (20)	1,075 (20)	2,602 (48)	18 (—)	18 (—)	1 (—)	16 (—)	568 (11)
South Dakota	857	167 (19)	542 (63)	5 (1)	65 (8)	18 (2)	1 (—)	1 (—)	58 (7)
Tennessee	13,014	2,726 (21)	6,116 (47)	1,544 (12)	114 (1)	22 (—)	6 (—)	432 (3)	2,038 (16)
Texas	22,444	15,079 (67)	2,588 (12)	1,725 (8)	397 (2)	47 (—)	2 (—)	180 (1)	2,419 (11)
U.S. Virgin Islands	2	0 (—)	0 (—)	2 (100)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)
Utah	1,597	1,099 (69)	284 (18)	20 (1)	6 (—)	48 (3)	1 (—)	17 (1)	116 (7)
Vermont	35	2 (6)	20 (57)	4 (11)	5 (14)	0 (—)	0 (—)	0 (—)	4 (11)
Virginia	3,966	1,684 (42)	1,272 (32)	633 (16)	23 (1)	6 (—)	0 (—)	17 (—)	331 (8)
Washington	9,601	6,115 (64)	1,295 (13)	265 (3)	219 (2)	92 (1)	39 (—)	95 (1)	1,289 (13)
West Virginia	1,792	249 (14)	1,363 (76)	78 (4)	2 (—)	0 (—)	0 (—)	8 (—)	92 (5)
Wisconsin	3,381	2,090 (62)	418 (12)	175 (5)	19 (1)	6 (—)	10 (—)	4 (—)	650 (19)
Wyoming	223	102 (46)	86 (39)	3 (1)	0 (—)	8 (4)	0 (—)	6 (3)	18 (8)

Abbreviations: AI/AN = American Indian/Alaska Native; COVID-19 = coronavirus disease 2019; NH = non-Hispanic; NH/PI = Native Hawaiian/Other Pacific Islander.
* SARS-CoV-2 viral tests include polymerase chain reaction and antigen tests.
† The Health Resources Services Administration funds health centers in all 50 states, the District of Columbia, and the following U.S. territories and freely associated states: American Samoa, Federated States of Micronesia, Guam, Northern Mariana Islands, Marshall Islands, Puerto Rico, and U.S. Virgin Islands.
§ Data for the number of persons receiving testing or who had positive test results are aggregated by health center before submission and cannot be deduplicated, which might inflate or misrepresent the number of patients who received testing or who had positive test results.

Summary

What is already known about this topic?

Long-standing social inequities and health disparities have resulted in increased risk for COVID-19 infection, severe illness, and death among racial and ethnic minority populations.

What is added by this report?

Health centers have provided racial and ethnic minority populations access to SARS-CoV-2 testing. Improving health centers' ability to reach groups at increased risk for COVID-19 might reduce transmission by identifying cases and supporting contact tracing and isolation.

What are the implications for public health practice?

Efforts to improve coordination of COVID-19 response-related activities between state and local public health departments and HRSA-funded health centers can increase access to testing and follow-up care for populations at increased risk for COVID-19.

The findings in this report are subject to at least five limitations. First, the data used in this analysis are based on responses from health centers that voluntarily reported data to the Health Center COVID-19 Survey and might not be representative of all health centers in the United States, its territories, and freely associated states. Second, data represent a date range of information provided by health centers specified by weekly reporting date. Summary information across report dates is not comparable because of differences in health center responses for a given report date. Third, race and ethnicity data were missing for approximately 22% of patients who received testing and 19% of patients who had positive test results. Fourth, the reported number of patients tested each week does not fully represent the same patients included in the reported number with positive test results that week because of a lag between the date the specimen is collected and the availability of test results. Therefore, positivity cannot be inferred by dividing the number of patients who received positive test results by the number receiving testing. Finally, data for the number of persons with testing or positive results are aggregated by health

centers before submission and cannot be deduplicated, which might inflate or misrepresent the number of patients receiving testing or positive test results.

Health centers are an integral component of health systems designed to address structural inequities (*10*). During the COVID-19 public health emergency, health centers have played an important role in providing access to testing in communities disproportionately affected by COVID-19. Health centers' ability to reach populations at higher risk for SARS-CoV-2 infection might reduce COVID-19 transmission by identifying cases and supporting public health contact tracing and isolation among populations they serve.

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References

1. Health Resources and Services Administration. 2019 Uniform Data System—National Health Center data. Rockville, MD: US Department of Health and human Services; 2020. https://data.hrsa.gov/tools/data-reporting/program-data/national
2. Killerby ME, Link-Gelles R, Haight SC, et al.; CDC COVID-19 Response Clinical Team. Characteristics associated with hospitalization among patients with COVID-19—metropolitan Atlanta, Georgia, March–April 2020. MMWR Morb Mortal Wkly Rep 2020;69:790–4. PMID:32584797 https://doi.org/10.15585/mmwr.mm6925e1
3. Stokes EK, Zambrano LD, Anderson KN, et al. Coronavirus disease 2019 case surveillance—United States, January 22–May 30, 2020. MMWR Morb Mortal Wkly Rep 2020;69:759–65. PMID:32555134 https://doi.org/10.15585/mmwr.mm6924e2
4. Gold JAW, Wong KK, Szablewski CM, et al. Characteristics and clinical outcomes of adult patients hospitalized with COVID-19—Georgia, March 2020. MMWR Morb Mortal Wkly Rep 2020;69:545–50. PMID:32379729 https://doi.org/10.15585/mmwr.mm6918e1
5. Wortham JM, Lee JT, Althomsons S, et al. Characteristics of persons who died with COVID-19—United States, February 12–May 18, 2020. MMWR Morb Mortal Wkly Rep 2020;69:923–9. PMID:32673298 https://doi.org/10.15585/mmwr.mm6928e1
6. Center KE, Da Silva J, Hernandez AL, et al. Multidisciplinary community-based investigation of a COVID-19 outbreak among Marshallese and Hispanic/Latino communities—Benton and Washington Counties, Arkansas, March–June 2020. MMWR Morb Mortal Wkly Rep 2020;69:1807–11. PMID:33270609 https://doi.org/10.15585/mmwr.mm6948a2
7. Podewils LJ, Burket TL, Mettenbrink C, et al. Disproportionate incidence of COVID-19 infection, hospitalizations, and deaths among persons identifying as Hispanic or Latino—Denver, Colorado March–October 2020. MMWR Morb Mortal Wkly Rep 2020;69:1812–6. PMID:33270613 https://doi.org/10.15585/mmwr.mm6948a3
8. National Academies of Sciences, Engineering, and Medicine. Integrating social care into the delivery of health care: moving upstream to improve the nation's health. Washington, DC: National Academies Press; 2019.
9. Heintzman J, O'Malley J, Marino M, et al. SARS-CoV-2 testing and changes in primary care services in a multistate network of community health centers during the COVID-19 pandemic. JAMA 2020;324:1459–62. PMID:32870237 https://doi.org/10.1001/jama.2020.15891
10. Lavoie JG, Varcoe C, Wathen CN, Ford-Gilboe M, Browne AJ; EQUIP Research Team. Sentinels of inequity: examining policy requirements for equity-oriented primary healthcare. BMC Health Serv Res 2018;18:705–17. PMID:30200952 https://doi.org/10.1186/s12913-018-3501-3

Telehealth Practice Among Health Centers During the COVID-19 Pandemic — United States, July 11–17, 2020

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Early in the coronavirus disease 2019 (COVID-19) pandemic, in-person ambulatory health care visits declined by 60% across the United States, while telehealth* visits increased, accounting for up to 30% of total care provided in some locations (*1*,*2*). In March 2020, the Centers for Medicare & Medicaid Services (CMS) released updated regulations and guidance changing telehealth provisions during the COVID-19 Public Health Emergency, including the elimination of geographic barriers and enhanced reimbursement for telehealth services† (*3*–*6*). The Health Resources and Services Administration (HRSA) administers a voluntary weekly Health Center COVID-19 Survey§ to track health centers' COVID-19 testing capacity and the impact of COVID-19 on operations, patients, and staff. CDC and HRSA analyzed data from the weekly COVID-19 survey completed by 1,009 HRSA-funded health centers (health centers¶) for the week of July 11–17, 2020, to describe telehealth service use in the United States by U.S. Census region,** urbanicity,†† staffing capacity, change in visit volume, and personal protective equipment (PPE) supply. Among the 1,009 health center respondents, 963 (95.4%) reported providing telehealth services. Health centers in urban areas were more likely to provide >30% of health care visits virtually (i.e., via telehealth) than were health centers in rural areas. Telehealth is a promising approach to promoting access to care and can facilitate public health mitigation strategies and help prevent transmission of SARS-CoV-2 and other respiratory illnesses, while supporting continuity of care. Although CMS's change of its telehealth provisions enabled health centers to expand telehealth by aligning guidance and leveraging federal resources, sustaining expanded use of telehealth services might require additional policies and resources.

This analysis used Health Center COVID-19 Survey data for the week of July 11–17, 2020; the response rate was 73.2% (1,009 of 1,379 health centers). Variables included health center location (city, county, state, and urban or rural classification); the percentage of visits through telehealth during the study week; the number of visits during the study week compared with the average number of weekly visits before the pandemic (in 2019); the staffing capacity of health centers during the study week, calculated using data on staff members who were unable to work because of the COVID-19 pandemic, either directly or indirectly (e.g., site or service closure, exposure to COVID-19, COVID-19 symptoms, lack of child care, or lack of PPE); and anticipated adequacy of PPE supplies to serve patients the following week (yes/no). Health centers were categorized into three groups based on the percentage of visits provided virtually using the median value (30%): 0%, ≤30%, and >30%. Log-binomial regression was used to calculate unadjusted prevalence ratios and describe the association between health center characteristics and the percentage of telehealth visits (i.e., those with >30% versus those with ≤30% telehealth visits). P-values <0.05 were considered

* Telehealth consists of the use of electronic information and telecommunication technologies to support clinical health care, patient and professional health-related education, public health, and health administration https://www.hrsa.gov/rural-health/telehealth.

† Specific to health centers, the Coronavirus Aid, Relief, and Economic Security (CARES) Act allowed health centers to act as distant sites for telehealth applications for the duration of the emergency. On April 17, 2020, CMS issued guidance allowing health centers including Federally Qualified Health Centers (FQHCs) to receive enhanced Medicare reimbursement for telehealth services, per the provision in the CARES Act. Health centers are able to provide and be reimbursed for Medicare services as a distant site provider via telehealth and health center providers can provide these services from any location as long as they are working for the health center and can provide any telehealth service. https://www.hhs.gov/coronavirus/telehealth/index.html.

§ https://bphc.hrsa.gov/emergency-response/coronavirus-health-center-data/.

¶ Data from HRSA funded health centers (i.e., Federally Qualified Health Centers [FQHCs]) are included for the analysis presented. The term health center is used to include both FQHCs and Health Center Program Look-Alikes. A Health Center Program Look-Alike is a health center that meets all Health Center Program requirements but does not receive Federal award funding. During COVID-19, HRSA provided one-time COVID-19 funding to FQHCs and Health Center Look-Alikes to support COVID-19 testing and response related activities.

** https://www.census.gov/geographies/reference-maps/2010/geo/2010-census-regions-and-divisions-of-the-united-states.html. *Midwest:* Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin; *Northeast:* Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont; *South*: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia; *West*: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming; *U.S. territories and freely associated states:* American Samoa, Federated States of Micronesia, Guam, Republic of the Marshall Islands, Puerto Rico, Republic of Palau, and U.S. Virgin Islands.

†† Urban/Rural classification is based on the Federal Office of Rural Health Policy criteria. https://www.hrsa.gov/rural-health/about-us/definition/index.html.

statistically significant. SAS (version 9.4; SAS Institute) was used to conduct all analyses. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[§§]

Among the 1,009 health centers that completed the July 11–17 COVID-19 survey, 46 (4.6%) reported no telehealth visits, 513 (50.8%) reported >0% but ≤30% telehealth visits, and 450 (44.6%) reported >30% telehealth visits (Table). The proportion of rural health centers varied among Census Regions (Northeast = 30.5%, Midwest = 40.8%, South = 47.0%, West = 40.4%, and U.S. territories and freely associated states[¶¶] = 65.4%). A higher proportion of health centers in the Northeast (56.1%; prevalence ratio [PR] = 1.81), West (58.9%; PR = 1.90), and U.S. territories and freely associated states (57.7%; PR = 1.86) reported ≥30% telehealth visits than did those in the South (31.1%). Overall, 55.1% of urban health centers reported providing >30% of visits by telehealth compared with 29.9% of rural health centers (PR = 1.84).

Compared with health centers that reported full staffing capacity, the prevalence of reporting >30% telehealth visits was 22% higher among those reporting 5% staff absence (PR = 1.22) and was 63% higher among health centers reporting ≥10% staff absence (PR = 1.63). No association was detected between the percentage of telehealth visits and PPE shortages for the week following the survey (the week ending July 24), nor was an association found between the percentage of telehealth visits and the change in the number of weekly visits from 2019.

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

[¶¶] U.S. territories and freely associated states with health centers that completed the COVID-19 survey, July 11–17, 2020: American Samoa, Guam, Republic of the Marshall Islands, Federated States of Micronesia, and Puerto Rico.

TABLE. Characteristics of health centers* by percentage of visits provided using telehealth and factors associated with telehealth expansion (N = 1,009) — Health Center COVID-19 Survey, United States, July 11–17, 2020

Characteristic	No. (column %)	No. (%) of health centers by % of visits by telehealth			Bivariate association for reporting >30% telehealth visits†	
		0%	>0%, ≤30%	>30%	Prevalence ratio (95% CI)	P-value
Total	**1,009 (100)**	**46 (4.6)**	**513 (50.8)**	**450 (44.6)**		
Region						
Northeast	164 (16.3)	4 (2.4)	68 (41.5)	92 (56.1)	1.81 (1.47–2.22)	<0.0001
Midwest	206 (20.4)	10 (4.9)	120 (58.3)	76 (36.9)	1.19 (0.93–1.51)	
South	338 (33.5)	20 (5.9)	213 (63.0)	105 (31.1)	Referent	
West	275 (27.3)	9 (3.3)	104 (37.8)	162 (58.9)	1.90 (1.57–2.29)	
U.S. territories and freely associated states§	26 (2.6)	3 (11.5)	8 (30.8)	15 (57.7)	1.86 (1.29–2.68)	
Urban/Rural classification¶						
Urban	588 (58.3)	17 (2.9)	247 (42.0)	324 (55.1)	1.84 (1.56–2.17)	<0.0001
Rural	421 (41.7)	29 (6.9)	266 (63.2)	126 (29.9)	Referent	
Staffing capacity**						
Full capacity	368 (36.5)	31 (8.4)	204 (55.4)	133 (36.1)	Referent	<0.0001
95% capacity	412 (40.8)	10 (2.4)	220 (53.4)	182 (44.2)	1.22 (1.03–1.45)	
≤90% capacity	229 (22.7)	5 (2.2)	89 (38.9)	135 (59.0)	1.63 (1.37–1.94)	
Weekly visits before the COVID-19 pandemic††						
Decrease	823 (81.6)	43(5.2)	408 (49.6)	372 (45.2)	Referent	0.71
No change	82 (8.1)	2 (2.4)	45 (54.9)	35 (42.7)	0.94 (0.73–1.23)	
Increase	104 (10.3)	1 (1.0)	60 (57.7)	43 (41.3)	0.91 (0.72–1.16)	
Personal protective equipment (PPE) shortage§§						
Yes	121 (12.0)	6 (5.0)	69 (57.0)	46 (38.0)	0.84 (0.66–1.06)	0.12
No	888 (88.0)	40 (4.5)	444 (50.0)	404 (45.5)	Referent	

Abbreviations: CI = confidence interval; COVID-19 = coronavirus disease 2019.

* Health centers include Health Resources and Services Administration–funded Federally Qualified Health Centers, which fall under the Consolidated Health Center Program (Section 1905(l)(2)(B) of the Social Security Act).

† Outcome variable was stratified by percent telehealth performed; percent telehealth performed was dichotomized into 0-30% and >30%. The prevalence ratios represent a model predicting >30% telehealth visits.

§ US Census regions are defined based on the 2010 Census regions and divisions of the United States (https://www.census.gov/geographies/reference-maps/2010/geo/2010-census-regions-and-divisions-of-the-united-states.html). U.S. territories and freely associated states with health centers that completed the COVID-19 Survey, July 11–17, 2020, include American Samoa, Guam, Marshall Islands, Federated States of Micronesia, and Puerto Rico.

¶ Urban/Rural classification is based on the Federal Office of Rural Health Policy criteria. https://www.hrsa.gov/rural-health/about-us/definition/index.html.

** Health centers reported the percentage of staff unable to work during the study week due to COVID-19-related issues (e.g., site/service closure, exposure, family/home obligations, lack of PPE).

†† Health centers reported the number of visits during the past week compared to the average number of weekly visits pre-COVID-19.

§§ Health centers reported whether they had adequate PPE to serve patients the following week.

Discussion

The COVID-19 pandemic has resulted in considerable expansion of telehealth services in the United States, which has facilitated care for a range of conditions and improved access for many underserved areas (*7*). Before the COVID-19 pandemic, lack of uniform coverage policies across insurers and states and obstacles to establishing telehealth in health systems (e.g., high startup costs, workflow reconfiguration, clinician buy-in, and patient interest) led to a slow adoption and use of telehealth services in the United States (*8*). Since the pandemic began, telehealth has been used to triage patients and reduce the impact of patient surge on facilities, address decreased access to health care, conserve PPE, and reduce the transmission of SARS-CoV-2 (*9*).

