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Racial and Ethnic Disparities in Fetal Deaths — United States, 2015–2017

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The spontaneous death or loss of a fetus during pregnancy is termed a fetal death. In the United States, national data on fetal deaths are available for losses at ≥20 weeks' gestation.* Deaths occurring during this period of pregnancy are commonly known as stillbirths. In 2017, approximately 23,000 fetal deaths were reported in the United States (*1*). Racial/ethnic disparities exist in the fetal mortality rate; however, much of the known disparity in fetal deaths is unexplained (*2*). CDC analyzed 2015–2017 U.S. fetal death report data and found that non-Hispanic Black (Black) women had more than twice the fetal mortality rate compared with non-Hispanic White (White) women and Hispanic women. Fetal mortality rates also varied by maternal state of residence. Cause of death analyses were conducted for jurisdictions where >50% of reports had a cause of death specified. Still, even in these jurisdictions, approximately 31% of fetal deaths had no cause of death reported on a fetal death report. There were differences by race and Hispanic origin in causes of death, with Black women having three times the rate of fetal deaths because of maternal complications compared with White women. The disparities suggest opportunities for prevention to reduce the U.S. fetal mortality rate. Improved documentation of cause of death on fetal death reports might help identify preventable causes and guide prevention efforts.

CDC used the 2015–2017 fetal death data files and birth certificates available from the National Vital Statistics System. Records were restricted to exclude fetal deaths occurring to non-U.S. residents and those of <20 weeks' gestation as determined by the obstetric estimate of gestational age at delivery (*3*). Data from all 50 states and the District of Columbia were used to calculate fetal mortality rates. Cause of death was examined in jurisdictions that used the 2003 revision of the

* https://www.cdc.gov/nchs/data_access/vitalstatsonline.htm.

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standard fetal death report[†] and where >50% of reports had a specified cause of death.

Fetal mortality rates are expressed as the number of fetal deaths per 1,000 live births plus fetal deaths. Rates were calculated nationally and by mothers' state of residence, race and Hispanic origin, age, and multiple-gestation pregnancy. Causes of death were reported on the fetal death report according to codes from the *International Classification of Diseases, Tenth Revision* (ICD-10). Codes for cause of death were categorized into 45 ranked causes of death, from which the selected causes were drawn (*4*). The five most common cause of death categories for the reporting jurisdictions[§] were examined by maternal race and Hispanic origin. Using a Poisson model, 95% confidence intervals (CIs) around the fetal mortality rate and crude rate ratios (RRs) were calculated. Data analysis was completed using SAS software (version 9.4; SAS Institute).

Overall, during 2015–2017, the U.S. fetal mortality rate was 6.0 per 1,000 live births and fetal deaths (Figure 1). Among Black women, the fetal mortality rate (11.2; 95% CI = 11.1–11.4) was more than twice that among White women (5.0; 95% CI = 5.0–5.1) and Hispanic women (5.1; 95% CI = 5.0–5.2). The fetal mortality rate among mothers aged <20 years (7.4) was 30% higher than that among mothers aged 20–39 years (5.7; RR = 1.3; 95% CI = 1.2–1.3), and the rate among mothers aged >40 years (10.0) was also significantly higher than that among mothers aged 20–39 years (RR = 1.8; 95% CI = 1.7–1.8). Fetal mortality among women who had multiple-gestation pregnancies (13.7) was more than twice that of mothers carrying singletons (5.7; RR = 2.4; 95% CI = 2.4–2.5).

The fetal mortality rate varied by U.S. state. Overall, rates were higher in the southern United States (Figure 2); Alabama reported the highest state-level fetal mortality rate among White women (6.9; 95% CI = 6.4–7.4) and Hispanic women (7.0; 95% CI = 5.8–8.6). Fetal mortality rates among Black women exceeded 16 per 1,000 in New Jersey (17.3; 95% CI = 16.1–18.7), West Virginia (16.8; 95% CI = 11.8–23.8), and Mississippi (16.3; 95% CI = 15.2–17.5).

Overall, 31% of fetal death reports had an unspecified cause of death. This was similar among Black, White, and Hispanic mothers. In the selected reporting jurisdictions, the five most common cause of fetal death categories were 1) complications of placenta, cord, and membrane; 2) maternal complications of pregnancy; 3) congenital malformations, deformations, and chromosomal abnormalities; 4) maternal conditions that might be unrelated to present pregnancy; and 5) syndrome of infant of diabetic mother and neonatal diabetes mellitus (Figure 3).

[†] https://www.cdc.gov/nchs/data/dvs/fetal_death_edit_specifications.pdf.

[§] Cause of death reporting jurisdictions: In 2015, included 39 states and the District of Columbia (excluding California, Connecticut, Georgia, Mississippi, New Jersey, New York, North Carolina, North Dakota, Tennessee, Wisconsin, and West Virginia); in 2016, included 38 states and the District of Columbia (excluding California, Connecticut, Georgia, Hawaii, Mississippi, New Jersey, New York, North Dakota, Tennessee, Vermont, Wisconsin, and West Virginia); in 2017, included 38 states and the District of Columbia (excluding California, Connecticut, Georgia, Michigan, Mississippi, New York, North Dakota, Rhode Island, Tennessee, Virginia, Vermont, and Wisconsin).

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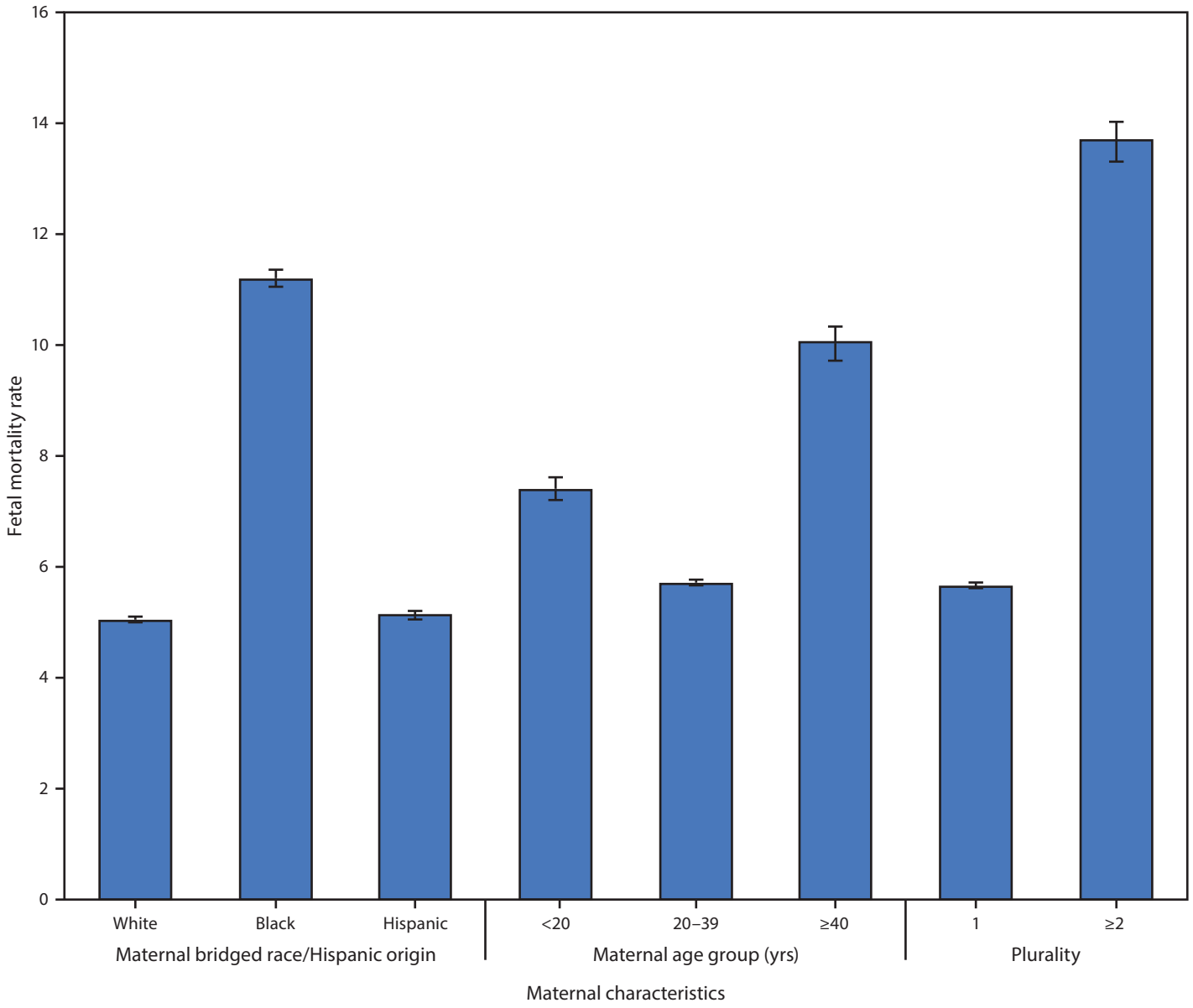
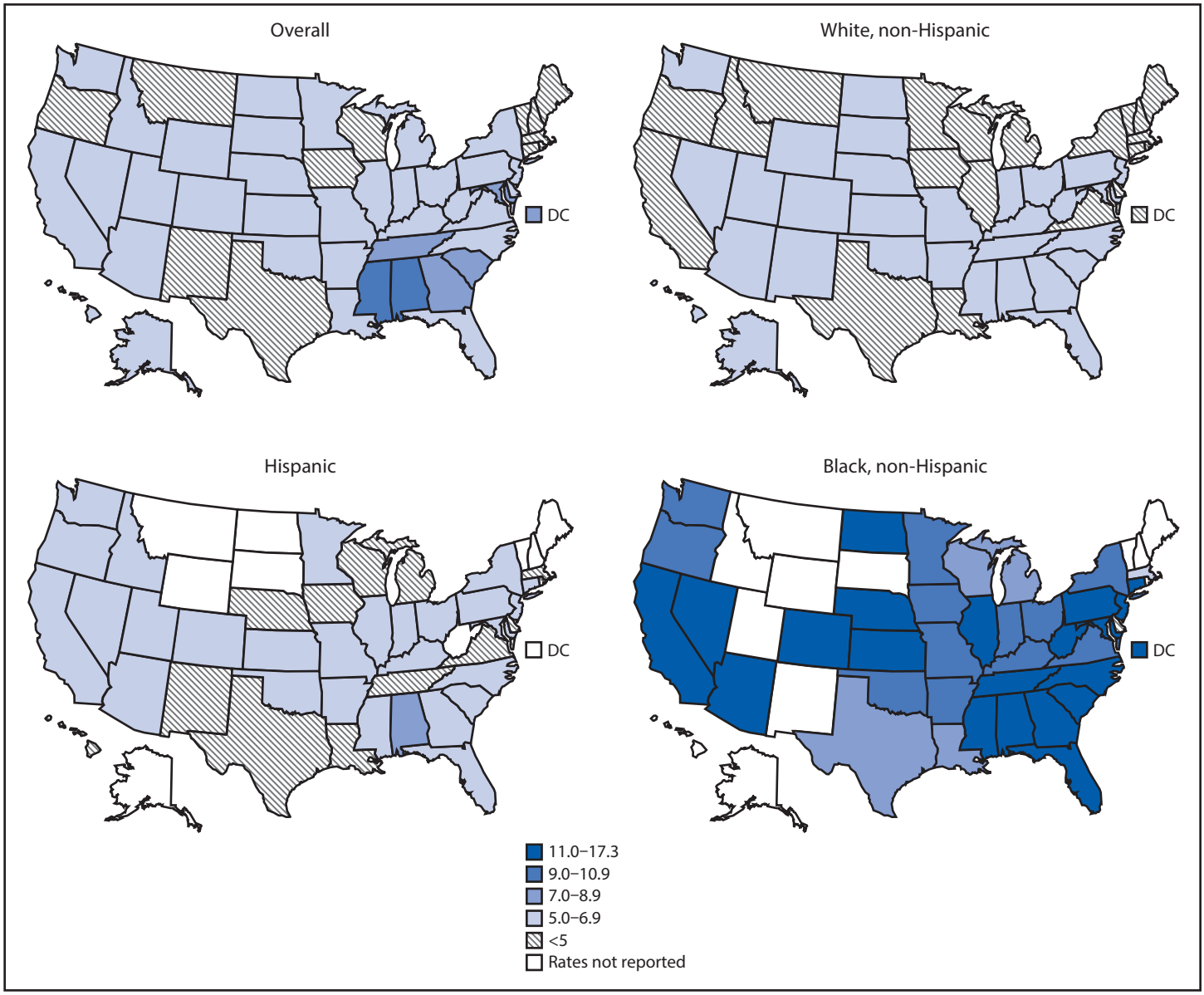
FIGURE 1. Fetal mortality rates,* by selected maternal characteristics† — United States,§ 2015–2017