This analysis includes data from HRSA-funded health centers (i.e., Federally Qualified Health Centers). Health centers are community-based and patient-directed organizations that deliver comprehensive, culturally competent, high-quality primary health care services and provide services regardless of patients' ability to pay, often reaching underserved communities and populations. HRSA's Health Center Program*** supports nearly 1,400 health centers that provide comprehensive primary health care to approximately 9% of persons across the United States, including one in five rural residents. This report indicates that the majority of health centers used telehealth services during the COVID-19 pandemic. HRSA has awarded funding to support efforts by health centers to mitigate the impacts of the COVID-19 pandemic. In addition to HRSA funding, the CMS provisions to eliminate geographic barriers and enhance reimbursement for telehealth services enabled health centers to expand telehealth services to continue provision of care, enhance response-related services, and reduce the risk for SARS-CoV-2 transmission (*3*–*6*). As the pandemic continues, health care providers and patients might transition back to in-person care; however, a substantial proportion of health care might continue to be provided through telehealth in the future (*2*). Telehealth service expansion is likely to continue to improve access to health care and enhance the health care system's capacity to respond to future public health emergencies.

As a critical provider of primary care for underserved populations, health centers can play a major role in expanding telehealth and access to care to ensure continuity of care in rural communities; however, the variation in telehealth expansion by region and urbanicity highlights remaining challenges. Approximately one half of health centers in the South are in rural areas, and most of the barriers faced by rural health centers before the pandemic (e.g., the logistics of implementing telehealth, lack of partners or providers, and limited broadband access) will require long-term solutions (*10*). Access to adequate broadband and audiovisual technologies might remain a challenge, specifically for rural health centers and patient populations.

The findings in this report are subject to at least three limitations. First, the data used in this analysis are based on those provided by health centers that reported data to HRSA for one week (July 11–17, 2020) and might not be representative of all health centers in the United States and U.S. territories and freely associated states. Second, these data might be subject to selection bias because completing the Health Center COVID-19 Survey is voluntary, and health centers that completed the survey during the study week might have characteristics (e.g., greater staffing capacity, differences in COVID-19 burden) that are different from those that did not complete the survey. Finally, the percentage of telehealth visits for a single week might not fully capture the expansion of telehealth or consider COVID-19 incidence during that week.

CDC has issued guidance on telehealth including considerations for health care systems, practices, and providers using telehealth services††† applicable both during and after the COVID-19 pandemic. The guidance provides practical approaches to telehealth that can be used to protect health care personnel, patients, and communities.§§§ In addition, CDC hosted Clinical Outreach and Communication Activities calls¶¶¶ to provide information to clinicians on telehealth benefits and challenges and to share experiences implementing telehealth in health centers.

The potential exists for health centers to improve access to care with removal of barriers, including increasing broadband access and support. Strategies to expand telehealth services through short-term policies and practice changes under the COVID-19 public health emergency have enabled health centers to expand telehealth by aligning guidance and leveraging federal resources (*3*,*4*). Sustaining expanded use of telehealth services in health centers after the pandemic ends might require additional policies and resources.

*** https://bphc.hrsa.gov/sites/default/files/bphc/about/healthcenterfactsheet.pdf.

††† https://www.cdc.gov/coronavirus/2019-ncov/hcp/telehealth.html.
§§§ https://www.cdc.gov/coronavirus/2019-ncov/hcp/ways-operate-effectively.html.
¶¶¶ https://emergency.cdc.gov/coca/.

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All HRSA-funded health centers that completed the weekly COVID-19 survey.

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Summary

What is already known about this topic?

Limited data are available on expansion of virtual health care visits (telehealth) among U.S. health centers during the COVID-19 pandemic.

What is added by this report?

During July 11–17, 2020, 963 (95.4%) of 1,009 Health Resources and Services Administration–funded health centers that responded to a voluntary weekly survey reported providing telehealth services. Health centers in urban areas were more likely to provide >30% of visits virtually than were those in rural areas.

What are the implications for public health practice?

Telehealth is a promising approach to promoting and expanding access to care, especially in the South and rural areas; this cost-effective modality can facilitate public health mitigation strategies and prevent transmission of SARS-CoV-2 and other respiratory illnesses, while supporting continuity of care.

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. Mehrotra A, Chernew M, Linetsky D, Hatch H, Cutler D, Schneider EC. The impact of the COVID-19 pandemic on outpatient visits: changing patterns of care in the newest COVID-19 hot spots. New York, NY: Commonwealth Fund; 2020. https://doi.org/10.26099/yaqe-q550
2. Mehrotra A, Chernew M, Linetsky D, Hatch H, Cutler D. The impact of the COVID-19 pandemic on outpatient visits: a rebound emerges," to the point (blog). New York, NY: Commonwealth Fund; 2020. https://doi.org/10.26099/ds9e-jm36
3. Centers for Medicare & Medicaid Services. COVID-19 emergency declaration blanket waivers for health care providers. Baltimore, MD: US Department of Health and Human Services, Centers for Medicare & Medicaid Services; 2020. https://www.cms.gov/files/document/covid19-emergency-declaration-health-care-providers-fact-sheet.pdf
4. Coronavirus Aid, Relief, and Economic Security (CARES) Act, Pub. L. 116-36, 134 Stat. 2811 (Mar. 27, 2020). https://www.congress.gov/bill/116th-congress/house-bill/748/text
5. Centers for Medicare & Medicaid Services. Telemedicine health care provider fact sheet. Baltimore, MD: US Department of Health and Human Services, Centers for Medicare & Medicaid Services; 2020. https://www.cms.gov/newsroom/fact-sheets/medicare-telemedicine-health-care-provider-fact-sheet
6. National Association of Community Health Centers. COVID-19 Telehealth implementation quick guide. Bethesda, MD: National Association of Community Health Centers; 2020. https://cdn1.digitellinc.com/uploads/nachc/articles/9d0b228f0f644e3cea607155232e2640.pdf
7. Koonin LM, Hoots B, Tsang CA, et al. Trends in the use of telehealth during the emergence of the COVID-19 pandemic—United States, January–March 2020. MMWR Morb Mortal Wkly Rep 2020;69:1595–9. PMID:33119561 https://doi.org/10.15585/mmwr.mm6943a3
8. Weigel G, Ramaswamy A, Sobel L, Salganicoff A, Cubanski J, Freedet M. Opportunities and barriers for telemedicine in the U.S. during the COVID-19 emergency and beyond. San Francisco, CA: Kaiser Family Foundation; 2020. https://www.kff.org/womens-health-policy/issue-brief/opportunities-and-barriers-for-telemedicine-in-the-u-s-during-the-covid-19-emergency-and-beyond
9. Martin G, Koizia L, Kooner A, et al. PanSurg Collaborative. Use of the hololens2 mixed reality headset for protecting health care workers during the COVID-19 pandemic: prospective, observational evaluation. J Med Internet Res 2020;22:e21486. PMID:32730222 https://doi.org/10.2196/21486.
10. Lin CC, Dievler A, Robbins C, Sripipatana A, Quinn M, Nair S. Telehealth in health centers: key adoption factors, barriers, and opportunities. Health Aff (Millwood) 2018;37:1967–74. PMID:30633683 https://doi.org/10.1377/hlthaff.2018.05125.

Factors That Might Affect SARS-CoV-2 Transmission Among Foreign-Born and U.S.-Born Poultry Facility Workers — Maryland, May 2020

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Numerous recent assessments indicate that meat and poultry processing facility workers are at increased risk for infection with SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19) (*1–4*). Physical proximity to other workers and shared equipment can facilitate disease transmission in these settings (*2–4*). The disproportionate number of foreign-born workers employed in meat and poultry processing reflects structural, social, and economic inequities that likely contribute to an increased COVID-19 incidence in this population* (*5*). In May 2020, the Maryland Department of Health and CDC investigated factors that might affect person-to-person SARS-CoV-2 transmission among persons who worked at two poultry processing facilities.† A survey administered to 359 workers identified differences in risk factors for SARS-CoV-2 infection between workers born outside the United States and U.S.-born workers. Compared with U.S.-born workers, foreign-born workers had higher odds of working in fixed locations on the production floor (odds ratio [OR] for cutup and packaging jobs = 4.8), of having shared commutes (OR = 1.9), and of living with other poultry workers (OR = 6.0). They had lower odds of participating in social gatherings (OR for visits to family = 0.2; OR for visits to friends = 0.4), and they visited fewer businesses in the week before the survey than did their U.S.-born coworkers. Some workplace risk factors can be mitigated through engineering and administrative controls focused on the production floor, and this will be of particular benefit to the foreign-born workers concentrated in these areas. Employers and health departments can also partner with local organizations to disseminate culturally and linguistically tailored messages about risk reduction behaviors in community settings, including shared transportation§ and household members dwelling in close quarters.¶

During a 2-day period in May 2020, interviews were conducted with a convenience sample of on-duty workers selected by management from two poultry processing facilities during the morning and evening shifts. Management selected workers assigned to different areas of the facility to minimize disruptions to production. Interviews were guided by a structured questionnaire that collected information about workers' demographic characteristics (e.g., sex, age, and country of birth) and their risks for contracting SARS-CoV-2 during the week preceding the interview (e.g., commuting, large household size, presence of other poultry workers in the household, visits to businesses, gatherings with friends and family, and COVID-19 information sources). Foreign-born workers were defined as workers born outside the United States, including immigrants and refugees. The questionnaire was developed in English and translated into Haitian Creole and Spanish. Interview data were combined with employment records provided by both facilities on workers' race and ethnicity, assigned roles, shifts, and years of employment. Roles were categorized to correspond with work locations. Fixed jobs on the production floor (e.g., cutup and packaging, evisceration, and receiving) were considered high-risk because they involve physical proximity to other workers and have been associated with SARS-CoV-2 transmission in other meat processing facilities (*2–4*). Cold temperature work areas were also considered high-risk because cold could prolong virus stability and facilitate transmission (*6*). Fixed jobs were compared with jobs that involved multiple work areas because the latter tend to be managerial or maintenance positions with more flexibility to maintain physical distance and have less contact with high-touch surfaces. Data were analyzed descriptively, and crude ORs were calculated to analyze the strength of the associations between being foreign-born and selected characteristics. For continuous variables, comparisons were based on the Wilcoxon rank sum test. Both structural factors (i.e., characteristics reflecting economic, social, policy, and organizational environments, such as work areas, housing and transportation) and behavioral factors (i.e., individual-level actions and practices, such as visits to businesses, social gatherings and use of masks) were evaluated. SAS software (version 9.4; SAS Institute) was used for all analyses. All activities were reviewed by CDC and were conducted consistent with applicable federal law and CDC policy.**

Among 2,345 total workers in facilities A and B, 359 (14.7%) were interviewed, including 154 (42.9%) from facility A (24.4% of facility A workers) and 205 (57.1%) from facility B (11.4% of facility B workers) (Table). The sample was evenly distributed by

* According to the Migration Policy Institute, immigrants represent 17% of all civilian-employed workers in the United States and 37% of meat processing industry workers. https://www.migrationpolicy.org/content/essential-role-immigrants-us-food-supply-chain.

† At this time, no reports suggest that COVID-19 can be transmitted to humans by food or food packaging. https://www.usda.gov/coronavirus/food-supply-chain#food-safety.

§ https://www.cdc.gov/coronavirus/2019-ncov/downloads/community/organizations/carpooling-fs.pdf.

¶ https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/living-in-close-quarters.html.

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

TABLE. Characteristics and activities of poultry processing workers, overall and by country of birth, and crude odds ratios (ORs) for being foreign-born — Maryland, May 2020

Characteristic or activity*	No. (column %)			Crude OR (95% CI) (categorical); p-value (continuous)†
	All (N = 359)	Country of birth		
		Foreign-born (n = 135)	U.S.-born (n = 224)	
Demographics				
Categorical variables				
Female	171 (48.7)	70 (53.9)	101 (45.7)	1.4 (0.9–2.2)
Race and ethnicity§				
Black	241 (73.3)	89 (80.2)	152 (69.7)	10.0 (3.0–32.8)
White¶	54 (16.4)	3 (2.7)	51 (23.4)	Referent
Hispanic/Latino	21 (6.4)	13 (11.7)	8 (3.7)	27.6 (6.4–118.9)
Asian	6 (1.8)	5 (4.5)	1 (0.5)	—†
Other race	7 (2.1)	1 (0.9)	6 (2.8)	—†
Interview language				
English¶	243 (67.7)	23 (17.0)	220 (98.2)	Referent
Haitian Creole	79 (22.0)	79 (58.5)	0 (0.0)	Undefined
Spanish	37 (10.3)	33 (24.4)	4 (1.8)	78.9 (25.7–242.6)
Continuous variables				
Median age in years (IQR)	41.1 (29.7–53.7)	39.4 (30.7–51.2)	42.6 (29.1–54.2)	0.46
Structural factors**				
Categorical variables				
Facility				
Facility A	154 (42.9)	41 (30.4)	113 (50.5)	0.4 (0.3–0.7)
Facility B¶	205 (57.1)	94 (69.6)	111 (49.6)	Referent
Shift††				
Morning shift¶	178 (54.3)	42 (38.2)	136 (62.4)	Referent
Evening shift	150 (45.7)	68 (61.8)	82 (37.6)	2.7 (1.7–4.3)
Area of plant				
Cutup and packaging	198 (56.6)	96 (73.3)	102 (46.6)	4.8 (2.3–10.0)
Evisceration	49 (14.0)	20 (15.3)	29 (13.2)	3.5 (1.5–8.5)
Multiple areas¶	61 (17.4)	10 (7.6)	51 (23.3)	Referent
Offsite§§	3 (0.9)	0 (0.0)	3 (1.4)	Undefined
Outside the production floor	13 (3.7)	0 (0.0)	13 (5.9)	Undefined
Receiving/Live hang/Scald and pick	13 (3.7)	3 (2.3)	10 (4.6)	1.5 (0.4–6.6)
Shipping/Cooler	13 (3.7)	2 (1.5)	11 (5.0)	0.9 (0.2–4.8)
Temperature of work area¶¶				
Cold	211 (60.3)	98 (72.6)	113 (50.5)	4.4 (2.1–9.2)
Hot	62 (17.7)	23 (17.0)	39 (17.4)	3.0 (1.3–7.0)
Multiple areas¶	61 (17.4)	10 (7.4)	51 (22.8)	Referent
Other	16 (4.6)	0 (0.0)	16 (7.1)	Undefined
Commute pattern***				
Alone	190 (52.9)	55 (40.7)	135 (60.3)	0.5 (0.3–0.7)
Shared, with other household members	52 (14.5)	23 (17.0)	29 (13.0)	1.4 (0.8–2.5)
Shared, with persons from outside the household	128 (35.7)	61 (45.2)	67 (29.9)	1.9 (1.2–3.0)
At least one other person in the household currently works at a poultry plant	137 (38.2)	86 (63.7)	51 (22.8)	6.0 (3.7–9.5)

See table footnotes on the next page.

sex (48.7% female, 171); median age was 41.1 years (interquartile range = 29.7–53.7 years). Non-Hispanic Black or African American persons accounted for 241 (73.3%) workers, non-Hispanic White persons for 54 (16.4%), and Hispanic or Latino persons for 21 (6.4%). Overall, 135 (37.8%) interviewed workers were foreign-born, 89 (65.9%) of whom were from Haiti.

Among all interviewed workers, 128 (35.7%) commuted to work via shared transport with persons from outside their household; among these, 104 (81.9%) reported wearing masks during transit.†† During the week before the interview, 265 (73.8%) interviewees visited grocery stores, and 188 (52.4%) visited gas stations. Visits to other businesses (e.g., restaurants, bars, and hair salons) were uncommon. Some workers participated in social gatherings: 77 (21.5%) visited family members, 36 (10.0%) visited friends, and 110 (30.9%) hosted a visitor in their home.

†† Data on mask usage was missing for one shared commuter, so the percentage who wore masks was calculated using a denominator of 127 workers.

TABLE. (*Continued*) Characteristics and activities of poultry processing workers, overall and by country of birth, and crude odds ratios (ORs) for being foreign-born — Maryland, May 2020

Characteristic or activity*	No. (column %)			Crude OR (95% CI) (categorical); p-value (continuous)†
		Country of birth		
	All (N = 359)	Foreign-born (n = 135)	U.S.-born (n = 224)	
Source of information about COVID-19* **				
Church	3 (0.8)	3 (2.2)	0 (0.0)	Undefined
Health officials	13 (3.6)	3 (2.2)	10 (4.5)	—†
Internet	121 (33.7)	33 (24.4)	88 (39.3)	0.5 (0.3–0.8)
Newspaper	7 (2.0)	4 (3.0)	3 (1.3)	—†
Person-to-person	56 (15.6)	23 (17.0)	33 (14.7)	1.2 (0.7–2.1)
Radio	24 (6.7)	17 (12.6)	7 (3.1)	4.5 (1.8–11.1)
Social media	66 (18.4)	25 (18.5)	41 (18.3)	1.0 (0.6–1.8)
TV news	257 (71.6)	90 (66.7)	167 (74.6)	0.7 (0.4–1.1)
Work	110 (30.6)	39 (28.9)	71 (31.7)	0.9 (0.5–1.4)
Continuous variables				
Median number of persons in the household (IQR)	4.0 (2.0–5.0)	4.0 (3.0–5.0)	3.0 (2.0–4.0)	<0.001
Behavioral factors†††				
Categorical variables				
Wears a mask during shared commute§§§	104 (81.9)	57 (93.4)	47 (71.2)	5.8 (1.8–18.1)
Business visits in the past week* **				
Beauty salon or barbershop	10 (2.8)	2 (1.5)	8 (3.6)	—†
Gas station	188 (52.4)	52 (38.5)	136 (60.7)	0.4 (0.3–0.6)
Grocery store	265 (73.8)	94 (69.6)	171 (76.3)	0.7 (0.4–1.1)
Laundromat	70 (19.5)	36 (26.7)	34 (15.2)	2.0 (1.2–3.4)
Liquor store	51 (14.2)	9 (6.7)	42 (18.8)	0.3 (0.1–0.7)
Medical office/Clinic/Hospital	26 (7.2)	11 (8.2)	15 (6.7)	1.2 (0.6–2.8)
Post office	24 (6.7)	5 (3.7)	19 (8.5)	0.4 (0.2–1.1)
Restaurant or bar	25 (7.0)	3 (2.2)	22 (9.8)	—†
Other store	26 (7.2)	9 (6.7)	17 (7.6)	0.9 (0.4–2.0)
Household visits in the past week* **				
Received visitors at own home	110 (30.9)	25 (18.8)	85 (38.1)	0.4 (0.2–0.6)
Went to family member's home	77 (21.5)	12 (8.9)	65 (29.0)	0.2 (0.1–0.5)
Went to friend's home	36 (10.0)	8 (5.9)	28 (12.5)	0.4 (0.2–1.0)
Continuous variables				
Median number of places visited in the past week (IQR)¶¶¶	1.0 (1.0–2.0)	1.0 (1.0–2.0)	2.0 (1.0–3.0)	<0.01

Abbreviations: CI = confidence interval; COVID-19 = coronavirus disease 2019; IQR = interquartile range.