* Fetal deaths per 1,000 births plus fetal deaths.
† Black women and White women were non-Hispanic; Hispanic women could be of any race.
§ Maternal bridged race/Hispanic origin excludes Rhode Island in 2015 because the state was unable to provide data on maternal race and Hispanic origin on the fetal death report.

The cause of death varied by maternal race and Hispanic origin. Among Black mothers, the rate of having a fetal death attributable to maternal conditions that might be unrelated to the present pregnancy was substantially higher than the rate among White mothers (1.4 versus 0.4; RR=3.4; 95% CI = 3.2–3.6), as was the rate of a fetal death attributable to maternal complications of pregnancy (1.8 versus 0.6; RR=3.1; 95% CI = 2.9–3.2). Compared with White mothers, Black mothers had elevated rates of fetal death attributable to syndrome of infant of a diabetic mother and neonatal diabetes mellitus (0.3 versus 0.1; RR = 2.8; 95% CI = 2.4–3.2); fetal death of unspecified cause (3.3 versus 1.6; RR = 2.0; 95% CI = 1.9–2.1); and fetus affected by complications of placenta, cord, and membranes (2.7 versus 1.4; RR = 2.0; 95% CI = 1.9–2.0). Compared with White mothers, Hispanic mothers had increased rates of fetal death attributable to maternal complications of pregnancy (0.8 versus 0.6; RR = 1.3; 95% CI 1.2–1.4) and syndrome of infant of a diabetic mother and neonatal diabetes mellitus (0.2 versus 0.1; RR = 2.1; 95% CI 1.8–2.4). No significant racial/ethnic differences in fetal mortality attributable to congenital malformations were identified.

FIGURE 2. Fetal mortality rates, by states*,† — United States, 2015–2017

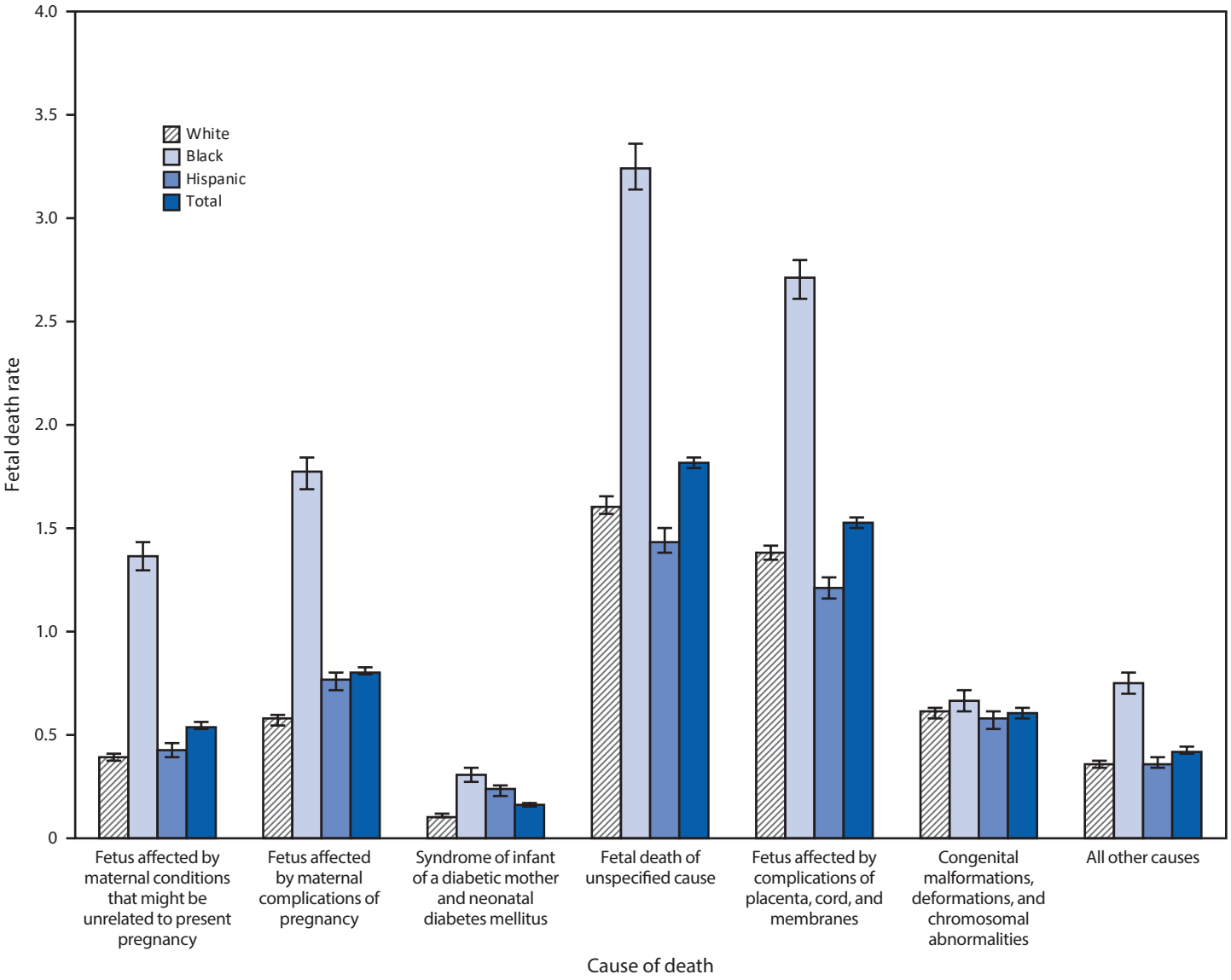


Abbreviation: DC = District of Columbia.
* Fetal deaths per 1,000 live births plus fetal deaths.
† Rates for states that reported fewer than 20 fetal deaths are not presented. The rate for Rhode Island is not presented because the state was unable to provide data on maternal race and Hispanic origin on the fetal death report in 2015.

Discussion

Fetal deaths in the United States are disproportionately higher among Black women than among White women; this racial disparity has been well-documented (*2*) and persistent (*5*). Other factors that increase the risk for fetal death include maternal age <20 or >40 years, and multiple-gestation pregnancy (*2*). This report also indicates variation in the fetal mortality rate among states; however, Black women experience increased fetal death rates nationwide. Although the reporting area differs, the most common causes of fetal death were similar to those reported previously (*6*). Findings from this report indicate that fetal mortality rates for all selected cause of death categories were higher among Black women than among White women, with the exception of congenital malformations, the rate of which was similar among all racial/ethnic groups examined. Rates of fetal mortality attributed to maternal complications of pregnancy and syndrome of infant of diabetic mother and neonatal diabetes mellitus were also increased among Hispanic women compared with those among White women.

FIGURE 3. Fetal mortality rates,* by cause of death categories and maternal race/ethnicity† among states where >50% of fetal deaths had a documented cause§,¶ — United States, 2015–2017**



* Deaths per 1,000 live births plus fetal deaths.
† White women and Black women were non-Hispanic; Hispanic women could be of any race.
§ 2015: 39 states and the District of Columbia. Excludes California, Connecticut, Georgia, Mississippi, New Jersey, New York, North Carolina, North Dakota, Tennessee, West Virginia, and Wisconsin. 2016: 38 states and the District of Columbia. Excludes California, Connecticut, Georgia, Hawaii, Mississippi, New Jersey, New York, North Dakota, Tennessee, Vermont, West Virginia, and Wisconsin. 2017: 38 states and the District of Columbia. Excludes California, Connecticut, Georgia, Michigan, Mississippi, New York, North Dakota, Rhode Island, Tennessee, Vermont, Virginia, and Wisconsin.
¶ Thirty-one percent of records are assigned to an unspecified cause of death. If reporting or diagnostic improvements resulted in more specified causes of death, fetal mortality rates for the cause of death categories could change markedly. These potential changes may differ by race/Hispanic origin.
** Excludes Rhode Island in 2015 because the state was unable to provide data on maternal race and Hispanic origin on the fetal death report.

The underlying reasons for the observed racial/ethnic disparities in fetal deaths are not fully understood. Some factors that might contribute to these disparities include differences in maternal preconception health, socioeconomic status, access to quality health care, stress, and racism, including institutional bias (*5*). There are opportunities for prevention of fetal deaths (*7*). Improvements in preconception health and prenatal care for Black women has the potential to reduce the disparity in fetal mortality rates (*5*,*8*); however, the lack of complete information on causes of fetal death has made it difficult to design and implement prevention strategies (*9*).