* Some workers were missing data on sex (eight), age (two), race and ethnicity (30), shift (30), area of plant (nine), and temperature of work area (nine).

† For categorical variables: ORs and 95% CIs of foreign-born workers compared with U.S.-born workers. ORs were only calculated for categories with at least five workers in each cell. For continuous variables: p-values for Wilcoxon rank sum test for foreign-born workers compared with U.S.-born workers.

§ Employment records combined race and ethnicity into a single variable and might have underestimated the Hispanic/Latino population.

¶ Reference group for ORs.

** Structural factors are characteristics or activities reflecting economic, social, policy, and organizational environments.

†† One respondent who worked the third shift (overnight) was excluded.

§§ Off-site refers to positions that are not located in the processing building, including delivery, wastewater, and human resource operations.

¶¶ Certain areas of the production floor are kept at specific temperatures to facilitate production. For example, areas where carcasses are scalded and defeathered are hot, and areas where carcasses are chilled are cold. Office areas are kept at room temperature.

*** Multiple answers were permitted, and each answer choice was analyzed as the odds of answering "yes" for that option compared with the odds of answering "no" ("no" was the reference group).

††† Behavioral factors are characteristics or activities reflecting individual-level actions and practices.

§§§ Percentage who wore masks was calculated out of 127 workers who commuted to work with persons outside their household (one shared commuter was missing data for this question).

¶¶¶ Sum of business and household visits in the past week.

The profile of foreign-born workers differed from that of U.S.-born workers in several ways. Compared with U.S.-born workers, foreign-born workers were disproportionately concentrated in certain jobs and areas of the facility (OR for workers assigned to cutup and packaging jobs versus those assigned to multiple areas = 4.8; OR for those assigned to cold-temperature versus to multiple-temperature work areas = 4.4).[§§] The odds of foreign-born workers commuting with persons from outside their household were 1.9 times the odds for U.S.-born workers.

[§§] "Assigned multiple areas" refers to jobs that involve regular movement around all areas of the facility or that avoid the production floor altogether (e.g., maintenance or quality assurance).

Summary

What is already known about this topic?

Workers at meat and poultry processing facilities are at increased risk for SARS-CoV-2 infection and are disproportionately foreign-born.

What is added by this report?

Compared with U.S.-born poultry workers, foreign-born workers at two Maryland facilities had higher odds of working on the production floor and of living with other poultry workers and lower odds of participating in social gatherings and visiting businesses during the preceding week.

What are the implications for public health practice?

Engineering and administrative controls might reduce SARS-CoV-2 transmission risk for workers on the production floor, many of whom are foreign-born. Culturally and linguistically tailored messages should be disseminated about mitigation measures, particularly those pertaining to carpools and close living quarters.

The median size of foreign-born workers' households was four persons, and that of U.S.-born workers was three (p<0.01). The odds of foreign-born workers living with other poultry workers were 6.0 times that of U.S.-born workers. Foreign-born workers were less likely than were U.S.-born workers to get information about COVID-19 from the Internet (OR = 0.5) and more likely to get information from radio (OR = 4.5).

In the week before being interviewed, foreign-born workers were less likely than were U.S.-born workers to have visited most businesses, including gas stations (OR = 0.4) and liquor stores (OR = 0.3), to have visited a family member's home (OR = 0.2) or a friend's home (OR = 0.4), or to have received visitors in their own home (OR = 0.4). Foreign-born workers had higher odds of wearing a mask during shared commutes, compared with U.S.-born workers who also had shared commutes (OR = 5.6).

Discussion

In a sample of poultry processing workers in two Maryland facilities, all workers reported risks that might affect SARS-CoV-2 transmission. Structural factors were more apparent than were behavioral factors, especially among foreign-born workers. Some structural factors (e.g., shared transportation and larger household size) are common features of foreign-born populations in the United States (*7*,*8*). However, other structural factors are more specific to the workplace and can be mitigated through engineering and administrative controls. For example, in other meat processing facilities, workers with fixed jobs on the production floor had the highest SARS-CoV-2 attack rates and the most frequent contact with ill coworkers[¶¶] (*2*–*4*). Engineering and administrative controls (e.g., modified alignment of workstations along processing lines, adequate ventilation, installation of physical barriers and handwashing stations, staggering of arrival and break times, and visual cues about social distancing) might reduce risk for SARS-CoV-2 transmission for all workers on the production floor, many of whom are foreign-born (*9*).

The findings in this report are subject to at least six limitations. First, the sample of workers who participated in interviews might not be representative of poultry processing workers in Maryland or meat and poultry processing workers more broadly. Managers might have been biased in their selection of workers to participate, and workers who were out sick or otherwise absent at the time of the interviews were excluded. Also, the demographics of workers in Maryland might differ from populations in other parts of the United States. Second, the interviews were conducted in three languages, and some questions might have been misinterpreted as a result of translation. Third, much of the information was obtained by self-report, which could be subject to social desirability bias. Fourth, employment records combined race and ethnicity into a single variable and might have underestimated the Hispanic/Latino population. Fifth, although many workers at the poultry plants were tested for SARS-CoV-2, testing results could not be linked with the survey data, so it was not possible to calculate the actual risk for confirmed disease associated with each factor. Finally, interviews were conducted in May, when movement and community activities in Maryland were limited by closures and restrictions; the frequency of activities outside the home might have increased in the weeks after the interviews.

This investigation suggests that foreign-born and U.S.-born workers in poultry processing facilities likely face some different risk factors for SARS-CoV-2 transmission, and these factors might vary inside and outside the plant. Collecting data that include country of birth can therefore be used to inform public health practice (*10*). Though many prevention measures will benefit all workers, employers and health departments might consider placing special emphasis on the risk factors facing vulnerable groups, including foreign-born workers. For example, in the workplace, engineering and administrative controls can be tailored to the production floor. In community settings, information can be disseminated about how to more safely navigate

[¶¶] The studies cited did not statistically control for nonwork factors, although genotyping provided evidence that the initial outbreak in Germany was primarily caused by transmission on the processing floor, rather than in shared living quarters or carpools. Shared living quarters and carpools were likely confounding factors in a second outbreak at the same facility in Germany.

common situations including carpools and close living quarters, and regulations such as mask mandates can also be considered. In addition, communities can increase sustained awareness and adherence to COVID-19 mitigation and prevention measures and guidance by collaborating with community-based organizations, such as labor groups and religious congregations that are directly led by persons from affected populations. These community-based organizations are well-positioned to disseminate culturally and linguistically tailored messages to foreign-born workers and the wider community.

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References

1. Waltenburg MA, Victoroff T, Rose CE, et al.; COVID-19 Response Team. Update on COVID-19 among workers in meat and poultry processing facilities—United States, April–May 2020. MMWR Morb Mortal Wkly Rep 2020;69:887–92. PMID:32644986 https://doi.org/10.15585/mmwr.mm6927e2
2. Donahue M, Sreenivasan N, Stover D, et al. Notes from the field: characteristics of meat processing facility workers with confirmed SARS-CoV-2 infection—Nebraska, April–May 2020. MMWR Morb Mortal Wkly Rep 2020;69:1020–2. PMID:32759920 https://doi.org/10.15585/mmwr.mm6931a3
3. Steinberg J, Kennedy ED, Basler C, et al. COVID-19 outbreak among employees at a meat processing facility—South Dakota, March–April 2020. MMWR Morb Mortal Wkly Rep 2020;69:1015–9. PMID:32759914 https://doi.org/10.15585/mmwr.mm6931a2
4. Günther T, Czech-Sioli M, Indenbirken D, et al. Investigation of a superspreading event preceding the largest meat processing plant-related SARS-coronavirus 2 outbreak in Germany. Rochester, NY; Social Science Research Network; 2020. https://ssrn.com/abstract=3654517
5. Migration Policy Institute. The essential role of immigrants in the U.S. food supply chain. Washington, DC: Migration Policy Institute; 2020. https://www.migrationpolicy.org/content/essential-role-immigrants-us-food-supply-chain
6. Riddell S, Goldie S, Hill A, Eagles D, Drew TW. The effect of temperature on persistence of SARS-CoV-2 on common surfaces. Virol J 2020;17:145. PMID:33028356 https://doi.org/10.1186/s12985-020-01418-7
7. Camarota SA. Immigrants in the United States. Washington, DC: Center for Immigration Studies; 2016. https://cis.org/sites/cis.org/files/immigrant-profile.pdf
8. Smart MJ, Klein NJ. A longitudinal analysis of cars, transit, and employment outcomes. San Jose, CA: Mineta Transportation Institute Publications; 2015. https://transweb.sjsu.edu/project/1244.html
9. CDC. Meat and poultry processing workers and employers: interim guidance from CDC and the Occupational Safety and Health Administration (OSHA). Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/coronavirus/2019-ncov/community/organizations/meat-poultry-processing-workers-employers.html
10. Rodriguez-Lainz A, McDonald M, Fonseca-Ford M, et al. Collection of data on race, ethnicity, language, and nativity by US public health surveillance and monitoring systems: gaps and opportunities. Public Health Rep 2018;133:45–54. PMID:29262290 https://doi.org/10.1177/0033354917745503

Update to CDC's Treatment Guidelines for Gonococcal Infection, 2020

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Sexually transmitted infections (STIs) caused by the bacteria *Neisseria gonorrhoeae* (gonococcal infections) have increased 63% since 2014 and are a cause of sequelae including pelvic inflammatory disease, ectopic pregnancy, and infertility and can facilitate transmission of human immunodeficiency virus (HIV) (*1*,*2*). Effective treatment can prevent complications and transmission, but *N. gonorrhoeae's* ability to acquire antimicrobial resistance influences treatment recommendations and complicates control (*3*). In 2010, CDC recommended a single 250 mg intramuscular (IM) dose of ceftriaxone and a single 1 g oral dose of azithromycin for treatment of uncomplicated gonococcal infections of the cervix, urethra, and rectum as a strategy for preventing ceftriaxone resistance and treating possible coinfection with *Chlamydia trachomatis* (*4*). Increasing concern for antimicrobial stewardship and the potential impact of dual therapy on commensal organisms and concurrent pathogens (*3*), in conjunction with the continued low incidence of ceftriaxone resistance and the increased incidence of azithromycin resistance, has led to reevaluation of this recommendation. This report, which updates previous guidelines (*5*), recommends a single 500 mg IM dose of ceftriaxone for treatment of uncomplicated urogenital, anorectal, and pharyngeal gonorrhea. If chlamydial infection has not been excluded, concurrent treatment with doxycycline (100 mg orally twice a day for 7 days) is recommended. Continuing to monitor for emergence of ceftriaxone resistance through surveillance and health care providers' reporting of treatment failures is essential to ensuring continued efficacy of recommended regimens.

Combination therapy, using a highly effective gonococcal therapeutic agent with cotreatment for chlamydia, has been recommended since 1985. In 2007, based on data from CDC's Gonococcal Isolate Surveillance Project* (GISP) indicating widely disseminated quinolone-resistant gonococcal strains in the United States, CDC no longer recommended fluoroquinolones for treatment, leaving cephalosporins as the only remaining recommended antimicrobial class (*6*). Availability of sensitive *C. trachomatis* nucleic acid amplification tests were widespread by 2010, but CDC recommended gonococcal dual therapy with a cephalosporin (ceftriaxone 250 mg IM or cefixime 400 mg orally) and either azithromycin or doxycycline (*4*) to reflect concerns regarding emerging gonococcal resistance. By 2011, the minimum inhibitory concentrations (MICs) of cefixime necessary to inhibit *N. gonorrhoeae* growth in vitro were increasing. In 2012, cefixime was no longer a recommended gonococcal regimen (*7*), with ceftriaxone and azithromycin combination therapy the only recommended regimen for uncomplicated gonorrhea (*5*). Since publication of the 2015 Sexually Transmitted Diseases (STD) Treatment Guidelines, concerns regarding antimicrobial stewardship have increased, especially the impact of antimicrobial use on the microbiome and data indicating azithromycin resistance (elevated MICs) for gonorrhea and other organisms (*1*,*3*). Pharmacokinetic and pharmacodynamic modeling has also affected the understanding of optimal antimicrobial dosing for *N. gonorrhoeae* treatment. This update provides the rationale for the change in gonorrhea treatment recommendations to a higher dose (500 mg) of ceftriaxone and removal of azithromycin from the recommended regimen.

During 2018, CDC staff members and subject matter experts identified essential questions regarding gonorrhea treatment to update the 2015 STD Treatment Guidelines (*5*). A literature search of PubMed, Embase, and Medline databases conducted for January 2013–May 2019 using the parameters (gonorrhea[MeSH]) OR (gonococcal[all fields] OR gonorrhea[all fields] OR "*Neisseria gonorrhoeae*"[all fields]) AND (treatment[MeSH] OR antibiotic[MeSH] OR therapy) generated >2,200 abstracts. Titles and abstracts were assessed, and 248 clinically relevant articles were reviewed. Abstracts from STD conferences held during 2015–2018 and on the National Institutes of Health clinical trials website (https://clinicaltrials.gov) were also reviewed.

GISP susceptibility data from January 2013 to May 2019 were reviewed. GISP monitors gonorrhea antimicrobial susceptibility patterns in the United States through monthly testing of urethral isolates from 25 symptomatic men in each of 25–30 STD specialty care clinics (*1*). Regional laboratories

* 2018 GISP sites: Albuquerque, New Mexico (1987–2018); Anchorage, Alaska (1987–2003, 2018); Atlanta, Georgia (1987–2018); Birmingham, Alabama (1987–2018); Boston, Massachusetts (1987–1992, 2014–2018); Buffalo, New York (2014–2018); Chicago, Illinois (1996–2018); Cleveland, Ohio (1991–2018); Columbus, Ohio (2012–2018); Dallas, Texas (1999–2018); Denver, Colorado (1987–2013, 2018); Greensboro, North Carolina (2002–2018); Honolulu, Hawaii (1987–2018); Indianapolis, Indiana (2013–2018); Jackson, Mississippi (2018); Kansas City, Missouri (1992–2001, 2007–2018); Las Vegas, Nevada (2002–2018); Los Angeles, California (2003–2018); Miami, Florida (1998–2013, 2018); Milwaukee, Wisconsin (2018); Minneapolis, Minnesota (1992–2018); New Orleans, Louisiana (1987–2018); New York, New York (2006–2018); Orange County, California (1991–2018); Phoenix, Arizona (1987–2018); Philadelphia, Pennsylvania (1987–2018); Pontiac, Michigan (2012–2018); Portland, Oregon (1987–2018); San Diego, California (1987–2018); San Francisco, California (1987–2018); Seattle, Washington (1987–2018); Tripler Army Medical Center, Hawaii (2001–2018); and Washington, DC (2018).

conduct antimicrobial susceptibility testing by agar dilution to determine MICs for selected antimicrobials. Although the Clinical and Laboratory Standards Institute (CLSI) has not established *N. gonorrhoeae* resistance breakpoints for ceftriaxone, cefixime, or azithromycin, CLSI categorizes isolates with MICs of ≤0.25 μg/mL as susceptible for ceftriaxone and cefixime, and those with MICs of ≤1.00 μg/mL as susceptible for azithromycin (*8*,*9*). To identify isolates with elevated MICs, GISP uses the following "alert values" to identify potential emerging resistance: MIC ≥0.125 μg/mL for ceftriaxone, ≥0.25 μg/mL for cefixime, and ≥2 μg/mL for azithromycin (*1*).

In 2019, during an in-person meeting of governmental and nongovernmental participants, CDC staff members and subject matter experts reviewed data and presented their individual expert opinions. Each essential question was discussed, and applicable published articles were reviewed for their strengths, weaknesses, and relevance. Individual participants evaluated the quality of evidence, provided their input, and discussed findings in the context of the modified rating system used by the U.S. Preventive Services Task Force.[†] CDC staff members independently reviewed tables of evidence,[§] individual comments from the participants and professional organizations, and existing guidelines from other organizations to determine if revisions to the 2015 CDC STD Treatment Guidelines were warranted.

Evidence and Rationale

Antimicrobial stewardship. The 2019 report on antimicrobial resistance threats in the United States (*3*) highlights that antimicrobial stewardship, i.e., the development, promotion, and implementation of activities to ensure the appropriate use of antimicrobials, remains a major public health concern. Data continue to document the impact of antimicrobials on the microbiome and on pathogenic organisms. A recent investigation comparing children who received twice-yearly azithromycin with children who received placebo found that the gut's resistome, a reservoir of antimicrobial resistance genes in the body, had increased determinants of macrolide and nonmacrolide resistance, including beta-lactam antibiotics, among children receiving azithromycin (*10*). A higher proportion of macrolide resistance in nasopharyngeal *Streptococcus pneumoniae* was demonstrated in communities receiving mass administration of oral azithromycin (*11*). Azithromycin resistance has been demonstrated in another STI, *Mycoplasma genitalium*, and sexually transmissible enteric pathogens (e.g., *Shigella* and *Campylobacter*) (*12*–*14*). In addition, evidence supports increasing concern for the efficacy of azithromycin to treat chlamydial infections, especially rectal infections (*15*,*16*).

[†] https://www.uspreventiveservicestaskforce.org/uspstf/grade-definitions.
[§] https://www.cdc.gov/std/treatment-guidelines/evidence.htm.

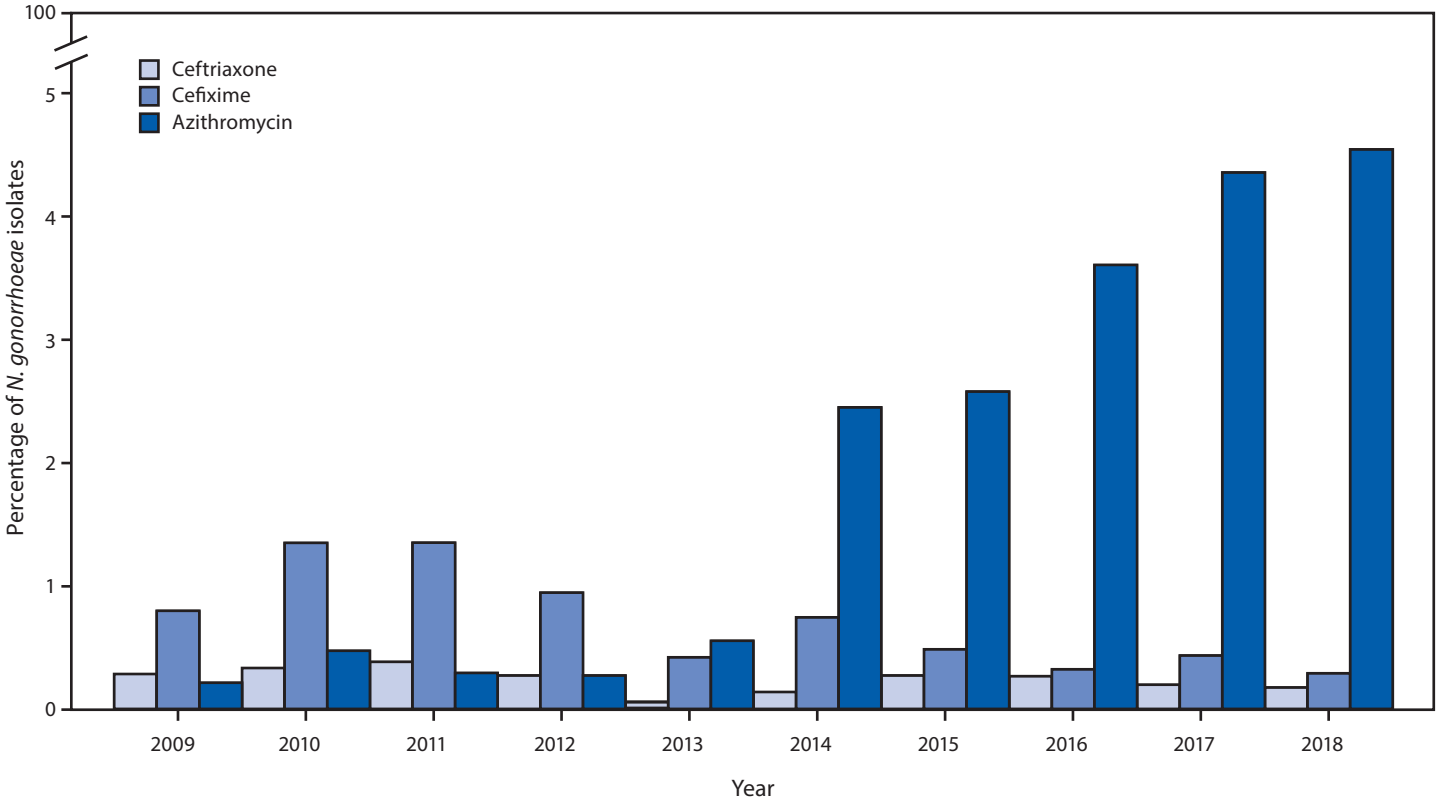
GISP data show that the ceftriaxone MIC50 and MIC90 (MIC required to inhibit growth of 50% and 90% of organisms, respectively) were only one doubling dilution higher during 2014–2018, compared with the respective ceftriaxone MIC50 and MIC90 during 1992–1995 (*1*). Although dual drug therapy with different mechanisms of action (ceftriaxone and azithromycin) might have mitigated emergence of reduced susceptibility to ceftriaxone in *N. gonorrhoeae*, concerns regarding potential harm to the microbiome and the effect on other pathogens diminishes the benefits of maintaining dual therapy as the recommended treatment regimen.

Pharmacokinetic and pharmacodynamic considerations. Ceftriaxone is a bactericidal third-generation cephalosporin with widely variable pharmacokinetics (*17*). Efficacy is best predicted by time that the serum free (i.e., unbound) drug concentration remains higher than the organism's MIC ($fT_{>MIC}$). Although no human data exist confirming the length of time above the MIC required to eradicate gonorrhea at different anatomic sites, using Monte Carlo modeling, ceftriaxone has been estimated to require concentrations higher than the strain MIC for approximately 20–24 hours for effective urogenital gonorrhea treatment (*18*). A 250 mg ceftriaxone dose does not reliably achieve levels higher than an MIC ≥0.125 μg/mL for an extended duration (*18*). A murine model was used to estimate pharmacokinetic and pharmacodynamic parameters needed for cure at urogenital sites for both susceptible and resistant strains of *N. gonorrhoeae* (*19*). Investigators evaluated the efficacy of various ceftriaxone doses (0.06–30 mg/kg body weight). The lowest ceftriaxone dose that was 100% effective at eradicating the susceptible organism (MIC = 0.008 μg/mL) 48 hours after treatment was 5 mg/kg body weight, which corresponded to an $fT_{>MIC}$ of 23.6 hours, consistent with the Monte Carlo simulation (*18*,*19*). Translating into human doses, a 500-mg dose corresponds to 5 mg/kg body weight (80–100 kg) human, whereas 250 mg only corresponds to 3 mg/kg body weight for an 80 kg person.

The pharynx tends to be screened less often (*1*) than other anatomic sites, and globally, most reported ceftriaxone-based regimen treatment failures have involved treatment of pharyngeal gonorrhea (*20*). Ceftriaxone concentrations tend to be more variable in the pharynx, and treatment of *N. gonorrhoeae* likely requires longer times above the strain's MIC (*21*,*22*). Continued uncertainty regarding ceftriaxone pharmacokinetics and pharmacodynamics in treating pharyngeal gonorrhea and the higher likelihood of treatment failures at this site strengthen the recommendation for an increase in the ceftriaxone dosage to 500 mg.

Changes in azithromycin susceptibility. Azithromycin resistance in *N. gonorrhoeae* is an increasing concern. Genomic epidemiology data confirm that azithromycin resistance can result from multiple mechanisms (*23*). Nationally, the

FIGURE. Percentage of *Neisseria gonorrhoeae* isolates with elevated minimum inhibitory concentrations (MICs)* to ceftriaxone, cefixime, and azithromycin — Gonococcal Isolate Surveillance Project, United States, 2009–2018



Source: CDC. Sexually Transmitted Disease Surveillance 2018. https://www.cdc.gov/std/stats18/default.htm.
* Elevated MIC = ceftriaxone ≥0.125 μg/mL; cefixime ≥0.25 μg/mL; azithromycin ≥2.0 μg/mL.

percentage of *N. gonorrhoeae* isolates with reduced susceptibility (MIC ≥2.0 μg/mL) increased more than sevenfold over 5 years (from 0.6% in 2013 to 4.6% in 2018) (Figure) (*1*). During 2018, among men who have sex with men, the proportion of GISP isolates with an azithromycin alert value was 8.6%, compared with 2.9% among men who have sex with women only (*1*). Studies have associated development of reduced azithromycin susceptibility with azithromycin exposure among patients with *N. gonorrhoeae* infection (*24*,*25*).

Recommendations

For treatment of uncomplicated urogenital, rectal, or pharyngeal gonorrhea, CDC recommends a single 500 mg IM dose of ceftriaxone (Box). For persons weighing ≥150 kg (300 lbs), a single 1 g IM dose of ceftriaxone should be administered. If chlamydial infection has not been excluded, doxycycline 100 mg orally twice a day for 7 days is recommended. When ceftriaxone cannot be used for treating urogenital or rectal gonorrhea because of cephalosporin allergy, a single 240 mg IM dose of gentamicin plus a single 2 g oral dose of azithromycin is an option. Gastrointestinal symptoms, primarily vomiting within 1 hour of dosing, have been reported among 3%–4% of treated persons (*26*). If administration of IM ceftriaxone is not available, a single 800 mg oral dose of cefixime is an alternative regimen. However, cefixime does not provide as high, or as sustained, bactericidal blood levels as does ceftriaxone and demonstrates limited treatment efficacy for pharyngeal gonorrhea (*27*,*28*).

In cases where gonococcal expedited partner therapy (provision of prescriptions or medications for the patient to take to a sex partner without the health care provider first examining the partner) is permissible by state law and the partner is unable or unlikely to seek timely treatment, the partner may be treated with a single 800 mg oral dose of cefixime, provided that concurrent chlamydial infection in the patient has been excluded. Otherwise, the partner may be treated with a single oral 800 mg cefixime dose plus oral doxycycline 100 mg twice daily for 7 days.

In cases of suspected cephalosporin treatment failure, clinicians should obtain relevant clinical specimens for culture and antimicrobial susceptibility testing, consult an infectious disease specialist or STD clinical expert (https://www.stdccn.org/)

BOX. CDC recommended regimens for uncomplicated gonococcal infections, 2020

Regimen for uncomplicated gonococcal infections of the cervix, urethra, or rectum:

Ceftriaxone 500 mg IM as a single dose for persons weighing <150 kg (300 lb).

- For persons weighing ≥150 kg (300 lb), 1 g of IM ceftriaxone should be administered.
- If chlamydial infection has not been excluded, providers should treat for chlamydia with doxycycline 100 mg orally twice daily for 7 days. During pregnancy, azithromycin 1 g as a single dose is recommended to treat chlamydia.

Alternative regimens for uncomplicated gonococcal infections of the cervix, urethra, or rectum if ceftriaxone is not available:

Gentamicin 240 mg IM as a single dose plus azithromycin 2 g orally as a single dose OR

Cefixime 800 mg orally as a single dose. If treating with cefixime, and chlamydial infection has not been excluded, providers should treat for chlamydia with doxycycline 100 mg orally twice daily for 7 days. During pregnancy, azithromycin 1 g as a single dose is recommended to treat chlamydia.

Recommended regimen for uncomplicated gonococcal infections of the pharynx:

Ceftriaxone 500 mg IM as a single dose for persons weighing <150 kg (300 lb).

- For persons weighing ≥150 kg (300 lb), 1 g of IM ceftriaxone should be administered.
- If chlamydia coinfection is identified when pharyngeal gonorrhea testing is performed, providers should treat for chlamydia with doxycycline 100 mg orally twice a day for 7 days. During pregnancy, azithromycin 1 g as a single dose is recommended to treat chlamydia.
- No reliable alternative treatments are available for pharyngeal gonorrhea. For persons with a history of a beta-lactam allergy, a thorough assessment of the reaction is recommended.*
- For persons with an anaphylactic or other severe reaction (e.g., Stevens Johnson syndrome) to ceftriaxone, consult an infectious disease specialist for an alternative treatment recommendation.

Abbreviation: IM = intramuscular.

*CDC. Sexually transmitted diseases treatment guidelines. MMWR Recomm Rep 2015;64(No. RR-3). https://www.cdc.gov/mmwr/preview/mmwrhtml/rr6403a1.htm.

Summary

What is already known about this topic?

Neisseria gonorrhoeae is an important cause of sexually transmitted infections that can have severe reproductive health consequences. *N. gonorrhoeae* can rapidly develop antibiotic resistance.

What is added by this report?

Based on review of recent evidence, CDC recommends a single 500 mg intramuscular dose of ceftriaxone for uncomplicated gonorrhea. Treatment for coinfection with *Chlamydia trachomatis* with oral doxycycline (100 mg twice daily for 7 days) should be administered when chlamydial infection has not been excluded.

What are the implications for public health practice?

Continuing to monitor for emergence of ceftriaxone resistance will be essential to ensuring continued efficacy of recommended regimens.

for guidance in clinical management, and report the case to CDC through state and local public health authorities within 24 hours. Health departments should prioritize notification and culture evaluation for the patient's sex partner(s) from the preceding 60 days for those with suspected cephalosporin treatment failure or persons whose gonococcal isolates demonstrate reduced susceptibility to cephalosporins.

A test-of-cure is unnecessary for persons with uncomplicated urogenital or rectal gonorrhea who are treated with any of the recommended or alternative regimens; however, for persons with pharyngeal gonorrhea, a test-of-cure is recommended, using culture or nucleic acid amplification tests 7–14 days after initial treatment, regardless of the treatment regimen. Because reinfection within 12 months ranges from 7% to 12% among persons previously treated for gonorrhea (*29*,*30*), persons who have been treated for gonorrhea should be retested 3 months after treatment regardless of whether they believe their sex partners were treated. If retesting at 3 months is not possible, clinicians should retest within 12 months after initial treatment.

Discussion

Continued support of gonorrhea prevention and control efforts remains fundamental, and preventing antibiotic resistance is crucial. The pharmacokinetics and pharmacodynamics of ceftriaxone indicate that a 500 mg dose in an average-weight U.S. adult achieves sufficiently high serum levels for an adequate duration to eradicate infection, even with wide pharmacokinetic variability. The high frequency of pharyngeal gonorrhea with substantial underscreening and the increased understanding of wide individual pharmacokinetic and pharmacodynamic variability has contributed to the recommendation for the increased ceftriaxone dose. These recommendations also include a test-of-cure for persons with

pharyngeal gonorrhea to ensure eradication or detection of a possible treatment failure.

Emerging antimicrobial resistance affects gonorrhea treatment recommendations and other STIs. CDC recommends ceftriaxone monotherapy for treatment because *N. gonorrhoeae* remains highly susceptible to ceftriaxone, azithromycin resistance is increasing, and prudent use of antimicrobial agents supports limiting their use. Continuing to monitor for emergence of ceftriaxone resistance through surveillance and health care providers' reporting of treatment failures will be essential to ensuring continued efficacy of recommended regimens.

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References

1. CDC. Sexually transmitted disease surveillance 2018. Atlanta, GA: US Department of Health and Human Services, CDC; 2019. https://www.cdc.gov/std/stats18/STDSurveillance2018-full-report.pdf
2. Fleming DT, Wasserheit JN. From epidemiological synergy to public health policy and practice: the contribution of other sexually transmitted diseases to sexual transmission of HIV infection. Sex Transm Infect 1999;75:3–17. PMID:10448335 https://doi.org/10.1136/sti.75.1.3
3. CDC. Antibiotic resistance threats in the United States, 2019. Atlanta, GA: US Department of Health and Human Services, CDC; 2019. https://www.cdc.gov/drugresistance/pdf/threats-report/2019-ar-threats-report-508.pdf
4. Workowski KA, Berman S; CDC. Sexually transmitted diseases treatment guidelines, 2010. MMWR Recomm Rep 2010;59(No. RR-12). PMID:21160459
5. Workowski KA, Bolan GA; CDC. Sexually transmitted diseases treatment guidelines, 2015. MMWR Recomm Rep 2015;64(No. RR-3). PMID:26042815
6. CDC. Update to CDC's sexually transmitted diseases treatment guidelines, 2006: fluoroquinolones no longer recommended for treatment of gonococcal infections. MMWR Morb Mortal Wkly Rep 2007;56:332–6. PMID:17431378
7. CDC. Update to CDC's Sexually transmitted diseases treatment guidelines, 2010: oral cephalosporins no longer a recommended treatment for gonococcal infections. MMWR Morb Mortal Wkly Rep 2012;61:590–4. PMID:22874837
8. Clinical and Laboratory Standards Institute. Performance standards for antimicrobial susceptibility testing. 30th ed. Wayne, PA: Clinical and Laboratory Standards Institute; 2020. https://clsi.org/media/3481/m100ed30_sample.pdf
9. Kersh EN, Allen V, Ransom E, et al. Rationale for a *Neisseria gonorrhoeae* susceptible-only interpretive breakpoint for azithromycin. Clin Infect Dis 2020;70:798–804. PMID:30963175
10. Doan T, Worden L, Hinterwirth A, et al. Macrolide and nonmacrolide resistance with mass azithromycin distribution. N Engl J Med 2020;383:1941–50. PMID:33176084 https://doi.org/10.1056/NEJMoa2002606
11. Doan T, Arzika AM, Hinterwirth A, et al.; MORDOR Study Group. Macrolide resistance in MORDOR I—a cluster-randomized trial in Niger. N Engl J Med 2019;380:2271–3. PMID:31167060 https://doi.org/10.1056/NEJMc1901535
12. Bachmann LH, Kirkcaldy RD, Geisler WM, et al. Prevalence of *Mycoplasma genitalium* infection, antimicrobial resistance mutations and symptom resolution following treatment of urethritis. Clin Infect Dis 2020;ciaa293. Epub March 18, 2020.
13. Yousfi K, Gaudreau C, Pilon PA, et al. Genetic mechanisms behind the spread of reduced susceptibility to azithromycin in *Shigella* strains isolated from men who have sex with men in Québec, Canada. Antimicrob Agents Chemother 2019;63:e01679–18. PMID:30455248
14. Gaudreau C, Pilon PA, Sylvestre JL, Boucher F, Bekal S. Multidrug-resistant *Campylobacter coli* in men who have sex with men, Quebec, Canada, 2015. Emerg Infect Dis 2016;22:1661–3. PMID:27533504 https://doi.org/10.3201/eid2209.151695
15. Kong FY, Tabrizi SN, Law M, et al. Azithromycin versus doxycycline for the treatment of genital chlamydia infection: a meta-analysis of randomized controlled trials. Clin Infect Dis 2014;59:193–205. PMID:24729507 https://doi.org/10.1093/cid/ciu220
16. Dombrowski JC, Wierzbicki MR, Newman L, et al. A randomized trial of azithromycin vs. doxycycline for the treatment of rectal chlamydia in men who have sex with men. Presented at the National STD Prevention Conference, Atlanta, GA: September 14–24, 2020.
17. Perry TR, Schentag JJ. Clinical use of ceftriaxone: a pharmacokinetic-pharmacodynamic perspective on the impact of minimum inhibitory concentration and serum protein binding. Clin Pharmacokinet 2001;40:685–94. PMID:11605716 https://doi.org/10.2165/00003088-200140090-00004
18. Chisholm SA, Mouton JW, Lewis DA, Nichols T, Ison CA, Livermore DM. Cephalosporin MIC creep among gonococci: time for a pharmacodynamic rethink? J Antimicrob Chemother 2010;65:2141–8. PMID:20693173 https://doi.org/10.1093/jac/dkq289