This findings in this report are subject to at least two limitations. First, because cause of fetal death is not available for states that do not use the 2003 revision of the fetal death report,

Summary

What is already known about this topic?

Approximately 23,000 fetal deaths occurred in the United States in 2017. Data from the National Vital Statistics System show racial/ethnic disparities in fetal mortality.

What is added by this report?

During 2015–2017, the fetal mortality rate among non-Hispanic Black women was more than twice that among non-Hispanic White women and Hispanic women. Fetal mortality rates varied by state and cause of death category. The rate of fetal death attributable to maternal complications among non-Hispanic Black women was three times that among White women.

What are the implications for public health practice?

Racial/ethnic disparities in prevalence of fetal death suggest opportunities to reduce the U.S. fetal mortality rate. Improved documentation of causes of fetal death might help guide prevention efforts.

and because jurisdictions where <50% of reports specified a cause of death were not included, presenting cause of death data nationwide was not possible. Therefore, this report is not nationally representative. Second, even in jurisdictions where >50% of reports specified a cause of death, nearly one third of records still lacked an informative cause. An improvement in reporting or diagnosis that resulted in fewer reports with unspecified causes would likely change the rate for other cause of death categories.

The U.S. fetal mortality rate has been relatively stable since 2006 (*10*), but racial/ethnic disparities persist and are demonstrated in four of the five most common cause of fetal death categories. Racial/ethnic disparities in causes of death could inform opportunities to reduce the U.S. fetal mortality rate. Results from this analysis suggest that reporting of causes of fetal deaths on fetal death reports could be improved. Given the racial/ethnic disparities in prevalence of fetal death and the incompleteness of many fetal death reports, opportunities for further research into preventable causes of fetal death are still to be determined.

Acknowledgment

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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.

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Cancers Associated with Human Papillomavirus in American Indian and Alaska Native Populations — United States, 2013–2017

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Human papillomavirus (HPV) causes most cervical cancers and some cancers of the penis, vulva, vagina, oropharynx, and anus. Cervical precancers can be detected through screening. HPV vaccination with the 9-valent HPV vaccine (9vHPV) can prevent approximately 92% of HPV-attributable cancers (*1*).* Previous studies have shown lower incidence of HPV-associated cancers in non-Hispanic American Indian and Alaska Native (AI/AN) populations compared with other racial subgroups (*2*); however, these rates might have been underestimated as a result of racial misclassification. Previous studies have shown that cancer registry data corrected for racial misclassification resulted in more accurate cancer incidence estimates for AI/AN populations (*3*,*4*). In addition, regional variations in cancer incidence among AI/AN populations suggest that nationally aggregated data might not adequately describe cancer outcomes within these populations (*5*). These variations might, in part, result from geographic disparities in the use of health services, such as cancer screening or vaccination (*6*). CDC analyzed data for 2013–2017 from central cancer registries linked with the Indian Health Service (IHS) patient registration database to assess the incidence of HPV-associated cancers and to estimate the number of cancers caused by HPV among AI/AN populations overall and by region. During 2013–2017, an estimated 1,030 HPV-associated cancers were reported in AI/AN populations. Of these cancers, 740 (72%) were determined to be attributable to HPV types targeted by 9vHPV; the majority were cervical cancers in females and oropharyngeal cancers in males. These data can help identify regions where AI/AN populations have disproportionately high rates of HPV-associated cancers and inform targeted regional vaccination and screening programs in AI/AN communities.

CDC analyzed cancer incidence data from the United States Cancer Statistics American Indian and Alaska Native Incidence Analytic Database (USCS AIAD), which includes data from central cancer registries that have been linked with the Indian Health Service (IHS) patient registration database (*4*). These methods have been shown to improve the accuracy of estimates of cancer incidence in AI/AN populations† (*3*).

Analyses were restricted to IHS purchased/referred care delivery area (PRCDA) counties, as defined in the October 10, 2017, Federal Register (82 FR 47004). These counties contain or are adjacent to federally recognized tribal lands and have higher proportions of AI/AN residents than do non-PRCDA counties. Data linkages have been shown to be most accurate in these counties (*5*). AI/AN persons accessing services through IHS are members of federally recognized tribes. Analyses were also limited to non-Hispanic populations because previous studies show that updated bridged intercensal population estimates significantly overestimate AI/AN populations of Hispanic origin (*4*).

Cancers were classified by anatomic site using the *International Classification of Diseases for Oncology, Third Edition*§ and were confirmed histologically. HPV-associated cancers were defined as invasive cancers at anatomic sites with cell types in which HPV DNA frequently is found, including carcinomas of the cervix (i.e., squamous cell cancers [SCC], adenocarcinomas, and other carcinomas) and SCC of the vulva, vagina, penis, oropharynx, and anus (including rectal SCC) (*1*).

Cancer incidence was expressed as cases per 100,000 population within PRCDA counties and, using 10 age groups, were directly age-adjusted to the 2000 U.S. standard population. Rates among non-Hispanic AI/AN populations were examined by sex, cancer type, and region. Rates by cancer type were compared with those among non-Hispanic White populations in PRCDA counties. Standardized rate ratios (RRs) were used to determine significant differences in rates ($p<0.05$). Data were suppressed when fewer than six cases were reported.

HPV status is not routinely collected in cancer registries. Therefore, to estimate the number of HPV-attributable cases, the number of HPV-associated cancers was multiplied by the percentage of each cancer type attributable to HPV, based on previous genotyping studies (*3*). Consistent with previous studies, rectal squamous cell carcinoma was not included in the genotyping study, and the HPV-attributable percentage for anal squamous cell carcinoma, a biologically similar tumor, was used (*7*).

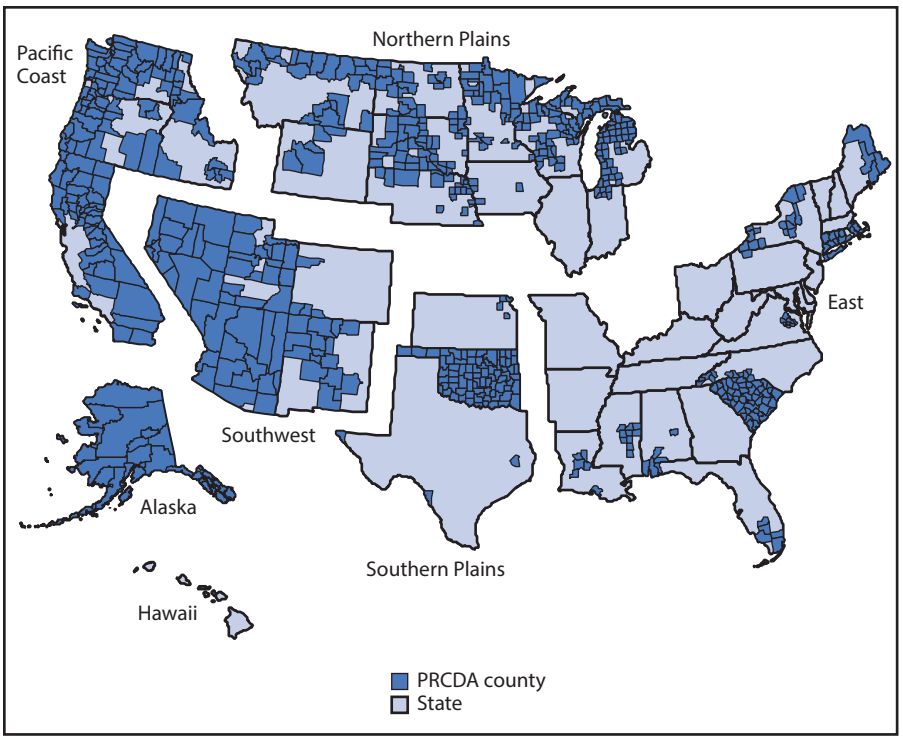
For this analysis, PRCDA counties were grouped into six regions: Alaska, East, Northern Plains, Pacific Coast, Southern Plains, and Southwest (Figure). Cervical cancer was

* Percentage of each cancer type attributable to HPV based on genotyping studies. The denominator is attributable to any HPV; the numerator is attributable to oncogenic HPV types 16, 18, 31, 33, 45, 52, and 58, for both sexes.

† Also available via the data visualization website https://gis.cdc.gov/Cancer/USCS/DataViz.html under Special Topics.

§ http://www.iacr.com.fr/index.php?option=com_content&view=category&layout=blog&id=100&Itemid=577.

FIGURE. Indian Health Service (IHS) Purchased/Referred Care Delivery Area (PRCDA)* counties, by region — United States, 2013–2017



Abbreviation: AI/AN = American Indian and Alaska Native.

* PRCDA consist of counties that contain federally recognized tribal lands or are adjacent to tribal lands. Race classification for the AI/AN population is more accurate in these counties. States that have at least one PRCDA-designated county, by IHS region and percentage of total AI/AN population residing in PRCDA counties, include Alaska (100%) (Alaska), Pacific Coast (60.3%) (California, Idaho, Oregon, and Washington), Southwest (83.9%) (Arizona, Colorado, Nevada, New Mexico, and Utah), Northern Plains (54.3%) (Indiana, Iowa, Michigan, Minnesota, Montana, Nebraska, North Dakota, South Dakota, Wisconsin, and Wyoming), Southern Plains (56.7%) (Kansas, Oklahoma, and Texas), and East (16.8%) (Alabama, Connecticut, Florida, Louisiana, Maine, Massachusetts, Mississippi, New York, North Carolina, Pennsylvania, Rhode Island, South Carolina, and Virginia). In the United States, 53.3% of the AI/AN population reside in PRCDA counties.

the most common HPV-associated cancer in AI/AN females (Table 1) in each region, and rates were significantly higher among AI/AN females than among White females, overall. Cervical cancers accounted for 57% (Northern Plains and the East) to 73% (Southwest) of HPV-associated cancers in AI/AN women. The highest rates of cervical cancer occurred in the Southern Plains (13.8 per 100,000), the lowest occurred in the East (6.5 per 100,000). Rates of other HPV-associated cancers in AI/AN females ranged from 0.7 to 2.6 per 100,000 for cancers of the anus, 0.4 to 3.1 for cancers of the oropharynx, and 0.8 to 3.6 for cancers of the vulva.

In AI/AN males, rates of HPV-associated cancers ranged from 10.0 (East) to 14.9 per 100,000 (Southern Plains) (Table 1). Oropharyngeal cancers were the most common cancers among AI/AN males across all regions, accounting for 67% (Alaska) to 86% (Northern Plains) of all HPV-associated cancers. Rates of oropharyngeal cancer were the highest in the Southern Plains (12.2 per 100,000) and lowest in the Southwest (3.3 per 100,000). Rates of other HPV-associated cancers in AI/AN males ranged from 0.5 to 1.7 per 100,000 for cancers of the penis and anus.