19. Connolly KL, Eakin AE, Gomez C, Osborn BL, Unemo M, Jerse AE. Pharmacokinetic data are predictive of in vivo efficacy for cefixime and ceftriaxone against susceptible and resistant *Neisseria gonorrhoeae* strains in the gonorrhea mouse model. Antimicrob Agents Chemother 2019;63:e01644–18. PMID:30642924 https://doi.org/10.1128/AAC.01644-18
20. Unemo M, Golparian D, Eyre DW. Antimicrobial resistance in *Neisseria gonorrhoeae* and treatment of gonorrhea. Methods Mol Biol 2019;1997:37–58. PMID:31119616 https://doi.org/10.1007/978-1-4939-9496-0_3
21. Blumer JL, Reed MD, Kaplan EL, Drusano GL. Explaining the poor bacteriologic eradication rate of single-dose ceftriaxone in group a streptococcal tonsillopharyngitis: a reverse engineering solution using pharmacodynamic modeling. Pediatrics 2005;116:927–32. PMID:16199703 https://doi.org/10.1542/peds.2004-2294
22. Moran JS, Levine WC. Drugs of choice for the treatment of uncomplicated gonococcal infections. Clin Infect Dis 1995;20(Suppl 1):S47–65. PMID:7795109 https://doi.org/10.1093/clinids/20.Supplement_1.S47
23. Grad YH, Harris SR, Kirkcaldy RD, et al. Genomic epidemiology of gonococcal resistance to extended-spectrum cephalosporins, macrolides, and fluoroquinolones in the United States, 2000–2013. J Infect Dis 2016;214:1579–87. PMID:27638945 https://doi.org/10.1093/infdis/jiw420
24. Wind CM, de Vries E, Schim van der Loeff MF, et al. Decreased azithromycin susceptibility of *Neisseria gonorrhoeae* isolates in patients recently treated with azithromycin. Clin Infect Dis 2017;65:37–45. PMID:28510723 https://doi.org/10.1093/cid/cix249
25. Gernert KM, Seby S, Schmerer MW, et al.; Antimicrobial-Resistant *Neisseria gonorrhoeae* Working Rroup. Azithromycin susceptibility of *Neisseria gonorrhoeae* in the USA in 2017: a genomic analysis of surveillance data. Lancet Microbe 2020;1:e154–64. PMID:33005903 https://doi.org/10.1016/S2666-5247(20)30059-8
26. Kirkcaldy RD, Weinstock HS, Moore PC, et al. The efficacy and safety of gentamicin plus azithromycin and gemifloxacin plus azithromycin as treatment of uncomplicated gonorrhea. Clin Infect Dis 2014;59:1083–91. PMID:25031289 https://doi.org/10.1093/cid/ciu521
27. Moran JS. Treating uncomplicated *Neisseria gonorrhoeae* infections: is the anatomic site of infection important? Sex Transm Dis 1995;22:39–47. PMID:7709324 https://doi.org/10.1097/00007435-199501000-00007
28. Gratrix J, Bergman J, Egan C, Drews SJ, Read R, Singh AE. Retrospective review of pharyngeal gonorrhea treatment failures in Alberta, Canada. Sex Transm Dis 2013;40:877–9. PMID:24113412 https://doi.org/10.1097/OLQ.0000000000000033
29. Fung M, Scott KC, Kent CK, Klausner JD. Chlamydial and gonococcal reinfection among men: a systematic review of data to evaluate the need for retesting. Sex Transm Infect 2007;83:304–9. PMID:17166889 https://doi.org/10.1136/sti.2006.024059
30. Hosenfeld CB, Workowski KA, Berman S, et al. Repeat infection with Chlamydia and gonorrhea among females: a systematic review of the literature. Sex Transm Dis 2009;36:478–89. PMID:19617871 https://doi.org/10.1097/OLQ.0b013e3181a2a933

Estimated Resource Costs for Implementation of CDC's Recommended COVID-19 Mitigation Strategies in Pre-Kindergarten through Grade 12 Public Schools — United States, 2020–21 School Year

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As school districts across the United States consider how to safely operate during the 2020–21 academic year, CDC recommends mitigation strategies that schools can adopt to reduce the risk for transmission of SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19) (*1*). To identify the resources and costs needed to implement school-based mitigation strategies and provide schools and jurisdictions with information to aid resource allocation, a microcosting methodology was employed to estimate costs in three categories: materials and consumables, additional custodial staff members, and potential additional transportation. National average estimates, using the national pre-kindergarten through grade 12 (preK–12) public enrollment of 50,685,567 students, range between a mean of $55 (materials and consumables only) to $442 (all three categories) per student. State-by-state estimates of additional funds needed as a percentage of fiscal year 2018 student expenditures (*2*) range from an additional 0.3% (materials and consumables only) to 7.1% (all three categories); however, only seven states had a maximum estimate above 4.2%. These estimates, although not exhaustive, highlight the level of resources needed to ensure that schools reopen and remain open in the safest possible manner and offer administrators at schools and school districts and other decision-makers the cost information necessary to budget and prioritize school resources during the COVID-19 pandemic.

Approximately 50 million students are enrolled in public elementary and secondary schools in the United States (*3*); since March 2020, approximately 270,000 cases of COVID-19 have been reported among school-aged children (aged 5–17 years) (*4*). Although current evidence indicates that the risk for SARS-CoV-2–related hospitalizations and deaths among children is lower than that among adults, the risk for morbidity and mortality posed to teachers and other staff members in the school environment is expected to mirror that of other adults with similar demographic characteristics in the community (*5*). As school districts across the United States consider how to safely operate schools for the 2020–21 academic year, CDC provides indicators to help local jurisdictions determine the risk associated with operating schools for in-person learning. These indicators include measures of underlying community transmission and a measure of adherence to five primary mitigation strategies (*1*): 1) consistent and correct use of masks, 2) social distancing to the extent possible, 3) hand hygiene and respiratory etiquette, 4) cleaning and disinfection, and 5) contact tracing in collaboration with the local health department. Other mitigation strategies that can also be used concurrently include cohorting and staggered scheduling (*1*). In this analysis, the resources needed to implement four of the five key mitigation strategies were identified and costs estimated, with the goal of providing estimates to aid resource allocation to ensure the safe operation of schools and reduce school-based transmission of SARS-CoV-2. Contact tracing, although an essential strategy to reduce transmission, was excluded because those costs are not financed by school district budgets.

A microcosting approach (*6*) was used to estimate resources and costs associated with implementing the critical CDC-recommended mitigation strategies. This approach involves collecting detailed data on resources needed for each strategy and applying unit costs for those resources. From a school budget perspective, resources needed to implement the four strategies are identified (Supplementary Table, https://stacks.cdc.gov/view/cdc/97907), and total costs associated with each resource are estimated. Direct budgetary costs are the focus of this analysis; opportunity costs are excluded. The estimates indicate resources needed in addition to those already allocated in annual school budgets. Costs were aggregated and analyzed nationally and for each state and the District of Columbia (DC). A range is provided for each cost to indicate levels of cost variation around each estimate.

Personnel costs for school custodians were estimated using data from the Bureau of Labor Statistics.* To account for fringe benefits, annual wages were increased by the state and local government average of 37.8%.† Labor demand for school custodians was derived from a study of national standards for allocating school custodians that increases the recommended

* The Bureau of Labor Statistics (BLS) provides national and state occupational employment and wage estimates each May (in the given year); the latest published estimates are provided for May 2019. https://www.bls.gov/oes/current/oessrcst.htm.

† Employer Costs for Employee Compensation reports are provided by BLS and provide benefit rates by industry type. https://www.bls.gov/bls/news-release/ecec.htm#2019.

number of custodians from a tier 3 level of cleaning (one custodian per 28,000–31,000 ft^2) to a tier 2 level of cleaning (one custodian per 18,000–20,000 ft^2) (*7*). The American Federation of Teachers estimates that tier 2 cleaning is needed for an estimated 10% of targeted physical areas per school (i.e., bathrooms, food service areas, and high-need classrooms, including special needs classes) (*8*). To allow for variation in school size, ranges of estimates for additional custodial services were estimated. The low estimate used an additional 1.25 full time equivalents (FTEs), and the high estimate used 2.5 FTEs (Supplementary Table, https://stacks.cdc.gov/view/cdc/97907) (*7*). Costs are inflated and reported in 2020 U.S. dollars.[§] Potential additional transportation costs were extrapolated from a report by the American Federation of Teachers that forecasts an estimated 36% national increase in funding needed for school transportation (*7*). These potential costs assume that some schools would require additional buses, drivers, and protocols to implement social distancing on buses. The 36% national increase was distributed across states and adjusted by states' past year transportation spending per student (*8*). Ranges for nonlabor costs for all materials and consumables were obtained from the U.S. General Services Administration (GSA) Supply Catalog 2020, GSA Advantage Disaster Relief and Pandemic Products online catalog, and through various e-commerce marketplace websites to derive a range of cost estimates across multiple sources and reflect price variability for materials across vendors.[¶] Aggregated material costs were adjusted for each state using the 2020 state-based composite cost of living index.[**] Average costs per student were calculated using the national preK–12 public student enrollment of 50,685,567 students (*3*). State-based cost estimates were adjusted based on the number of schools and the total school population within each state. Estimated pandemic-related per-student costs were calculated as a percentage of fiscal year 2018 per-student expenditures as reported by the National Center for Education Statistics (*2*).

National costs per student range between a mean of $55 (materials and consumables only) to $442 (three categories) (Table 1). The highest cost categories were related to employing additional custodians per school (44.8% of total costs) and potential additional transportation (42.8% of total cost). For state-based estimates, the incremental increase in costs per student for materials and consumables ranges from $47 to $109 per student; implementation of all strategies combined (including high and low projections for additional custodial staff members) range between $204 (Utah) and $912 (DC) (Table 2). Utah's and DC's average total costs are lower and higher, respectively, than the national range (Table 1) because of their lower and higher transportation costs per pupil, relative to other states. All other state estimates fall within the national range. Additional funds needed as a percentage of fiscal year 2018 per-student expenditures range from 0.3% (materials and consumables only) to 7.1% (all three categories), although only seven states had a maximum estimate >4.2% (Table 2).

Discussion

Successfully operating schools during the COVID-19 pandemic requires sufficient resources to implement and sustain effective mitigation strategies. This cost estimate for the resources needed to safely reopen and keep schools open for in-person learning found that the average school district will need to invest $55 per student for materials and consumables only. This cost increases to a maximum average of $442 per student if a school district needs or chooses to employ the maximum number of additional custodial staff members per school and add additional transportation. Costs might be lower, depending on the extent of the learning model as schools transition from virtual to hybrid or in-person learning. These estimates provide schools, districts, and other jurisdictions with the cost information necessary to budget and prioritize resources during the COVID-19 pandemic.

The findings in this report are subject to at least four limitations. First, costs related to food service operations were not included. Although some schools might incur additional costs to provide student meals, estimates might significantly vary given differences in the need for school meal programs across districts. Second, a 1-month supply of face masks for the school population was estimated and was not included as an ongoing cost for schools, based on the assumption that teachers and staff members would purchase their own masks, and schools would add masks to the student supply list. Third, costs related to social distancing within the classroom were not estimated because other resources for schools recommended by CDC (e.g., physical barriers in the classroom, such as individual student desk shields) (*9*) were included in the estimates. Resource needs and costs for social distancing will vary with individual school needs. Finally, although contact tracing is a primary mitigation strategy, costs for contact tracing were excluded because school districts do not bear the financial responsibility for hiring and employing contact tracers.

[§] Consumer Price Index databases are provided annually by BLS. https://www.bls.gov/cpi/data.htm.

[¶] Nonlabor material sources retrieved from U.S. General Services Administration (GSA) Global Supply Catalog 2020 (https://www.gsaglobalsupply.gsa.gov/advantage/); GSA Advantage (https://www.gsaadvantage.gov/advantage) Disaster Relief and Pandemic Products Supply; School Kids Healthcare (https://www.buyemp.com/school-kids-healthcare-transition), School Health (https://www.schoolhealth.com), School Nurse Supply (https://www.schoolnursesupplyinc.com), and Amazon Marketplace (https://www.amazon.com/s?k=coronavirus).

[**] The Missouri Economic Research and Information Center Cost of Living Data Series provides state level cost of living indices for 2020. https://meric.mo.gov/data/cost-living-data-series.

TABLE 1. Estimated national costs for selected resources needed for school-based implementation of CDC's recommended COVID-19 mitigation strategies — United States, 2020–21 school year

Cost item	Unit cost, USD*	No. of units†	Total cost, USD	Unit cost range, USD*	Total cost range, USD
Materials and consumables					
Plexiglass shield (1 per school)	74.99	98,456	7,383,215	49.50–147.75	4,873,572–19,272,762
Student desk shields (1 per student)	37.20	50,685,567	1,885,503,092	14.99–75.95	759,776,649–3,849,568,814
Reusable face shield (1 per teacher and other staff member)	4.88	6,382,813	31,148,128	1.93–17.40	12,318,829–111,060,947
Disposable face masks (1-month supply per student, teacher, and staff member)	0.31	1,141,367,601	353,823,956	0.10–1.50	114,136,760–1,712,051,402
Disposable gloves (2 pair per teacher and other staff member)	0.18	12,765,626	2,297,813	0.17–0.25	2,170,156–3,191,407
Hand sanitizer dispenser (4 units per school)	109.89	393,824	43,277,319	81.67–137.36	32,163,606–54,095,665
Hand sanitizer dispenser refills (1 refill per month per unit per school)	2.07	3,938,240	8,163,972	1.55–2.58	6,104,272–10,160,659
Hand sanitizer (1 bottle per student)	4.89	50,685,567	247,852,423	3.67–6.11	186,016,031–309,688,814
Multipurpose cleaners (180-day supply per school)	4.48	17,722,080	79,394,918	3.36–5.60	59,546,189–99,243,648
Disinfectants/Virucides (180-day supply per school)	4.99	17,722,080	88,344,569	3.74–6.24	66,280,579–110,585,779
No touch thermometer (2 per school)	59.00	196,912	11,617,808	25.99–75.99	5,117,743–14,963,343
Oximeter (2 per school)	84.99	196,912	16,735,551	15.95–199.99	3,140,746–39,380,431
Signage (1 kit of 100 hallway floor signs and 30 hallway directional arrows per school)	268.44	98,456	26,429,529	178.96–357.92	18,604,246–35,239,372
Total materials and consumables§	—	—	**2,801,972,293**	—	**1,075,901,224–12,584,162,010**
Personnel¶					
Custodian FTEs (high estimate)**	40,837	246,140	10,051,712,049	31,314–51,953	7,707,613,702–12,699,213,527
Custodian FTEs (low estimate) **	40,837	123,070	5,025,824,797	31,314–51,953	3,853,806,851–6,349,606,764
Potential additional transportation††	—	—	**9,600,000,000**	—	**8,131,200,000–18,969,600,000**
Cost per student§§					
Average materials and consumables cost per student	—	—	55	—	21–248
Average personnel cost per student (high)	—	—	198	—	152–251
Average personnel cost per student (low)	—	—	99	—	76–125
Average potential transportation cost per student§§	—	—	189	—	160–374

Abbreviations: COVID-19 = coronavirus disease 2019; FTEs = full-time equivalents; USD = U.S. dollars.

* Unit cost is the average cost per resource and the unit cost range are minimum and maximum cost values per resource derived from all material sources, retrieved from U.S. General Services Administration (GSA) Global Supply Catalog (https://www.gsaglobalsupply.gsa.gov/advantage/), GSA Advantage Disaster (https://www.gsaadvantage.gov/advantage/) Disaster Relief and Pandemic Products Supply; School Kids Healthcare (https://www.buyemp.com/school-kids-healthcare-transition), School Health (https://www.schoolhealth.com), School Nurse Supply (https://www.schoolnursesupplyinc.com), and Amazon Marketplace (https://www.amazon.com/s?k=coronavirus).

† Quantity of units for schools and school populations derived from school population fiscal year 2018 data published by the National Center for Education Statistics. https://nces.ed.gov/.

§ Cost range for materials and consumables adjusted by lowest and highest state composite cost of living index. https://meric.mo.gov/data/cost-living-data-series.

¶ Cost for personnel derived from the Bureau of Labor Statistics wage estimates (updated as of May 2019) and are inflation-adjusted to August 2020 USD using the Consumer Price Index (CPI) Databases (https://www.bls.gov/cpi/data.htm); all other costs reported in current 2020 USD.

** The high and low estimates for school custodians are 2.5 and 1.25 additional custodian FTEs per school for tier 2 cleaning needed for an estimated 10% of targeted physical areas per school (i.e., bathrooms, food service areas, and high need classrooms, including special needs classes) https://nces.ed.gov/pubs2003/2003347.pdf; https://www.aft.org/sites/default/files/wysiwyg/reopen-schools-financial-implications.pdf.