For all regions combined, rates of all HPV-associated cancers were higher among AI/AN females than among White females (RR = 1.16) and lower among AI/AN males than among White males (RR = 0.86) (Table 1). Among AI/AN females, 63% of HPV-associated cancers were cervical cancer, compared with 39% in White females. Rates of cervical cancer also were higher among AI/AN females than among White females (RR = 1.58). Rates of cancers of the anus were lower among AI/AN females than among White females (RR = 0.61). In AI/AN males, cancers of the oropharynx represented 82% of HPV-associated cancers, compared with 83% in White males. Rates of oropharyngeal cancers were lower in AI/AN males than in White males (RR = 0.84).

During 2013–2017, among the estimated 500 cancers in AI/AN females that could have been prevented by 9vHPV, 330 were cervical cancers (Table 2). Among AI/AN males, a majority of the estimated 240 cancers that could have been prevented by 9vHPV were cancers of the oropharynx. The largest number of potentially vaccine-preventable cancers in AI/AN occurred among those in the Pacific Coast (180) and Southern Plains (230).

Discussion

Incidence of HPV-associated cancers in AI/AN populations varied by geographic region and sex. Overall, rates of HPV-associated cancers were higher in AI/AN females, but lower in AI/AN males when compared with rates in the non-Hispanic White population. Cervical cancer and oropharyngeal cancers accounted for the highest incidences, compared with other HPV-associated cancers among AI/AN females and males, respectively.

HPV vaccination is an important element of primary cancer prevention (*8*) and recommended for prevention of all cancer types associated with HPV, including cervical and oropharyngeal cancers.¶ The Advisory Committee on Immunization Practices recommends routine HPV vaccination at age 11–12 years and catch-up HPV vaccination for all adults through age 26 years.** The *Healthy People 2020* target is for

¶ https://www.cdc.gov/cancer/hpv/basic_info/.

TABLE 1. Incidence* and percent distribution of human papillomavirus (HPV)-associated cancers,† by sex, cancer type, region, and race/ethnicity§ — Indian Health Service (IHS) Purchased/Referred Care Delivery Area (PRCDA) counties,¶ United States, 2013–2017

Characteristic	AI/AN, rate (%)						All regions combined		
	Northern Plains	Alaska	Southern Plains	Pacific Coast	East	Southwest	AI/AN, rate (%)	Non-Hispanic White, rate (%)	RR
Sex, cancer type									
Female									
All HPV-associated cancers	20.0 (100)	21.6 (100)	21.1 (100)	18.5 (100)	11.1 (100)	8.9 (100)	15.9 (100)	13.7 (100)	1.16**
Cervix	11.2 (57)	12.8 (59)	13.8 (65)	12.6 (63)	6.5 (57)	6.6 (73)	10.3 (63)	6.5 (39)	1.58**
Vagina	—††	—	—	—	—	—	0.4 (2)	0.4 (3)	1.11
Vulva	3.6 (16)	3.1 (12)	3.3 (16)	1.1 (8)	1.9 (17)	0.8 (8)	2.0 (13)	2.2 (18)	0.93
Oropharynx	2.3 (11)	3.1 (14)	1.8 (9)	2.1 (14)	—	0.4 (5)	1.5 (10)	1.9 (16)	0.80
Anus	2.6 (13)	2.0 (12)	1.7 (9)	2.5 (15)	—	0.7 (9)	1.7 (11)	2.7 (23)	0.61**
Male									
All HPV-associated cancers	10.6 (100)	11.4 (100)	14.9 (100)	12.7 (100)	10.0 (100)	4.1 (100)	10.2 (100)	11.8 (100)	0.86**
Oropharynx	9.0 (86)	6.3 (67)	12.2 (83)	10.3 (81)	8.6 (84)	3.3 (78)	8.2 (82)	9.7 (83)	0.84**
Anus	—	—	1.7 (10)	1.3 (11)	—	—	1.1 (11)	1.4 (11)	0.78
Penis	—	—	1.1 (7)	1.1 (7)	—	0.5 (13)	0.9 (8)	0.7 (6)	1.26

Abbreviations: AI/AN = American Indians and Alaska Natives; ICD-O-3 = *International Classification of Diseases for Oncology, Third Edition*; RR = rate ratio.

* Cases per 100,000 persons; age-adjusted to the 2000 U.S. standard population.

† HPV-associated cancers were defined as invasive cancers at anatomic sites with cell types in which HPV DNA frequently is found. All cancers were histologically confirmed. Cervical cancers (ICD-O-3 site codes C53.0–C53.9) are limited to carcinomas (ICD-O-3 histology codes 8010–8671, 8940–8941). Vaginal (ICD-O-3 site code C52.9), vulvar (ICD-O-3 site codes C51.0–C51.9), penile (ICD-O-3 site codes C60.0–60.9), anal (ICD-O-3 site codes C20.9, C21.0–C21.9) and oropharyngeal cancers are limited to squamous cell carcinomas (ICD-O-3 histology codes 8050–8084, 8120–8131).

§ AI/AN race was reported by cancer registries or identified through linkage with the IHS patient registration database. To minimize racial/ethnic misclassification, analyses were restricted to AI/AN of non-Hispanic origin.

¶ Compiled from data for 2013–2017 from 50 states and the District of Columbia in cancer registries that met data quality criteria and linked with the IHS patient registration database; based on patients who resided in a PRCDA-designated county. States that have at least one PRCDA-designated county, by region and percentage of total AI/AN population residing in PRCDA counties, include Alaska (100%) (Alaska), Pacific Coast (60.3%) (California, Idaho, Oregon, and Washington), Southwest (83.9%) (Arizona, Colorado, Nevada, New Mexico, and Utah), Northern Plains (54.3%) (Indiana, Iowa, Michigan, Minnesota, Montana, Nebraska, North Dakota, South Dakota, Wisconsin, and Wyoming), Southern Plains (56.7%) (Kansas, Oklahoma, and Texas), and East (16.8%) (Alabama, Connecticut, Florida, Louisiana, Maine, Massachusetts, Mississippi, New York, North Carolina, Pennsylvania, Rhode Island, South Carolina, and Virginia). In the United States, 53.3% of the AI/AN population reside in PRCDA counties.

** For all regions combined, the rate among AI/AN was significantly ($p<0.05$) different from the rate among non-Hispanic Whites.

†† Dash indicates that data were suppressed when fewer than six cases were reported.

80% of teens aged 13–15 years to receive 2 or 3 doses of HPV vaccine.†† In 2018, approximately 85.1% of IHS adolescent patients aged 13–17 years had received at least their first dose of HPV vaccine, 73.3% had received 2 doses, and 48.4% had received 3 doses.§§ First dose HPV vaccination estimates from the National Immunization Survey-Teen are approximately 70% for AI/AN teens, and up-to-date coverage is estimated to be approximately 57.3%.¶¶ Despite the high rates of first dose vaccination, HPV vaccination still lags behind coverage for other vaccines administered in the same age range, suggesting that local and culturally tailored interventions might increase coverage (*9*).

In addition to HPV vaccination, screening is an important strategy to prevent cervical cancer, the only HPV-associated cancer that has routine screening recommendations. In 2017, only 54.8% of AI/AN women had been screened according to current cervical cancer screening recommendations, despite the *Healthy People 2020* target of 95% (*10*). Federal programs such as CDC's National Breast and Cervical Cancer Early Detection Program provide access to cervical cancer screening and diagnostic services to underserved women.*** Partnerships also have been established with tribal programs, states, and other organizations to increase outreach and education for AI/AN women. The current coronavirus disease 2019 (COVID-19) pandemic is potentially disrupting recommended screening and prevention services in underserved populations. Future studies can evaluate the effect of the COVID-19 pandemic on receipt of preventive health services in Indian country.

The findings in this report are subject to at least three limitations. First, population-based cancer registries do not routinely collect or report information on HPV genotype status in cancer registries; therefore, HPV-attributable cancers

** https://www.cdc.gov/vaccines/vpd/hpv/hcp/recommendations.html.

†† IID-114 and IID-11.5; https://www.healthypeople.gov/2020/topics-objectives/topic/immunization-and-infectious-diseases/objectives.

§§ https://www.ihs.gov/sites/epi/themes/responsive2017/display_objects/documents/vaccine/reports/FY18_4thQuarter.pdf. IHS does not currently report "up to date" according to those with ≥3 doses, and those with 2 doses when the first HPV vaccine dose was initiated before age 15 years.

¶¶ https://stacks.cdc.gov/view/cdc/80676.

*** https://www.cdc.gov/cancer/nbccedp/index.htm.

TABLE 2. Estimated number of human papillomavirus (HPV)–attributable cancers,* by sex, cancer type,† region, and HPV type,§ among American Indians and Alaska Natives¶ — Indian Health Service (IHS) Purchased/Referred Care Delivery Area (PRCDA) counties, United States, 2013–2017**

Characteristic	Estimated no.		
	9vHPV-targeted	Other HPV	HPV-negative
All HPV-associated cancers	**740**	**90**	**200**
Sex			
Female	500	50	100
Male	240	40	100
Cancer type			
Cervix	330	40	40
Vagina	10	<10	<10
Vulva	50	10	30
Oropharynx	230	40	110
Anus	100	<10	10
Penis	20	<10	10
Region			
Northern Plains	130	20	40
Alaska	60	10	20
Southern Plains	210	30	60
Pacific Coast	180	20	50
East	50	10	10
Southwest	110	10	30

Abbreviations: 9vHPV = 9-valent HPV vaccine; ICD-O-3 = *International Classification of Diseases for Oncology, Third Edition*.

* HPV-attributable cancers are cancers that are probably caused by HPV (https://academic.oup.com/jnci/article/107/6/djv086/872092). Estimates for attributable fraction were based on studies that used population-based data from cancer tissue studies to estimate the percentage of those cancers probably caused by HPV.

† HPV-associated cancers were defined as invasive cancers at anatomic sites with cell types in which HPV DNA frequently is found. All cancers were histologically confirmed. Cervical cancers (ICD-O-3 site codes C53.0–C53.9) are limited to carcinomas (ICD-O-3 histology codes 8010–8671, 8940–8941). Vaginal (ICD-O-3 site code C52.9), vulvar (ICD-O-3 site codes C51.0–C51.9), penile (ICD-O-3 site codes C60.0–60.9), anal (ICD-O-3 site codes C20.9, C21.0–C21.9), and oropharyngeal (ICD-O-3 site codes C01.9, C02.4, C02.8, C05.1, C05.2, C09.0, C09.1, C09.8, C09.9, C10.0, C10.1, C10.2, C10.3, C10.4, C10.8, C10.9, C14.0, C14.2 and C14.8) cancer sites are limited to squamous cell carcinomas (ICD-O-3 histology codes 8050–8084, 8120–8131).