†† Costs of potential additional transportation, where needed, were estimated assuming that such costs are equivalent to 36% of national costs for student transportation. https://www.aft.org/sites/default/files/wysiwyg/reopen-schools-financial-implications.pdf.

§§ Based on national pre-kindergarten–grade 12 public student enrollment of 50,685,567 students. https://nces.ed.gov/.

Summary

What is already known about this topic?

CDC recommends mitigation strategies that schools can adopt to minimize the risk for transmission of SARS-CoV-2 in school settings.

What is added by this report?

Costs per student for implementation of strategies range from a mean of $55 (materials and consumables only) to $442 (materials and consumables, additional custodial staff members, and potential additional transportation). Incremental costs across states range from an additional 0.3% to 7.1% in costs needed above reported fiscal year 2018 school expenditures per student.

What are the implications for public health practice?

These findings offer schools, school districts, and other decision makers cost information necessary to budget and prioritize school resources during the COVID-19 pandemic.

The benefits of schools extend beyond academic achievements and have critical implications for student health, safety, social and emotional well-being, and the economy, because in-person learning allows parents and caretakers to return to work (*9*). Although the list of resources identified in this analysis is not exhaustive, the cost estimates illustrate the level of resources needed to help ensure that schools both reopen and operate in the safest possible manner. In addition, this report provides cost data that can be used as a baseline for future studies examining the cost-effectiveness of mitigation strategies in school settings and those comparing costs and benefits across multiple sectors of the economy.

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TABLE 2. Estimated costs for selected resources needed for school-based implementation of CDC's recommended COVID-19 mitigation strategies, by state — United States, 2020–21 school year

State	No. of schools*	No. of teachers/ staff members*	Total student enrollment*	Cost, USD: Materials/ Consumables	Custodian FTEs (low est.)†	Custodian FTEs (high est.)†	Potential additional transportation§	Avg. total cost per student, range¶	Avg. cost per student (materials/ consumables only)	FY18* expenditures per student	Pandemic costs, % increase,** range
Alabama	1,509	71,628	742,444	36,773,905	63,369,776	126,739,552	136,505,880	319–404	50	9,717	0.5–4.2
Alaska	508	16,982	132,872	9,431,191	30,381,042	60,762,083	29,442,960	521–750	71	17,726	0.4–4.2
Arizona	2,284	103,175	1,110,851	61,469,251	111,849,022	223,698,043	136,946,520	279–380	55	8,373	0.7–4.5
Arkansas	1,088	73,658	496,085	24,187,597	46,814,518	93,629,037	68,657,040	282–376	49	10,168	0.5–3.7
California	10,303	577,836	6,304,266	497,309,250	618,835,013	1,237,670,026	638,704,080	278–377	79	12,664	0.6–3.0
Colorado	1,862	111,939	910,280	51,930,527	95,898,121	191,796,241	99,713,880	272–377	57	10,238	0.6–3.7
Connecticut	1,369	98,166	531,288	36,477,044	84,231,421	168,462,843	189,668,880	584–743	69	20,147	0.3–3.7
Delaware	223	17,098	136,293	8,114,416	11,223,913	22,447,827	37,752,480	419–501	60	15,282	0.4–3.3
District of Columbia	228	14,106	87,315	7,756,625	13,773,041	27,546,082	44,319,600	754–912	89	23,155	0.4–3.9
Florida	4,322	345,644	2,832,424	155,323,788	197,729,771	395,459,542	381,070,800	259–329	55	9,663	0.6–3.4
Georgia	2,297	224,488	1,768,642	87,993,477	97,806,719	195,613,439	323,339,040	288–343	50	10,760	0.5–3.2
Hawaii	290	22,596	180,837	19,753,419	16,819,007	33,638,014	23,746,680	334–427	109	15,242	0.7–2.8
Idaho	744	27,186	301,186	15,700,537	33,499,456	66,998,911	38,018,160	290–401	52	7,846	0.7–5.1
Illinois	4,175	260,463	2,005,153	99,427,837	221,424,361	442,848,721	506,354,760	413–523	50	15,912	0.3–3.3
Indiana	1,921	152,826	1,054,187	52,156,534	$92,649,830	185,299,660	234,095,040	359–447	49	10,033	0.5–4.5
Iowa	1,349	72,886	511,850	25,861,692	67,664,761	135,329,522	77,619,960	334–467	51	11,724	0.4–4.0
Kansas	1,320	73,271	497,088	23,769,356	61,662,744	123,325,488	81,582,480	336–460	48	11,095	0.4–4.1
Kentucky	1,541	97,712	680,978	35,461,085	71,535,339	143,070,678	148,091,760	375–480	52	11,081	0.5–4.3
Louisiana	1,390	107,600	715,135	36,963,040	54,206,386	108,412,772	170,258,760	366–441	52	11,636	0.4–3.8
Maine	611	35,241	180,473	11,492,983	33,131,047	66,262,095	48,734,640	517–701	64	15,069	0.4–4.7
Maryland	1,437	115,516	893,684	63,235,650	72,450,055	144,900,111	255,236,040	437–518	71	15,155	0.5–3.4
Massachusetts	1,862	128,291	964,791	69,173,739	118,317,113	236,634,225	282,796,200	487–610	72	18,328	0.4–3.3
Michigan	3,468	181,468	1,516,398	75,527,660	169,352,411	338,704,821	270,858,960	340–452	50	11,688	0.4–3.9
Minnesota	2,478	117,236	884,944	49,506,741	140,130,095	280,260,189	237,747,960	483–641	56	12,910	0.4–5.0
Mississippi	1,076	67,757	478,321	22,396,022	41,497,850	82,995,700	75,434,040	291–378	47	8,909	0.5–4.2
Missouri	2,424	128,938	915,472	44,686,239	117,494,068	234,988,135	191,587,680	386–515	49	11,034	0.4–4.7
Montana	823	21,329	149,474	8,940,482	41,734,659	83,469,318	29,641,320	537–817	60	11,512	0.5–7.1
Nebraska	1,085	47,292	323,766	16,609,144	53,805,991	107,611,982	43,724,880	353–519	51	12,813	0.4–4.0
Nevada	662	26,430	485,785	29,217,364	36,329,799	72,659,597	61,859,880	262–337	60	9,040	0.7–3.7
New Hampshire	490	31,981	179,433	10,712,581	25,540,197	51,080,393	48,024,360	470–612	60	16,588	0.4–3.7
New Jersey	2,588	236,559	1,408,102	95,276,011	145,057,788	290,115,576	434,831,040	479–583	68	20,316	0.3–2.9
New Mexico	884	37,573	334,345	16,116,820	38,021,569	76,043,139	38,696,040	278–391	48	9,963	0.5–3.9
New York	4,824	372,692	2,724,663	234,815,599	302,459,976	604,919,952	1,042,712,640	580–691	86	23,686	0.4–2.9
North Carolina	2,603	190,855	1,553,513	82,013,680	111,732,994	223,465,988	218,620,080	265–337	53	9,277	0.6–3.6
North Dakota	518	17,984	111,920	5,970,395	28,284,484	56,568,967	22,965,480	511–764	53	13,783	0.4–5.5
Ohio	3,619	322,611	1,704,399	86,775,862	179,032,654	358,065,308	381,186,000	380–485	51	12,893	0.4–3.8
Oklahoma	1,800	85,914	695,092	33,314,203	76,148,280	152,296,560	64,328,040	250–360	48	8,174	0.6–4.4
Oregon	1,242	65,928	608,014	45,139,592	67,047,072	134,094,145	112,797,000	370–480	74	11,903	0.6–4.0
Pennsylvania	3,019	241,548	1,726,809	98,512,658	154,654,766	309,309,532	486,006,840	428–518	57	16,377	0.3–3.2
Rhode Island	313	19,482	142,949	9,372,034	16,918,292	33,836,583	38,119,680	451–569	66	16,954	0.4–3.4
South Carolina	1,248	78,108	777,507	41,046,461	51,721,301	103,442,602	116,117,640	269–335	53	10,705	0.5–3.1
South Dakota	698	19,543	137,823	7,595,999	32,185,705	64,371,410	18,681,120	424–658	55	10,263	0.5–6.4
Tennessee	1,859	128,469	1,001,967	49,849,862	79,092,549	158,185,099	130,509,000	259–338	50	9,599	0.5–3.5
Texas	8,826	690,078	5,401,341	273,803,482	391,623,742	783,247,483	564,675,120	228–300	51	9,670	0.5–3.1
Utah	1,033	56,146	668,274	35,796,979	45,622,342	91,244,683	54,689,400	204–272	54	7,576	0.7–3.6
Vermont	314	18,183	88,028	5,678,841	17,751,189	35,502,379	21,240,720	507–709	65	20,149	0.3–3.5
Virginia	2,133	178,550	1,291,462	72,391,508	99,604,648	199,209,295	297,275,760	363–440	56	12,224	0.5–3.6
Washington	2,427	94,882	1,110,367	68,869,580	153,215,600	306,431,200	205,493,040	385–523	62	12,985	0.5–4.0
West Virginia	744	38,452	272,266	13,906,999	34,614,395	69,228,791	86,911,560	497–625	51	11,572	0.4–5.4
Wisconsin	2,255	101,250	860,753	45,536,382	112,992,469	225,984,938	162,415,440	373–504	53	12,446	0.4–4.1
Wyoming	370	17,268	94,258	4,924,000	19,483,025	38,966,051	26,206,560	537–744	52	16,134	0.3–4.6
Total costs††	—	—	—	**3,014,066,119**	**4,998,422,363**	**9,996,844,725**	**9,436,012,920**	—	—	—	—

Abbreviations: avg. = average; COVID-19 = coronavirus disease 2019; est. = estimate; FTEs = full-time equivalents; FY = fiscal year; USD = U.S. dollars.

* Number of schools, number of teachers and staff members, total student enrollment, and FY18 expenditures per student derived from school population FY18 data published by the National Center for Education Statistics. https://nces.ed.gov/.

† The high and low estimates for school custodians are 2.5 and 1.25 additional custodian FTEs per school for tier 2 cleaning needed for an estimated 10% of targeted physical areas per school (i.e., bathrooms, food service areas, and high-need classrooms, including special needs classes). https://nces.ed.gov/pubs2003/2003347.pdf; https://www.aft.org/sites/default/files/wysiwyg/reopen-schools-financial-implications.pdf.

§ Costs of potential additional transportation, where needed, were estimated assuming that such costs are equivalent to a 36% increase of FY18 state expenditures for student transportation. https://www.aft.org/sites/default/files/wysiwyg/reopen-schools-financial-implications.pdf.

¶ Low percentage cost calculated using only the average cost per student for materials and consumables. High percentage cost calculated using high average total cost per student, which includes all three cost categories (Materials and Consumables, Custodian FTEs [high est.], and Potential additional transportation).

** Percentage increase in expenditure per student above FY18 levels.

†† Total costs for each category of state estimates fall within the national range of estimates per category. The national range uses a range of prices nationwide for that item, multiplied by the number of units nationally, adjusted by the highest and lowest nationwide cost of living index. The state estimates are specific to each state's school population and are estimated using a combination of past year transportation expenditures, the average wage for custodians, and average price of materials in that state, with adjustments for the state-specific cost of living index.

References

1. CDC. Coronavirus disease 2019 (COVID-19) indicators for dynamic school decision-making. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/coronavirus/2019-ncov/community/schools-childcare/indicators.html
2. National Center for Education Statistics. Revenues and expenditures for public elementary and secondary school districts: FY 18. Washington, DC: US Department of Education, National Center for Education Statistics; 2020. https://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2020308
3. Hussar B, Zhang J, Hein S, et al. The condition of education 2020. NCES 2020–144. Washington, DC: U.S. Department of Education, National Center for Education Statistics; 2020. https://nces.ed.gov/pubs2020/2020144.pdf
4. Leeb RT, Price S, Sliwa S, et al. COVID-19 trends among school-aged children—United States, March 1–September 19, 2020. MMWR Morb Mortal Wkly Rep 2020;69:1410–5. PMID:33001869 https://doi.org/10.15585/mmwr.mm6939e2
5. Selden TM, Berdahl TA, Fang Z. The risk of severe COVID-19 within households of school employees and school-age children. Health Aff (Millwood) 2020;39:2002–9. PMID:32941086 https://doi.org/10.1377/hlthaff.2020.01536
6. Xu X, Grossetta Nardini HK, Ruger JP. Micro-costing studies in the health and medical literature: protocol for a systematic review. Syst Rev 2014;3:47. PMID:24887208 https://doi.org/10.1186/2046-4053-3-47
7. National Forum on Education Statistics. Planning guide for maintaining school facilities. NCES 2003–347. Washington, DC: US Department of Education, National Center for Education Statistics, National Forum on Education Statistics; 2003. https://nces.ed.gov/pubs2003/2003347.pdf
8. American Federation of Teachers. Reopening schools during a time of triple crisis: financial implications. Washington, DC: American Federation of Teachers; 2020. https://www.aft.org/sites/default/files/wysiwyg/reopen-schools-financial-implications.pdf
9. CDC. Coronavirus disease 2019 (COVID-19). Operating schools during COVID-19: CDC's considerations. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/coronavirus/2019-ncov/community/schools-childcare/schools.html

The Advisory Committee on Immunization Practices' Interim Recommendation for Use of Pfizer-BioNTech COVID-19 Vaccine — United States, December 2020

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On December 11, 2020, the Food and Drug Administration (FDA) issued an Emergency Use Authorization (EUA) for the Pfizer-BioNTech COVID-19 (BNT162b2) vaccine (Pfizer, Inc; Philadelphia, Pennsylvania), a lipid nanoparticle-formulated, nucleoside-modified mRNA vaccine encoding the prefusion spike glycoprotein of SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19) (*1*). Vaccination with the Pfizer-BioNTech COVID-19 vaccine consists of 2 doses (30 μg, 0.3 mL each) administered intramuscularly, 3 weeks apart. On December 12, 2020, the Advisory Committee on Immunization Practices (ACIP) issued an interim recommendation* for use of the Pfizer-BioNTech COVID-19 vaccine in persons aged ≥16 years for the prevention of COVID-19. To guide its deliberations regarding the vaccine, ACIP employed the Evidence to Recommendation (EtR) Framework,† using the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) approach.§ The recommendation for the Pfizer-BioNTech COVID-19 vaccine should be implemented in conjunction with ACIP's interim recommendation for allocating initial supplies of COVID-19 vaccines (*2*). The ACIP recommendation for the use of the Pfizer-BioNTech COVID-19 vaccine under EUA is interim and will be updated as additional information becomes available.

Since June 2020, ACIP has convened nine public meetings to review data on the epidemiology of COVID-19 and the potential use of COVID-19 vaccines, including the Pfizer-BioNTech COVID-19 vaccine (*3*). Within the EtR Framework, ACIP considered the importance of the public health problem of COVID-19, as well as issues of resource use, benefits and harms, patients' values and preferences, acceptability, feasibility, and equity for the Pfizer-BioNTech COVID-19 vaccine. To inform the EtR Framework, the COVID-19 Vaccines Work Group, comprising experts in infectious disease, vaccinology, vaccine safety, public health, and ethics, held 27 meetings to review COVID-19 surveillance data, evidence for vaccine efficacy and safety, and implementation considerations for COVID-19 vaccines, including the Pfizer-BioNTech COVID-19 vaccine. After a systematic review of the literature, the Work Group used the GRADE approach to assess the certainty of evidence for outcomes related to the vaccine, rated on a scale of 1 (high certainty) to 4 (very low certainty) (*4*). Work Group conclusions regarding the evidence for the Pfizer-BioNTech COVID-19 vaccine were presented to ACIP at public meetings.

The body of evidence for the Pfizer-BioNTech COVID-19 vaccine was primarily informed by one large, randomized, double-blind, placebo-controlled Phase II/III clinical trial that enrolled >43,000 participants (median age = 52 years, range = 16–91 years) (*5*,*6*). Interim findings from this clinical trial, using data from participants with a median of 2 months of follow-up, indicate that the Pfizer-BioNTech COVID-19 vaccine was 95.0% effective (95% confidence interval = 90.3%–97.6%) in preventing symptomatic laboratory-confirmed COVID-19 in persons without evidence of previous SARS-CoV-2 infection. Consistent high efficacy (≥92%) was observed across age, sex, race, and ethnicity categories and among persons with underlying medical conditions as well as among participants with evidence of previous SARS-CoV-2 infection. Although numbers of observed hospitalizations and deaths were low, the available data were consistent with reduced risk for these severe outcomes among vaccinated persons compared with that among placebo recipients. Among vaccine recipients, reactogenicity symptoms, defined as solicited local injection site or systemic reactions during the 7 days after vaccination, were frequent and mostly mild to moderate. Systemic adverse reactions were more commonly reported after the second dose than after the first dose and were generally more frequent and severe in persons aged 18–55 years than in those aged >55 years. Systemic adverse reactions had a median onset of 1–2 days after vaccine receipt and resolved in a median of 1 day. Severe local and systemic adverse reactions (grade ≥3, defined as interfering with daily activity) occurred more commonly in vaccine recipients than in placebo recipients. Among vaccine recipients, 8.8% reported any grade ≥3 reaction; the most common symptoms were fatigue (4.2%), headache (2.4%), muscle pain (1.8%), chills (1.7%), and injection site pain

* On December 12, 2020, ACIP voted 11–0 (three recusals) in favor of the interim recommendation for use of Pfizer-BioNTech COVID-19 vaccine. Three ACIP members recused themselves because of participation in clinical trials and/or other studies involving companies producing COVID-19 vaccines.

† https://www.cdc.gov/vaccines/acip/recs/grade/downloads/ACIP-evidence-recframe-508.pdf.

§ https://www.cdc.gov/vaccines/acip/recs/grade/about-grade.html.

(1.4%). Generally, grade ≥3 reactions were more commonly reported after the second dose than after the first dose and were less prevalent in older than in younger participants. Serious adverse events[¶] were observed in a similar proportion of vaccine (0.6%) and placebo (0.5%) recipients and encompassed medical events occurring at a frequency similar to that within the general population (*6*). No specific safety concerns were identified in subgroup analyses by age, race, ethnicity, underlying medical conditions, or previous SARS-CoV-2 infection. A detailed summary of safety data, including information on reactogenicity, is available at https://www.cdc.gov/vaccines/covid-19/info-by-manufacturer/pfizer/reactogenicity.html.

From the GRADE evidence assessment, the level of certainty for the benefits of the Pfizer-BioNTech COVID-19 vaccine was type 1 (high certainty) for the prevention of symptomatic COVID-19. Evidence was type 3 (low certainty) for the estimate of prevention of COVID-19–associated hospitalization and type 4 (very low certainty) for the estimate of prevention of death. Data on hospitalizations and deaths are limited at this time, but a vaccine that effectively prevents symptomatic infection is expected to also prevent hospitalizations and deaths. Regarding potential harms after vaccination, evidence was type 2 (moderate certainty) for serious adverse events and type 1 (high certainty) for reactogenicity. No data were available to assess the efficacy for prevention of asymptomatic SARS-CoV-2 infection. Data reviewed within the EtR Framework supported the use of the Pfizer-BioNTech COVID-19 vaccine. ACIP determined that COVID-19 is a major public health problem and that use of the Pfizer-BioNTech COVID-19 vaccine is a reasonable and efficient allocation of resources. Whereas there might be uncertainty in how all populations value the vaccine, it was determined that for most populations, the desirable effects outweigh the undesirable effects. The vaccine is probably acceptable to implementation stakeholders and feasible to implement in spite of difficult ultracold-chain storage and requirements for handling and administration. These requirements could limit the availability of the Pfizer-BioNTech COVID-19 vaccine to some populations thereby negatively impacting health equity. Therefore, efforts should be made to overcome these challenges and advance health equity. The GRADE evidence profile and EtR supporting evidence are available at https://www.cdc.gov/vaccines/acip/recs/grade/covid-19-pfizer-biontech-vaccine.html and https://www.cdc.gov/vaccines/acip/recs/grade/covid-19-pfizer-biontech-etr.html.

[¶] Serious adverse events are defined as any untoward medical occurrence that results in death, is life-threatening, requires inpatient hospitalization or prolongation of existing hospitalization, or results in persistent disability/incapacity.

Before vaccination, the EUA Fact Sheet should be provided to recipients and caregivers. Providers should counsel Pfizer-BioNTech COVID-19 vaccine recipients about expected systemic and local reactogenicity. Additional clinical considerations, including details of administration and use in special populations (e.g., persons who are pregnant or immunocompromised or who have severe allergies) are available at https://www.cdc.gov/vaccines/covid-19/info-by-manufacturer/pfizer/clinical-considerations.html. Additional studies of safety and effectiveness are planned after authorization and will be important to inform future ACIP recommendations as well as increase public confidence in the COVID-19 vaccination program. The interim recommendation and clinical considerations are based on use of the Pfizer-BioNTech COVID-19 vaccine under an EUA and might change as more evidence becomes available. ACIP will continue to review additional data as they become available; updates to recommendations or clinical considerations will be posted on the ACIP website (https://www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/covid-19.html).

Reporting of Vaccine Adverse Events

Adverse events that occur in a recipient after receipt of COVID-19 vaccine should be reported to the Vaccine Adverse Events Reporting System (VAERS). FDA requires that vaccination providers report vaccination administration errors, serious adverse events, cases of multisystem inflammatory syndrome, and cases of COVID-19 that result in hospitalization or death after administration of COVID-19 vaccine under EUA. Reporting is encouraged for any clinically significant adverse event, whether or not it is clear that a vaccine caused the adverse event. Information on how to submit a report to VAERS is available at https://vaers.hhs.gov/index.html or 1-800-822-7967. In addition, CDC has developed a new, voluntary smartphone-based tool, v-safe, that uses text messaging and web surveys to provide near real-time health check-ins after patients receive COVID-19 vaccination. The CDC/v-safe call center follows up on reports to v-safe that indicate a medically significant health impact to collect additional information for completion of a VAERS report. Information on v-safe is available at https://www.cdc.gov/vsafe.

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Summary

What is already known about this topic?

On December 11, 2020, the Food and Drug Administration issued an Emergency Use Authorization for the Pfizer-BioNTech COVID-19 vaccine.

What is added by this report?

On December 12, 2020, after an explicit, evidence-based review of all available data, the Advisory Committee on Immunization Practices (ACIP) issued an interim recommendation for use of the Pfizer-BioNTech COVID-19 vaccine in persons aged ≥16 years for the prevention of COVID-19.

What are the implications for public health practice?

The recommendation for the Pfizer-BioNTech COVID-19 vaccine should be implemented in conjunction with ACIP's interim recommendation for allocating initial supplies of COVID-19 vaccines.

References

1. Food and Drug Administration. Pfizer-BioNTech COVID-19 Vaccine Emergency Use Authorization. Silver Spring, MD: US Department of Health and Human Services, Food and Drug Administration; 2020. https://www.fda.gov/emergency-preparedness-and-response/coronavirus-disease-2019-covid-19/pfizer-biontech-covid-19-vaccine
2. Dooling K, McClung N, Chamberland M, et al. The Advisory Committee on Immunization Practices' interim recommendation for allocating initial supplies of COVID-19 vaccine—United States, 2020. MMWR Morb Mortal Wkly Rep 2020;69:1857–9. PMID:33301429 https://doi.org/10.15585/mmwr.mm6949e1
3. Advisory Committee on Immunization Practices. ACIP meeting information. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/vaccines/acip/meetings/index.html
4. Advisory Committee on Immunization Practices. Advisory Committee on Immunization Practices (ACIP): GRADE (grading of recommendations, assessment, development and evaluation). Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/vaccines/acip/recs/grade
5. Vaccines and Related Biological Products Advisory Committee. Vaccines and Related Biological Products Advisory Committee December 10, 2020, meeting: sponsor briefing document. Silver Spring, MD: US Department of Health and Human Services, Food and Drug Administration; 2020. https://www.fda.gov/media/144246/download
6. Vaccines and Related Biological Products Advisory Committee. Vaccines and Related Biological Products Advisory Committee December 10, 2020, meeting: FDA briefing document. Silver Spring, MD: US Department of Health and Human Services, Food and Drug Administration; 2020. https://www.fda.gov/media/144245/download

Factors Associated with Positive SARS-CoV-2 Test Results in Outpatient Health Facilities and Emergency Departments Among Children and Adolescents Aged <18 Years — Mississippi, September–November 2020

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As of December 14, 2020, children and adolescents aged <18 years have accounted for 10.2% of coronavirus disease 2019 (COVID-19) cases reported in the United States.* Mitigation strategies to prevent infection with SARS-CoV-2, the virus that causes COVID-19, among persons of all ages, are important for pandemic control. Characterization of risk factors for SARS-CoV-2 infection among children and adolescents can inform efforts by parents, school and program administrators, and public health officials to reduce SARS-CoV-2 transmission. To assess school, community, and close contact exposures associated with pediatric COVID-19, a case-control study was conducted to compare exposures reported by parents or guardians of children and adolescents aged <18 years with SARS-CoV-2 infection confirmed by reverse transcription–polymerase chain reaction (RT-PCR) testing (case-patients) with exposures reported among those who received negative SARS-CoV-2 RT-PCR test results (control participants). Among 397 children and adolescents investigated, in-person school or child care attendance ≤14 days before the SARS-CoV-2 test was reported for 62% of case-patients and 68% of control participants and was not associated with a positive SARS-CoV-2 test result (adjusted odds ratio [aOR] = 0.8, 95% confidence interval [CI] = 0.5–1.3). Among 236 children aged ≥2 years who attended child care or school during the 2 weeks before SARS-CoV-2 testing, parents of 64% of case-patients and 76% of control participants reported that their child and all staff members wore masks inside the facility (aOR = 0.4, 95% CI = 0.2–0.8). In the 2 weeks preceding SARS-CoV-2 testing, case-patients were more likely to have had close contact with a person with known COVID-19 (aOR = 3.2, 95% CI = 2.0–5.0), have attended gatherings† with persons outside their household, including social functions (aOR = 2.4, 95% CI = 1.1–5.5) or activities with other children (aOR = 3.3, 95% CI = 1.3–8.4), or have had visitors in the home (aOR = 1.9, 95% CI = 1.2–2.9) than were control participants. Close contacts with persons with COVID-19 and gatherings contribute to SARS-CoV-2 infections in children and adolescents. Consistent use of masks, social distancing, isolation of infected persons, and quarantine of those who are exposed to the virus continue to be important to prevent COVID-19 spread.

This investigation included children and adolescents aged <18 years who received testing for presence of SARS-CoV-2 in nasopharyngeal swab specimens by RT-PCR at outpatient testing health care centers (including drive-up testing locations) or emergency departments associated with the University of Mississippi Medical Center (UMMC) during September 1–November 5, 2020 (*1*). A COVID-19 case was confirmed by a positive SARS-CoV-2 RT-PCR test result. After excluding inconclusive RT-PCR results, lists of children and adolescents with an electronic medical record of a SARS-CoV-2 test within the study period were randomly ordered by laboratory result. Children with negative SARS-CoV-2 RT-PCR test results were frequency matched to the number of case-patients enrolled by age group (0–3, 4–8, 9–14 and 15–17 years), sex, and test date interval (September 1–24, September 22–October 18, and October 14–November 5, 2020),§ with a target sample size of 150 case-patients and twice the number of control participants as case-patients per stratum. In all, 896 potentially eligible children (290 with positive test results and 606 with negative test results for SARS-CoV-2) were identified and telephoned an average of 32 days after SARS-CoV-2 testing. In all, 494 parents or guardians could not be contacted or refused, and five were excluded because the child had been hospitalized with COVID-19, leaving 397 participants, including 154 case-patients (positive SARS-CoV-2 test results) and 243 control participants (negative SARS-CoV-2 test results). Trained interviewers administered structured interviews in English or Spanish (three interviews) by telephone and entered data into REDCap software (*2*). This project was deemed nonresearch public health practice by the CDC and the University of Mississippi Medical Center Institutional Review Boards and conducted consistent with applicable federal law and CDC policy.¶

* https://covid.cdc.gov/covid-data-tracker/#demographics. Aged <18 years = 1,207,363 (10.2%) of 11,886,368 cases with age group available.

† Respondents were asked "Did your family/household attend any social gatherings with other persons who do not live in your home (like weddings, funerals, parties, celebrations, etc.)?" and "Did your child attend any gatherings (10 or more children) outside of the home or school (like birthday parties, playdates, etc.)?"

§ Overlapping dates resulted from the approach used to create the three lists; duplicates were removed.

¶ Activity was determined to meet the requirements of public health surveillance as defined in 45 CFR 46.102(l)(2).

Data collected included participant demographic characteristics, symptoms, close contact (within 6 feet for ≥15 minutes) with a person with known COVID-19, school or child care attendance, and family or community exposures ≤14 days before the SARS-CoV-2 test. For participants who attended in-person school or child care, parents or guardians were asked about the frequency of mask use among students and staff members inside the facility. Parents were also asked about frequency of mask use and social distancing by child and among other persons present for each community exposure. Descriptive and statistical analyses were performed to compare case-patients with control participants, assessing differences in demographic characteristics, school, community exposures, and close contact. Logistic regression models accounting for child sex, age group, and race/ethnicity were used to estimate aORs and 95% CIs, comparing odds of exposures among case-patients and control participants. In each model, SARS-CoV-2 test result (i.e., positive or negative) was the outcome variable, and each exposure response was the predictor variable. Statistical analyses were conducted using SAS software (version 9.4; SAS Institute).

Among the 397 participants, 82 (21%) were aged <4 years, 214 (54%) were female, 217 (55%) were non-Hispanic Black, and 145 (37%) were non-Hispanic White (Table). Participants were tested in outpatient health facilities (78%) or emergency departments (22%); 53% were tested because they were experiencing symptoms; case-patients were more likely than were control participants to be tested because of close contact with a COVID-19 case (66% versus 41%) (p<0.01). Overall, case-patients were more likely to have had close contact with a person with known COVID-19 than control participants (aOR = 3.2, 95% CI = 2.0–5.0); 64% of close contacts of case-patients and 48% of those of control participants were family members (p = 0.02), whereas school or child care classmates were reported as close contacts for 15% and 27%, respectively (p = 0.04). In-person school or child care attendance ≤14 days before the SARS-CoV-2 test was reported for 62% of case-patients and 68% of control participants and was not associated with a positive SARS-CoV-2 test result (aOR = 0.8, 95% CI = 0.5–1.3). Among 236 children aged ≥2 years who attended child care or school during the 2 weeks before the SARS-CoV-2 test, parents of 64% of case-patients and 76% of control participants reported that their child and all staff members wore masks inside the facility (aOR = 0.4, 95% CI = 0.2–0.8).

Compared with control participants, case-patients were more likely to have attended gatherings with persons outside their household, including social functions (aOR = 2.4, 95% CI = 1.1–5.5), activities with children (aOR = 3.3, 95% CI = 1.3–8.4), or to have had visitors at home (aOR = 1.9, 95% CI = 1.2–2.9) during the 14 days before the SARS-CoV-2 test (Figure); 27% of all parents whose children attended social gatherings reported mask use by all persons present and 46% reported adherence to social distancing, whereas 16% and 39%, respectively reported mask use and social distancing when having visitors in the home.

Discussion

In this investigation, children and adolescents who received positive test results for SARS-CoV-2 were more likely than were similarly aged participants who had negative test results to have had reported close contact with a person with confirmed COVID-19 and less likely to have had reported consistent mask use by students and staff members inside the school facility. Among participants with close contact with a person with COVID-19, close contacts of case-patients were more likely to be family members and less likely to be school or child care classmates than were those of control participants. Attending in-person school or child care during the 2 weeks before the SARS-CoV-2 test was not associated with increased likelihood of a positive SARS-CoV-2 test result. The majority of respondents reported universal mask use inside school and child care facilities as recommended by Mississippi State Department of Health,** although parents of case-patients were less likely than were those of control participants to report consistent mask use indoors among their child aged ≥2 years and staff members. Efforts to reduce COVID-19 in families and communities, in addition to mitigation strategies in schools and child care programs, are important for preventing transmission to children and adolescents.†† With increasing COVID-19 incidence and various behaviors across the country, timely investigations to identify activities associated with SARS-CoV-2 transmission can inform targeted mitigation strategies at local levels.

Among children and adolescents with COVID-19, 69% reported close contact with a person with COVID-19, similar to previous findings among children and adults (*3*–*5*). Most close contact exposures were to family members, consistent with household transmission of SARS-CoV-2 (*6*–*8*). Fewer (42%) children who received a negative SARS-CoV-2 test result reported close contact with a person with known COVID-19. To help slow the spread of SARS-CoV-2, persons exposed to someone with COVID-19 should stay home, in addition to adhering to recommendations to wear masks, maintain social distance, and wash hands often.§§ If a family member or other close contact is ill, additional prevention measures can be taken to reduce transmission, such as wearing masks, reducing shared meals and items, cleaning and disinfecting the home, and wearing gloves for those with and without known COVID-19.¶¶

** https://msdh.ms.gov/msdhsite/_static/resources/9917.pdf.
†† https://www.cdc.gov/coronavirus/2019-ncov/community/schools-childcare/index.html.
§§ https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/disinfecting-your-home.html.
¶¶ https://www.cdc.gov/coronavirus/2019-ncov/if-you-are-sick/index.html; https://www.cdc.gov/coronavirus/2019-ncov/if-you-are-sick/quarantine.html.

TABLE. Characteristics of children and adolescents aged <18 years who received positive and negative SARS-CoV-2 test results (N = 397)* — Mississippi, September–November 2020

Characteristic	No. (%) Case-patients (n = 154)	No. (%) Control-participants (n = 243)	P-value†
Age group, yrs			0.17
<4	38 (25)	44 (18)	
4–8	28 (18)	62 (26)	
9–14	60 (39)	101 (42)	
15–17	28 (18)	36 (15)	
Sex			0.32
Male	68 (44)	115 (47)	
Female	86 (56)	128 (53)	
Race/Ethnicity (missing = 20)			0.15
Black, non-Hispanic	92 (62)	125 (55)	
Hispanic	4 (3)	2 (1)	
Other, non-Hispanic	2 (1)	7 (3)	
White, non-Hispanic	50 (34)	95 (41)	
Clinical setting			0.97
Emergency department	34 (22)	54 (22)	
Outpatient	120 (78)	189 (78)	
Reason for SARS-CoV-2 testing§			
Felt unwell	86 (56)	123 (51)	0.31
Close contact with COVID-19 case	101 (66)	99 (41)	<0.01
Required for school/day care	1 (1)	14 (6)	0.01
Previous close contact with a person with known COVID-19 (missing = 10)	104 (69)	100 (42)	<0.01
Relationship to close contact with known COVID-19§ (n = 204)			
Family member	67 (64)	48 (48)	0.02
Friend	8 (8)	15 (15)	0.10
School classmate	16 (15)	27 (27)	0.04
Household size, mean (SD)	4.5 (1.3)	4.4 (1.5)	0.21
Residence type (missing = 11)			0.37
Single family home	119 (78)	196 (84)	
Apartment building	28 (18)	31 (13)	
Group home	5 (3)	7 (3)	
School or child care exposure ≤14 days before SARS-CoV-2 test¶ (missing = 7)			0.24
In classroom or child care	95 (62)	161 (68)	
At home	58 (38)	76 (32)	
Among participants attending school or child care (n = 256)¶			
Days per week, mean	4.6 (0.9)	4.5 (1.0)	0.24
Hybrid model with some days at home	18 (19)	36 (23)	0.46
>10 students per classroom	60 (76)	96 (72)	0.45
Indoor school activities	17 (19)	29 (19)	1.00
Community exposure ≤14 days before SARS-CoV-2 test**			
Social gatherings	17 (11)	13 (6)	0.04
Sporting events or concerts	26 (18)	46 (20)	0.62
Religious services	19 (13)	42 (18)	0.16
Child gatherings (e.g., birthday parties, playdates)	14 (9)	9 (4)	0.03
Travel with others	8 (5)	7 (3)	0.26
Visitors in home	61 (42)	72 (31)	0.05
Restaurants	29 (20)	37 (16)	0.35
Household member working in health care with patient contact	36 (24)	50 (21)	0.62

Abbreviations: COVID-19 = coronavirus disease 2019; SD = standard deviation.