§ "9vHPV-targeted" includes oncogenic HPV types 16, 18, 31, 33, 45, 52, and 58. "Other HPV" includes other oncogenic HPV types. "HPV-negative" cancers are those that occur at anatomic sites in which HPV-associated cancers are often found, but HPV DNA was not detected. The estimated number of HPV-attributable cancers was calculated by multiplying the number of HPV-associated cancer cases by the percentage of each cancer type attributable to HPV, grouped as types targeted by 9vHPV and other HPV types. HPV-negative estimates were the difference of the total count and the HPV-attributable estimates. Estimates were rounded to the nearest 10; estimates <10 are not displayed.

¶ AI/AN race was reported by cancer registries or identified through linkage with the IHS patient registration database. To minimize racial/ethnic misclassification, analyses were restricted to AI/AN of non-Hispanic origin.

** Compiled from data for 2013–2017 from 50 states and the District of Columbia in cancer registries that met data quality criteria and linked with the IHS patient registration database; based on patients who resided in a PRCDA-designated county. States that have at least one PRCDA-designated county, by region and percentage of total AI/AN population residing in PRCDA counties, include Alaska (100%) (Alaska), Pacific Coast (60.3%) (California, Idaho, Oregon, and Washington), Southwest (83.9%) (Arizona, Colorado, Nevada, New Mexico, and Utah), Northern Plains (54.3%) (Indiana, Iowa, Michigan, Minnesota, Montana, Nebraska, North Dakota, South Dakota, Wisconsin, and Wyoming), Southern Plains (56.7%) (Kansas, Oklahoma, and Texas), and East (16.8%) (Alabama, Connecticut, Florida, Louisiana, Maine, Massachusetts, Mississippi, New York, North Carolina, Pennsylvania, Rhode Island, South Carolina, and Virginia). In the United States, 53.3% of the AI/AN population reside in PRCDA counties.

Summary

What is already known about this topic?

Human papillomavirus (HPV) causes nearly all cervical cancers and some cancers of the vagina, vulva, penis, anus, and oropharynx. Racial misclassification of American Indian and Alaska Native (AI/AN) populations in cancer registry data results in cancer incidence underestimates.

What is added by this report?

In data from central cancer registries linked with Indian Health Service patient information, 740 (72%) of 1,030 HPV-associated cancers among AI/AN were estimated to be types targeted by 9-valent HPV vaccine. Oropharyngeal cancers were the most common HPV-associated cancers among AI/AN males, and cervical cancers were the most common among AI/AN females.

What are the implications for public health practice?

Surveillance for HPV-associated cancers by region can inform local HPV vaccination and cervical cancer screening efforts targeting AI/AN communities.

can only be estimated. Second, this report only includes data for members of federally recognized tribes and those who have accessed services through IHS. Rates might differ for AI/AN populations not included in this report. Finally, although the exclusion of Hispanic AI/AN persons from the analyses reduced the overall AI/AN incidence by less than 5% (*4*), this exclusion might disproportionally affect rates in some states and regions.

Data from the central cancer registries can be used to monitor the long-term effect of HPV vaccination and current cancer screening strategies for AI/AN populations. Understanding the regional variation of HPV-associated cancers can aid in the development of targeted and culturally appropriate interventions to address disparities in AI/AN populations.

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Serial Testing for SARS-CoV-2 and Virus Whole Genome Sequencing Inform Infection Risk at Two Skilled Nursing Facilities with COVID-19 Outbreaks — Minnesota, April–June 2020

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SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19), can spread rapidly in high-risk congregate settings such as skilled nursing facilities (SNFs) (*1*). In Minnesota, SNF-associated cases accounted for 3,950 (8%) of 48,711 COVID-19 cases reported through July 21, 2020; 35% of SNF-associated cases involved health care personnel (HCP*), including six deaths. Facility-wide, serial testing in SNFs has been used to identify residents with asymptomatic and presymptomatic SARS-CoV-2 infection to inform mitigation efforts, including cohorting of residents with positive test results and exclusion of infected HCP from the workplace (*2*,*3*). During April–June 2020, the Minnesota Department of Health (MDH), with CDC assistance, conducted weekly serial testing at two SNFs experiencing COVID-19 outbreaks. Among 259 tested residents, and 341 tested HCP, 64% and 33%, respectively, had positive reverse transcription–polymerase chain reaction (RT-PCR) SARS-CoV-2 test results. Continued SARS-CoV-2 transmission was potentially facilitated by lapses in infection prevention and control (IPC) practices, up to 12-day delays in receiving HCP test results (53%) at one facility, and incomplete HCP participation (71%). Genetic sequencing demonstrated that SARS-CoV-2 viral genomes from HCP and resident specimens were clustered by facility, suggesting facility-based transmission. Residents and HCP working in SNFs are at risk for infection with SARS-CoV-2. As part of comprehensive COVID-19 preparation and response, including early identification of cases, SNFs should conduct serial testing of residents and HCP, maximize HCP testing participation, ensure availability of personal protective equipment (PPE), and enhance IPC practices† (*4*–*5*).

Interim guidance for HCP mask use and SNF visitor restriction was implemented statewide by March 31, 2020; however, during April, an increase in COVID-19 diagnoses and deaths among SNF residents in Minnesota occurred. In light of the release of CDC interim guidance on May 1 (*6*), and in an effort to improve IPC and implement facility-wide SARS-CoV-2 testing, two SNFs located in the Minneapolis-St. Paul metropolitan area contacted MDH after identifying multiple confirmed resident and HCP COVID-19 cases. During April 30–June 12, nasal, nasopharyngeal, or oral swabs were collected from residents and HCP and were tested to detect SARS-CoV-2 nucleic acid by RT-PCR, which was conducted at MDH Public Health Laboratory (MDH-PHL) and multiple commercial laboratories (*6*). After a first round of testing on April 30 and May 7 in facilities A and B, respectively, serial testing was conducted in residents every 7–10 days. HCP were offered testing services at the facility during serial testing of residents as well as whenever it was convenient to account for work schedules. Residents and HCP with positive test results were excluded from future serial testing. Starting in mid-March, HCP were screened daily for COVID-19–compatible symptoms, and symptomatic HCP were sent home per MDH and CDC guidance.§ Symptomatic residents and HCP were tested outside of scheduled serial testing. Data on symptoms, demographic characteristics, and HCP work assignment were collected from resident charts, MDH COVID-19 case interviews, and SNF administrator interviews. MDH and CDC provided frequent onsite IPC assessment to both facilities, including review of cohorting, hand hygiene practices, and use of PPE. Residents with positive SARS-CoV-2 test results were moved to a COVID-19 care unit within each facility, and HCP with positive test results were excluded from work for at least 10 days (*7*). Whole genome sequencing was conducted by MDH-PHL on available¶ specimens using previously described methods (*8*). Phylogenetic relationships, including distinct clustering of viral whole genome sequences,

* HCP include, but are not limited to, emergency medical service personnel, nurses, nursing assistants, physicians, technicians, therapists, phlebotomists, pharmacists, students and trainees, contractual staff members not employed by the health care facility, and persons not directly involved in patient care, but who could be exposed to infectious agents that can be transmitted in the health care setting (e.g., clerical, dietary, environmental services, laundry, security, engineering and facilities management, administrative, billing, and volunteer personnel). HCP does not include clinical laboratory personnel.

† https://www.cms.gov/files/document/qso-20-30-nh.pdf.

§ https://www.health.state.mn.us/diseases/coronavirus/hcp/hcwrecs.pdf.

¶ Available HCP and resident specimens were those tested and stored at MDH-PHL or sent to MDH by collaborating laboratories and those from which RNA was successfully extracted.

were inferred based on nucleotide differences via IQ-TREE, using general time reversible substitution models (*9*) as a part of the Nextstrain workflow (*10*). Descriptive analyses were conducted using R (version 3.6.1; The R Foundation). This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.**

Facility A

As of April 14, the census at facility A included 78 residents, with 156 HCP. Before serial testing (April 17–29), COVID-19 was laboratory-confirmed in 14 (18%) symptomatic residents. Facility A conducted three rounds of testing during April 30–May 18. During the first round of serial testing, 23 (43%) of 53 tested residents had positive SARS-CoV-2 RT-PCR test results (Figure 1); 11 refused testing. Between the first and second rounds of testing, supplementary†† testing of residents at risk, including nine persons who refused the first round of testing, identified 12 confirmed cases among 18 persons tested. During the second and third rounds, 4% (one of 24) and 5% (one of 21) of residents, respectively, tested positive; ongoing clinical monitoring and testing of symptomatic residents did not detect additional cases. Overall, 51 (66%) of 77§§ residents tested had positive test results; 14 (27%) were hospitalized and 12 (24%) died.

During April 15–29, 15 (10%) symptomatic HCP at facility A received diagnoses of confirmed COVID-19 by their health care providers (Figure 1). Among those 15 HCP, 14 (93%) worked on the third floor, where 12 of 14 residents with positive test results resided. During the first round of resident testing (April 30), specimens were collected from 43 HCP, eight (20%) of whom received a positive test result. During April 15–June 11, among 156 HCP, 108 (69%) were tested, 38 (35%) of whom had positive test results. Twenty-three (21%) HCP were tested more than once; among these, five (22%) had a positive test result after an initial negative test.

Facility B

On April 29, the census at facility B included 183 residents with 324 HCP. Before serial testing (April 29–May 6), 24 (13%) residents had had positive SARS-CoV-2 test results after symptom onset or being tested as a roommate contact (Figure 1). Facility B conducted six rounds of testing during May 7–June 11. During the first, second, third, and fourth rounds, 24% (36 of 153), 25% (26 of 106), 16% (12 of 75), and 10% (six of 59) of residents, respectively, had positive test results. No new cases were identified among the 50 facility B residents tested in the last two rounds. Overall, among 182 residents tested, 114 (63%) COVID-19 cases were identified; 19 (17%) were hospitalized, and 40 (35%) died.

An initial round of onsite HCP testing was offered in facility B during May 1–6; 30 (42%) of 71 HCP tested on site, and one HCP tested by a primary health care provider had positive SARS-CoV-2 test results (Figure 1). Among the 31 HCP COVID-19 cases, 18 (58%) HCP worked on the first floor, where 21 (88%) of 24 infected residents were initially identified. During May 1–7, reporting of results was delayed up to 12 days for 124 HCP tested by a commercial laboratory, 44 (35%) of whom had positive SARS-CoV-2 test results; subsequently, a different laboratory was used. Overall, from May 1–June 12, 233 (72%) of 324 HCP were tested, 76 (33%) of whom had positive test results. A total of 124 (53%) results from initial HCP tests were delayed up to 12 days. Forty-nine (21%) HCP were tested more than once, including nine (18%) who had a positive test after initially testing negative.

Characteristics of COVID-19 Cases in Health Care Personnel

Among 114 total HCP COVID-19 cases diagnosed at facilities A and B, 73 (64%) were in nurses or nursing assistants who provided direct resident care. Additional infections were identified among HCP not involved in direct care, including 13 dietary, six housekeeping, and eight social services staff members (Table). Among the 114 HCP cases, four (4%) were hospitalized, and two (2%) died. Fifty-eight (51%) persons were symptomatic on the day of testing. Among 65 HCP interviewed by MDH, 30 (46%) reported working on or after the date of their symptom onset before receiving positive test results.

Whole Genome Sequencing

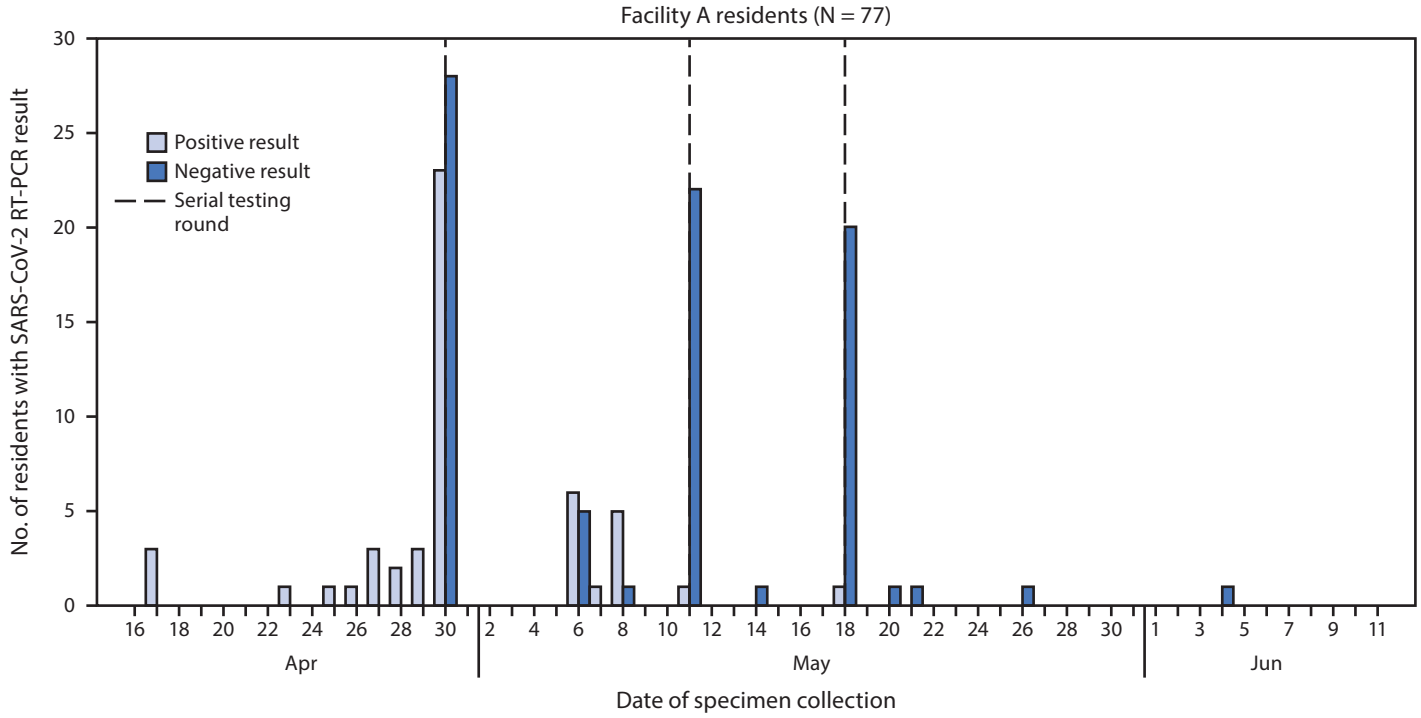
Specimens from 18 (35%) residents and seven (18%) HCP at facility A were sequenced (Figure 2). Strains from 17 residents and five HCP were genetically similar, including one collected from a dietary worker with limited resident contact. Specimens from two HCP and one resident at facility A had distinctly different virus sequences from the first cluster and from each other. At facility B, 75 (66%) resident specimens and five (7%) HCP specimens were sequenced, all of which were genetically similar. The observed viral diversity of specimens associated within the two facilities was less than that observed in all sequenced specimens sampled from Minnesota cases in the community during the same period, April–June 2020 (data not shown).

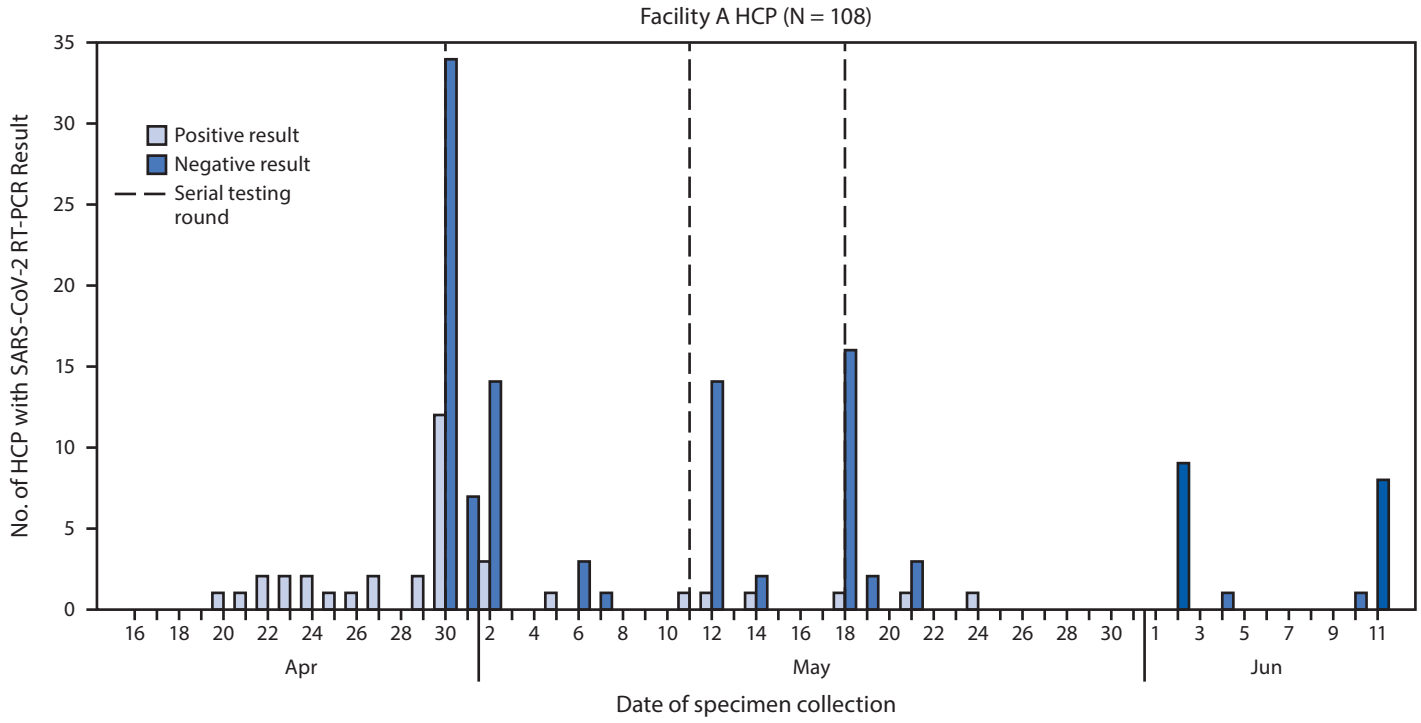
** 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. **241(d); 5 U.S.C. **552a; 44 U.S.C. **3501 et seq.

†† Supplementary testing of nine residents who refused testing on April 30 was performed on May 5; five results were positive. Supplementary testing was performed on residents when it was discovered that two of these residents with positive test results lived in the memory care unit and had interacted with residents in that unit, and another seven cases were detected.

§§ One resident at each of facility A and B refused testing throughout the outbreak and both were treated with transmission-based precautions.

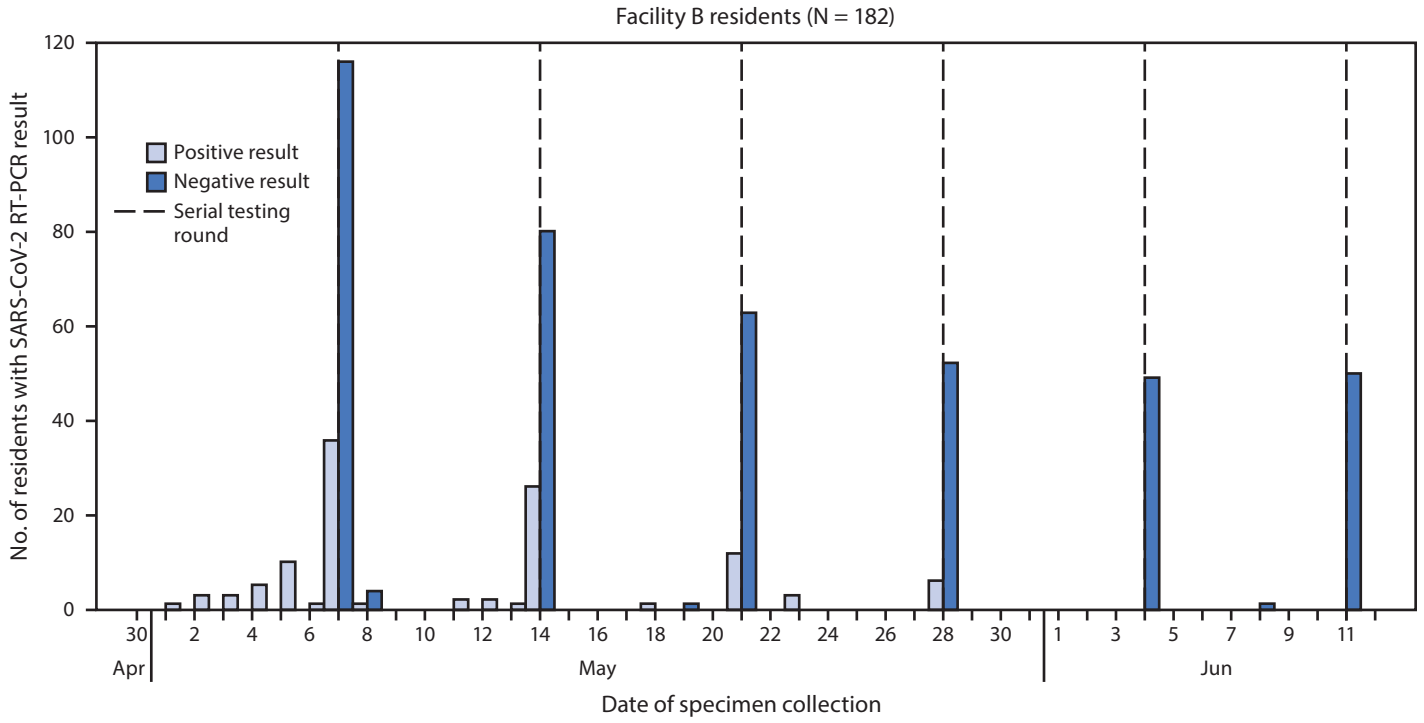
FIGURE 1. Date of serial testing round and daily specimen test results*,†,§ for SARS-CoV-2 detection by reverse transcription–polymerase chain reaction (RT-PCR) testing — two skilled nursing facilities, Minnesota, April–June 2020