* Respondents who completed the interview and average of 32 days after their child's test date.

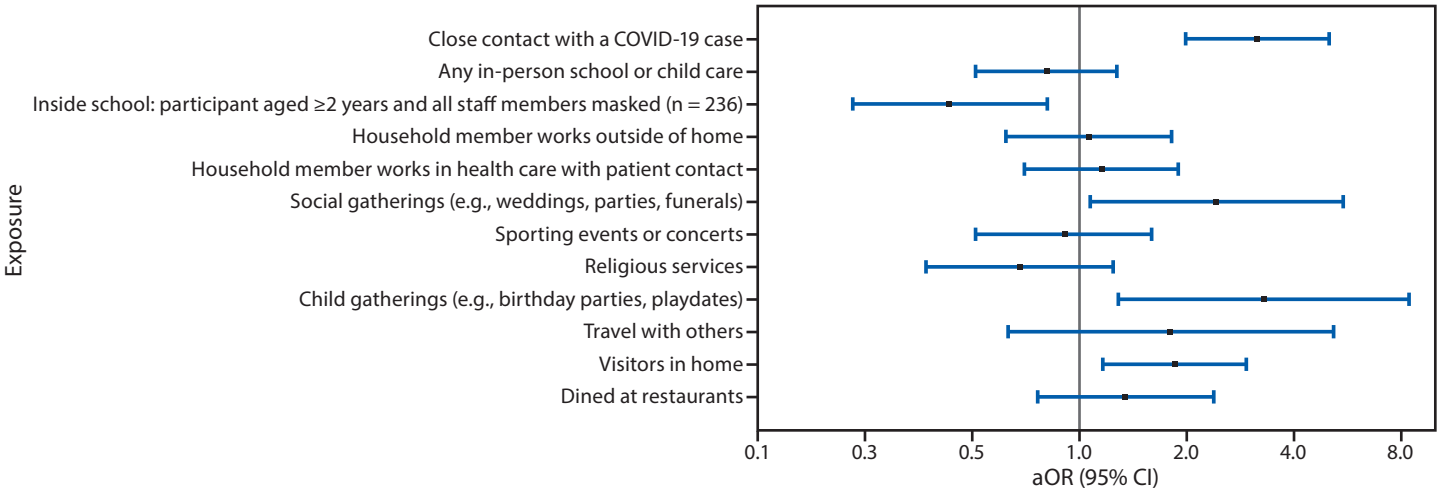
† P-value for comparison of characteristics of case-patients with control participants using Fisher's exact text or Pearson's chi-squared test for categorical variables or Wilcoxon rank sum test for continuous variables.

§ Parents could provide more than one response.

¶ Questions about school attendance and participation in athletics or school-related activities were "Did your child attend school in-person (all of the week, part of the week [part time virtual], none of the week [all virtual])" (missing = 6); "How many days per week did your child attend daycare/school outside the home?"; "On the days when the child attended daycare/school in person, was the classroom (less than half full (<5 students), more than half full (5-10 students), full (approximately 10 students), more than full (>10 students); responses were dichotomized as more than full (yes/no)"; "Did your child participate in any indoor school-related activities like choir, band, clubs, etc.?" (missing = 9); "Did your child participate in any indoor sports like basketball, volleyball, etc.?" (missing = 4). Attending school or child care was dichotomized as ≥1 day in the past 2 weeks or none. For affirmative responses about the child's participation in sports or school-related activities, parents were asked to specify activities.

** Community exposure questions asked in reference to the 2 weeks before the child's SARS-CoV-2 test were "Did your family/household attend any social gatherings with other people who do not live in your home (like weddings, funerals, parties, celebrations, etc.)?" (missing = 15); "Did your family/members of your household attend any sporting events or concerts?" (missing = 14); "Did your family/household attend meetings or religious services with 10 or more people who do not live with you?" (missing = 12); "Did your child attend any gatherings (10 or more children) outside of the home or school (like birthday parties, playdates, etc.)?" (missing = 14); "Did your family/household travel with any other people/families who do not live with you?" (missing = 10); "Did you receive visitors into your home?" (missing = 21); "Did your family/household eat in restaurants?" (missing = 21); "Are you or anyone in the household a health care provider that provides direct patient contact?" (missing = 10). For each affirmative response, respondents were asked if the activity took place inside or outside, if other persons at the event were masked (everyone, some, no one), and if social distancing was observed.

FIGURE. Adjusted odds ratios (aORs)* and 95% confidence intervals (CIs) for close contact, school or child care, and community exposures† associated with confirmed COVID-19 among children and adolescents aged <18 years (N = 397) — Mississippi, September–November 2020



Abbreviation: COVID-19 = coronavirus disease 2019.

* Odds ratios were estimated using logistic regression models adjusting for sex, age group, and race/ethnicity.

† Close contact, school or child care, and community exposure questions asked in reference to the 2 weeks before the child's SARS-CoV-2 test were "Did the child have close contact with another person with confirmed COVID-19?"; "Did your child attend school in person (all of the week, part of the week [part time virtual], none of the week [all virtual])" (missing = 6); "Did your child wear a mask inside at daycare/school? (all the time, some of the time, none of the time)?" (missing = 15); "Did the teachers/staff at your child's daycare/school wear a mask inside (all of the time, some of the time, none of the time)?" (missing = 15); "Did your family/household attend any social gatherings with other people who do not live in your home (like weddings, funerals, parties, celebrations, etc.)?" (missing = 13); "Did your family/members of your household attend any sporting events or concerts?" (missing = 12); "Did your family/household attend meetings or religious services with 10 or more people who do not live with you?" (missing = 11); "Did your child attend any gatherings (10 or more children) outside of the home or school (like birthday parties, playdates, etc.)?" (missing = 12); "Did your family/household travel with any other people/families who do not live with you?" (missing = 8); "Did you receive visitors into your home?" (missing = 19); "Did your family/household eat in restaurants?" (missing = 19); "Are you or anyone in the household a health care provider that provides direct patient contact?" (missing = 8). For each affirmative response, respondents were asked if the activity took place inside or outside, if other persons at the event were masked (everyone, some, or no one) and if social distancing was observed. Mask use inside school by the child and all staff members was dichotomized as all the time (for both questions) versus all other responses.

Summary

What is already known about the topic?

Community and close contact exposures contribute to the spread of COVID-19.

What is added by this report?

Among children and adolescents aged <18 years in Mississippi, close contact with persons with COVID-19 and gatherings with persons outside the household and lack of consistent mask use in school were associated with SARS-CoV-2 infection, whereas attending school or child care was not associated with receiving positive SARS-CoV-2 test results.

What are the implications for public health practice?

Close contacts with persons with COVID-19 and gatherings contribute to SARS-CoV-2 infections in children and adolescents. Consistent use of face masks and social distancing continue to be important to prevent COVID-19 spread.

The findings in this report are subject to at least four limitations. First, the sample included 397 children and adolescents tested during September–November 2020 at health care facilities associated with one large academic medical center in Mississippi and might not be representative of children and adolescents in other geographic areas of the United States. Further, parents of eligible children who could not be contacted or refused to participate could be systematically different from those who were interviewed for this investigation. Second, unmeasured confounding is possible, such that reported behaviors might represent factors, including concurrently participating in activities in which possible exposures could have taken place, that were not included in the analysis or measured in the study. Most respondents were aware of their child's SARS-CoV-2 test results and interviews were conducted several weeks after testing, factors which could have influenced parent responses. Third, parent report of frequency of mask or cloth face covering use at schools and child care programs was not verified. Finally, case or control status might be subject to misclassification because of imperfect sensitivity or specificity of PCR-based testing.

This investigation highlights differences in community and close contact exposures and in-school mask use between children and adolescents who received a positive SARS-CoV-2 test result and those who received a negative SARS-CoV-2 test result during the beginning of the 2020–21 academic year in Mississippi. Continued efforts to prevent transmission at schools and child care programs are important, as are assessments of various types of activities and exposures to identify risk factors for

COVID-19 as children engage in classroom and social interactions (*9*,*10*). Exposures and activities in which persons are less likely to maintain mask use and social distancing, including family gatherings and group activities, might be important risk factors for SARS-CoV-2 infection among children and adolescents. Promoting behaviors to reduce exposures to SARS-CoV-2 among children and adolescents in the household and community, as well as in schools and child care programs, is needed to prevent COVID-19 outbreaks at schools*** and child care programs and slow the spread of COVID-19.

*** https://www.msdh.ms.gov/msdhsite/_static/resources/11292.pdf.

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References

1. Inagaki K, Garg P, Hobbs CV. SARS-CoV-2 positivity rates among children of racial and ethnic minority groups in Mississippi. Pediatrics 2020. Epub October 28, 2020. PMID:33115793 https://doi.org/10.1542/peds.2020-024349
2. Harris PA, Taylor R, Minor BL, et al.; REDCap Consortium. The REDCap consortium: building an international community of software platform partners. J Biomed Inform 2019;95:103208. PMID:31078660 https://doi.org/10.1016/j.jbi.2019.103208
3. Marshall K, Vahey GM, McDonald E, et al.; Colorado Investigation Team. Exposures before issuance of stay-at-home orders among persons with laboratory-confirmed COVID-19—Colorado, March 2020. MMWR Morb Mortal Wkly Rep 2020;69:847–9. PMID:32614809 https://doi.org/10.15585/mmwr.mm6926e4
4. Tenforde MW, Billig Rose E, Lindsell CJ, et al.; CDC COVID-19 Response Team. Characteristics of adult outpatients and inpatients with COVID-19—11 academic medical centers, United States, March–May 2020. MMWR Morb Mortal Wkly Rep 2020;69:841–6. PMID:32614810 https://doi.org/10.15585/mmwr.mm6926e3
5. Fisher KA, Tenforde MW, Feldstein LR, et al.; IVY Network Investigators; CDC COVID-19 Response Team. Community and close contact exposures associated with COVID-19 among symptomatic adults ≥18 years in 11 outpatient health care facilities—United States, July 2020. MMWR Morb Mortal Wkly Rep 2020;69:1258–64. PMID:32915165 https://doi.org/10.15585/mmwr.mm6936a5
6. Grijalva CG, Rolfes MA, Zhu Y, et al. Transmission of SARS-COV-2 infections in households—Tennessee and Wisconsin, April–September 2020. MMWR Morb Mortal Wkly Rep 2020;69:1631–4. PMID:33151916 https://doi.org/10.15585/mmwr.mm6944e1
7. Lewis NM, Chu VT, Ye D, et al. Household transmission of SARS-CoV-2 in the United States. Clin Infect Dis 2020. Epub August 16, 2020. PMID:33185244 https://doi.org/10.1093/cid/ciaa1166
8. Lei H, Xu X, Xiao S, Wu X, Shu Y. Household transmission of COVID-19-a systematic review and meta-analysis. J Infect 2020;81: 979–97. PMID:32858069 https://doi.org/10.1016/j.jinf.2020.08.033
9. Leeb RT, Price S, Sliwa S, et al. COVID-19 trends among school-aged children—United States, March 1–September 19, 2020. MMWR Morb Mortal Wkly Rep 2020;69:1410–5. PMID:33001869 https://doi.org/10.15585/mmwr.mm6939e2
10. Coronado F, Blough S, Bergeron D, et al. Implementing mitigation strategies in early care and education settings for prevention of SARS-CoV-2 transmission—eight states, September–October 2020. MMWR Morb Mortal Wkly Rep 2020;69:1868–72 http://dx.doi.org/10.15585/mmwr.mm6949e3. PMID:33301431

Erratum

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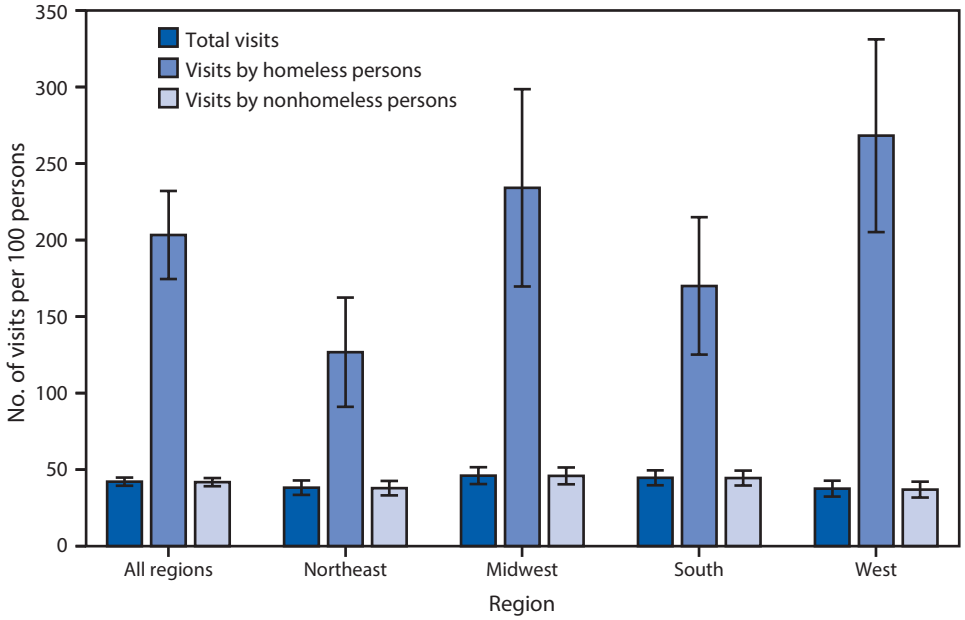
In the report "COVID-19 Outbreak — New York City, February 29–June 1, 2020," on p. 1725, the list of authors should have read "Corinne N. Thompson, PhD[1]; Jennifer Baumgartner, MSPH[1]; Carolina Pichardo[1]; Brian Toro[1]; Lan Li, MPH[1]; Robert Arciuolo, MPH[1]; Pui Ying Chan, MPH[1]; Judy Chen[1]; Gretchen Culp, PhD[1]; Alexander Davidson, MPH[1]; Katelynn Devinney, MPH[1]; Alan Dorsinville, MPH[1]; Meredith Eddy, MPH[1]; Michele English[1]; Ana Maria Fireteanu, MPH[1]; Laura Graf, MPH[1]; Anita Geevarughese, MD[1]; Sharon K. Greene, PhD[1]; Kevin Guerra, MPH[1]; Mary Huynh, PhD[1]; Christina Hwang, MPH[1]; Maryam Iqbal, MPH[1]; Jillian Jessup, MPH[1]; Jillian Knorr, MPH[1]; **Ramona Lall, PhD[1];** Julia Latash, MPH[1]; Ellen Lee, MD[1]; Kristen Lee, MPH[1]; Wenhui Li, PhD[1]; Robert Mathes, MPH[1]; Emily McGibbon, MPH[1]; Natasha McIntosh[1]; Matthew Montesano, MPH[1]; Miranda S. Moore, MPH[1]; Kenya Murray, MPH[1]; Stephanie Ngai, MPH[1]; Marc Paladini, MPH[1]; Rachel Paneth-Pollak, MD[1]; Hilary Parton, MPH[1]; Eric Peterson, MPH[1]; Renee Pouchet, MHA[1]; Jyotsna Ramachandran, MPH[1]; Kathleen Reilly, PhD[1]; Jennifer Sanderson Slutsker, MPH[1]; Gretchen Van Wye, PhD[1]; Amanda Wahnich, MPH[1]; Ann Winters, MD[1]; Marcelle Layton, MD[1]; Lucretia Jones, DrPH[1]; Vasudha Reddy, MPH[1]; Anne Fine, MD[1]."

The affiliation for Dr. Lall is New York City Department of Health and Mental Hygiene, Long Island City, New York.

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Rate of Emergency Department (ED) Visits,* by Homeless Status† and Geographic Region§ — National Hospital Ambulatory Medical Care Survey, United States, 2015–2018¶



* Visit rates for the homeless population are based on sets of estimates of the U.S. homeless population, reported by the U.S. Department of Housing and Urban Development, from data collected on a single night in January of each year during 2015–2018. Visit rates for the total population are based on sets of estimates of the U.S. civilian, noninstitutionalized population developed by the U.S. Census Bureau's Population Division and reflect the population as of July 1 of each year during 2015–2018. The nonhomeless population was computed by subtraction. Error bars indicate 95% confidence intervals.

† Homeless persons are identified as being homeless or living in a homeless shelter. Nonhomeless persons are identified as having a private residence, living in a nursing home, or having some other living arrangement. Patient residence was missing for 2.3% of ED visits; these records were excluded from the analysis.

§ *Northeast*: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. *Midwest*: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. *South*: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia. *West*: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

¶ Based on a sample of visits to EDs in noninstitutional general and short-stay hospitals, exclusive of federal, military, and Veterans Administration hospitals, located in U.S. states and the District of Columbia.

During 2015–2018, there were annual averages of 42 ED visits per 100 total population, 42 ED visits per 100 nonhomeless persons, and 203 ED visits per 100 homeless persons. Within each region, the rate of ED visits among homeless persons was higher than the rate for nonhomeless persons. The rates of visits for nonhomeless persons did not differ by region; however, among homeless persons, visit rates were higher in the West (268) than in the Northeast (127) and South (170) and higher in the Midwest (234) than in the Northeast.

Source: National Center for Health Statistics, National Hospital Ambulatory Medical Care Survey, 2015–2018. https://www.cdc.gov/nchs/ahcd/ahcd_questionnaires.htm.

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