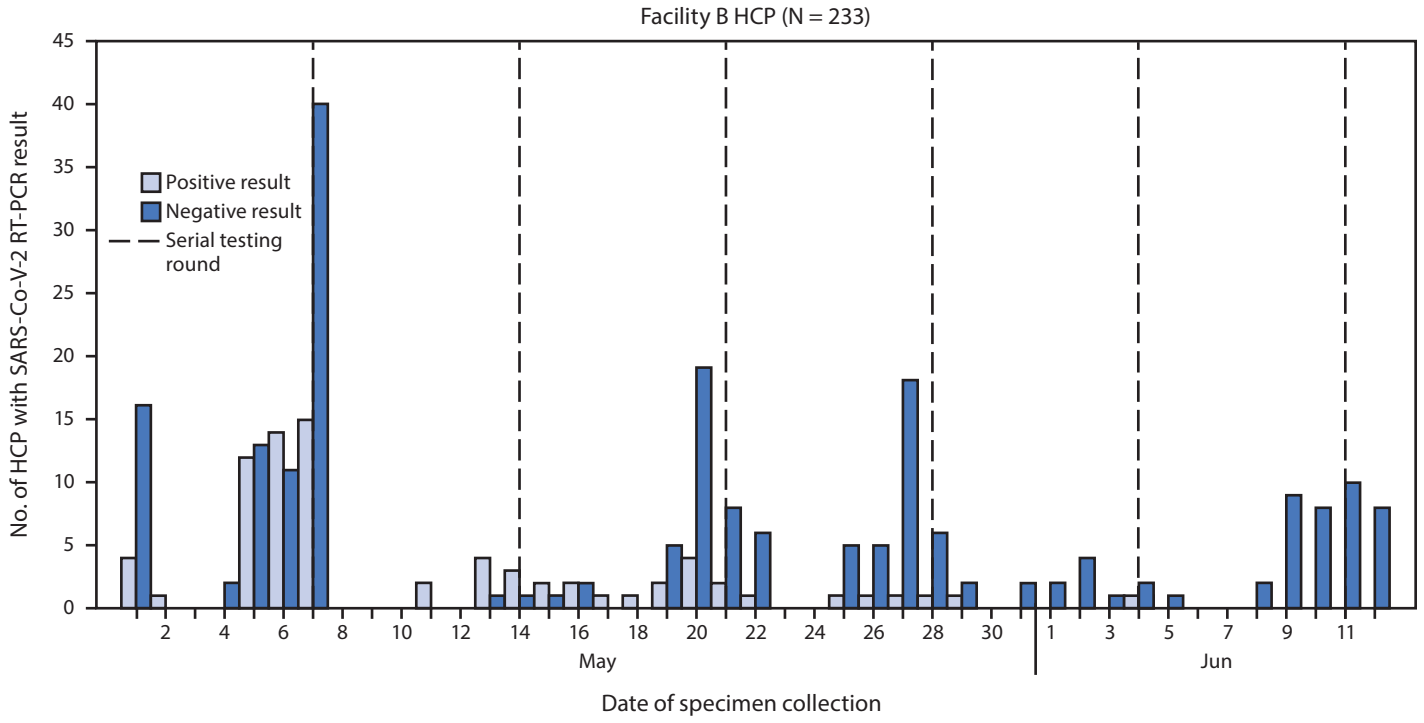




See figure footnotes on the next page.

FIGURE 1. (*Continued*) Date of serial testing round and daily specimen test results*,†,§ for SARS-CoV-2 detection by reverse transcription–polymerase chain reaction (RT-PCR) testing — two skilled nursing facilities, Minnesota, April–June 2020





Abbreviation: HCP = health care personnel.

* In facility A, two residents had indeterminate results for specimens collected on April 30; one resident had a positive test result on May 7 and one resident had another indeterminate test result on May 11 before a negative test result on May 14.

† In facility A, one HCP had an indeterminate test result on May 21 and was not retested.

§ In facility B, one resident had an indeterminate result on May 7 and had a positive test result on May 14, one resident had an indeterminate result on May 28 and had a negative test result on June 4, and one resident had an indeterminate result on June 4 and had a negative test result on June 8.

TABLE. Demographic characteristics, symptoms, and risk characteristics of health care personnel (HCP) and residents with positive SARS-CoV-2 test results — facility A and facility B, Minnesota, April–June 2020

Characteristic	No. (%)			
	Facility A		Facility B	
	Health care personnel (N = 38)	Residents (N = 51)	Health care personnel (N = 76)	Residents (N = 114)
Sex				
Male	8 (21)	26 (51)	22 (29)	50 (44)
Female	30 (79)	25 (49)	53 (70)	64 (56)
Unknown	0 (—)	0 (—)	1 (1)	0 (—)
Age, yrs				
Median (range)	52 (18–66)	72 (33–100)	45 (17–65)	81 (52–105)
Symptomatic*,† on date of testing	26 (68)	20 (39)	32 (42)	75 (66)
No symptoms*,† on date of testing	12 (32)	31 (61)	44 (58)	39 (34)
Symptom onset ≤14 days after testing	0 (–)	28 (55)	2 (3)	35 (31)
Asymptomatic	6 (16)	3 (6)	3 (4)	4 (4)
Risk behaviors/practices				
Worked on or after date of symptom onset†				
Yes	16 (42)	N/A	14 (18)	N/A
No	12 (32)	N/A	16 (21)	N/A
Unknown/Missing	10 (26)	N/A	46 (61)	N/A
Staff member role				
Nurse/Certified nursing assistant	20 (53)	N/A	53 (70)	N/A
Nursing administration	1 (3)	N/A	2 (3)	N/A
Dietary	5 (13)	N/A	8 (11)	N/A
Rehabilitation	0 (—)	N/A	4 (5)	N/A
Social services	2 (5)	N/A	6 (8)	N/A
Administration	2 (5)	N/A	0 (—)	N/A
Housekeeping	3 (8)	N/A	3 (4)	N/A
Maintenance	1 (3)	N/A	0 (—)	N/A
Unknown/Missing	4 (11)	N/A	0 (—)	N/A
Area worked/resided				
1st floor	2 (5)	12 (24)	16 (21)	51 (45)
2nd floor	1 (3)	1 (2)	15 (20)	26 (23)
3rd floor	10 (26)	22 (43)	3 (4)	16 (14)
Multiple floors	17 (45)	0 (—)	17 (22)	12 (11)
Memory care§	1 (3)	16 (31)	5 (7)	9 (8)
COVID-19 unit	0 (—)	0 (—)	3 (4)	0 (—)
Unknown/Missing	7 (18)	0 (—)	17 (22)	0 (—)

Abbreviations: COVID-19 = coronavirus disease 2019; N/A = not applicable.

* Symptoms screening data incomplete for three residents at facility A and two residents at facility B. At facility A, one resident was discharged to another facility 2 days after a positive test result (presumed asymptomatic), one resident was evaluated at a hospital for abdominal pain and had a positive SARS-CoV-2 test result the following day (presumed asymptomatic), and one resident was evaluated at a hospital for severe chest pain and decreased oxygen saturation 4 days after a positive test result (presumed symptom onset ≤14 days after testing). At facility B, one resident was evaluated at a hospital for shortness of breath 7 days after positive SARS-CoV-2 test result (presumed symptom onset ≤14 days after testing), and one resident was admitted to hospital unresponsive with low oxygen saturation on date of testing (presumed symptomatic on date of testing).

† Eight HCP at facility A and 41 HCP at facility B were not interviewed by Minnesota Department of Health. All HCP were screened for symptoms and temperature upon entering the facility and excluded if they had COVID-19–compatible symptoms; therefore, HCP with unknown or missing symptoms data who tested on the day of a facility-wide screening (six HCP at facility A and 39 HCP at facility B) were presumed asymptomatic on date of testing. HCP with unknown or missing symptoms data who were tested by their primary care provider (three HCP at facility A and three HCP at facility B) were presumed symptomatic on date of testing.

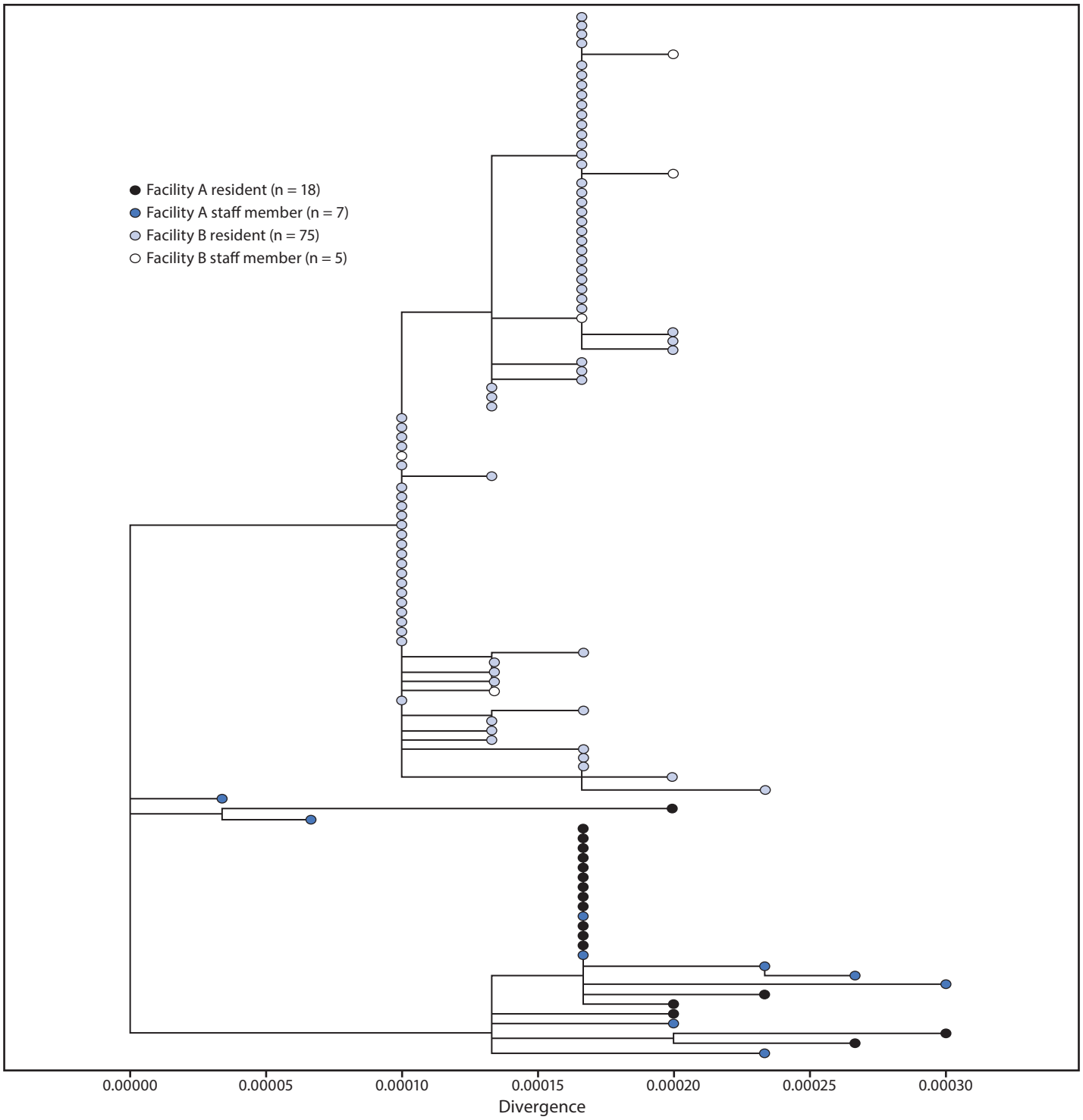
§ Memory care unit was located on second floor or third floor.

Discussion

SARS-CoV-2 transmission was decreased by early identification of asymptomatic infections through introduction of facility-wide testing and prompt implementation of mitigation efforts, including cohorting of infected residents and exclusion of infected HCP in two SNFs in Minnesota. Challenges to case identification and outbreak control included delays in reporting of test results, HCP working while symptomatic, and low baseline knowledge of and experience with IPC and PPE use. Low HCP participation in serial testing limited complete identification of infections. Anecdotal reports from HCP included anxiety about receiving positive test results, including financial losses resulting from work exclusion, and concern about workplace and community stigma.

SARS-CoV-2 viral RNA sequences isolated from HCP and residents were genetically most similar to other strains associated with the same facility, suggesting transmission within the facility. Two HCP from facility A had genetically distinct

FIGURE 2. Phylogenetic trees showing genetic distance between available* SARS-CoV-2 virus specimens collected from health care personnel (HCP) and residents at facility A† and facility B§— Minnesota, April–June 2020



* Genetic divergence based on nucleotide difference is indicated by length of branches. Available specimens included specimens tested and stored at Minnesota Public Health Laboratory and commercial labs where specimens could be retrieved and where RNA could be extracted.

† Available specimens from facility A included HCP and residents diagnosed after April 29. At facility A, 17 resident and five HCP specimens had genetically similar virus strains, including one HCP with limited resident contact. Two HCP had virus sequences that were genetically different from the facility A cluster and were more similar to cases associated with community transmission in Minnesota. A third strain identified in a resident during the third testing round was genetically different from both HCP and resident strains.

§ Available specimens from facility B included HCP diagnosed after May 6 and residents diagnosed after April 29, throughout the outbreak. At facility B, 75 resident specimens and five HCP specimens shared genetically related strains.

Summary

What is already known about this topic?

Facility-wide, serial testing in skilled nursing facilities (SNFs) can identify asymptomatic SARS-CoV-2 infections among health care personnel (HCP) and residents to inform mitigation efforts.

What is added by this report?

Serial facility-wide testing at two Minnesota SNFs identified COVID-19 cases among 64% of residents and 33% of HCP. Genetic sequencing found facility-specific clustering of viral genomes from HCP and residents' specimens, suggesting intrafacility transmission.

What are the implications for public health practice?

HCP working in SNFs are at risk for infection during COVID-19 outbreaks. To protect residents and prevent SARS-CoV-2 infection among HCP, SNFs need enhanced infection prevention and control practices, assured availability of personal protective equipment, improved HCP testing participation, flexible medical leave, and timely result reporting.

strains, highlighting the additional risk for community-acquired infections among HCP and the potential for multiple introductions. Sequence similarity among resident and HCP specimens and high rates of HCP infection, including in HCP with limited resident contact, highlight the potential for transmission between HCP or indirect routes of HCP infection from residents.

The findings in this report are subject to at least four limitations. First, symptom status might have been misclassified because case investigation data were incomplete. Second, not all eligible residents participated in each testing round, and some results were indeterminate and required follow-up repeat testing; one participant at each facility refused all testing. Third, limited participation by HCP in serial testing could have biased identification of infections and limited interpretation of genomic sequencing. Finally, whole genome sequencing was conducted on available specimens, and few specimens from the early stages of outbreaks were available, limiting the description of genetic diversity.

Serial testing of residents and all HCP, until no new cases are detected after 14 days (*4*), together with IPC strengthening, are critical strategies necessary to control COVID-19 outbreaks in SNFs. Because residents and HCP can sustain SARS-CoV-2 transmission and HCP present an ongoing risk for introducing SARS-CoV-2-from the community, barriers to HCP testing must be addressed and overcome for test-based approaches to successfully reduce COVID-19–related morbidity and mortality. HCP in SNFs are at high risk for infection, especially in outbreak settings. Testing, IPC education, flexible medical leave and PPE resources must be targeted to this at-risk workforce (*4*,*5*).

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Preventing COVID-19 Outbreaks in Long-Term Care Facilities Through Preemptive Testing of Residents and Staff Members — Fulton County, Georgia, March–May 2020

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Long-term care facility (LTCF) residents are at particularly high risk for morbidity and mortality associated with infection with SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19), given their age and high prevalence of chronic medical conditions, combined with functional impairment that often requires frequent, close contact with health care providers, who might inadvertently spread the virus to residents (*1*,*2*). During March–May 2020 in Fulton County, Georgia, >50% of COVID-19–associated deaths occurred among LTCF residents, although these persons represented <1% of the population (*3*,*4*). Mass testing for SARS-CoV-2 has been an effective strategy for identifying asymptomatic and presymptomatic infections in LTCFs (*5*). This analysis sought to evaluate the timing at which mass testing took place in relation to the known presence of a COVID-19 infection and the resulting number of infections that occurred. In 15 LTCFs that performed facility-wide testing in response to an identified case, high prevalences of additional cases in residents and staff members were found at initial testing (28.0% and 7.4%, respectively), suggesting spread of infection had already occurred by the time the first case was identified. Prevalence was also high during follow-up, with a total of 42.4% of residents and 11.8% of staff members infected overall in the response facilities. In comparison, 13 LTCFs conducted testing as a preventive strategy before a case was identified. Although the majority of these LTCFs identified at least one COVID-19 case, the prevalence was significantly lower at initial testing in both residents and staff members (0.5% and 1.0%, respectively) and overall after follow-up (1.5% and 1.7%, respectively). These findings indicate that early awareness of infections might help facilities prevent potential outbreaks by prioritizing and adhering more strictly to infection prevention and control (IPC) recommendations, resulting in fewer infections than would occur when relying on symptom-based screening (*6*,*7*).

Facility-wide testing in LTCFs (i.e., skilled nursing, memory care, and assisted living facilities) in Fulton County began when the first COVID-19 LTCF outbreak was identified in March 2020. Because SARS-CoV-2 test kits and staffing capacity were limited, facility-wide testing at the beginning of the COVID-19 pandemic focused on LTCFs that already had at least one known confirmed case of COVID-19 in a resident or staff member; these initial cases were detected through testing of symptomatic persons. Testing was carried out 1–5 days after identification of the index case,* depending on Fulton County Board of Health (FCBOH) field testing team availability. Mass testing in LTCFs without known infections began on April 29† when additional testing support was provided by the National Guard. A 1-day testing event for consenting residents and staff members was held at each LTCF during March 31–May 18 to identify the baseline infection prevalence, and symptom-based screening was conducted for 4 weeks thereafter to identify subsequent cases. Testing at 15 facilities was conducted in response to a confirmed SARS-CoV-2 infection identified through symptom-based screening; those tested at these 15 facilities were referred to as "the response group." There were 13 LTCFs that conducted preemptive testing before any case had been identified§; those tested at these 13 facilities were referred to as "the preventive group."

Trained health care staff members from FCBOH and the National Guard collected nasopharyngeal swab samples at 22 LTCFs. Samples were tested for SARS-CoV-2 by real-time reverse transcription–polymerase chain reaction (RT-PCR) at various Georgia laboratories; a confirmed COVID-19 case was defined as a positive RT-PCR test result. When test results were received from participating laboratories they were immediately reported to the facilities, and IPC guidance and implementation support was provided at sites where positive results were identified to mitigate further disease transmission (*6*). Six LTCFs (three in each group) contracted with private companies to collect nasopharyngeal swabs and perform RT-PCR testing; these results were reported to FCBOH. Sample collection, transportation, and testing were conducted in accordance with the most recent CDC guidelines (*8*). Staff members absent on the day of testing but who provided evidence of a positive RT-PCR test result were included in this analysis, and those employed and tested at multiple LTCFs were counted in each facility's staff census and case count. One LTCF declined testing

* Turnaround time to receive test results from COVID-19 testing sites in Fulton County during the study period ranged from 3 to 10 days.
† One LTCF in the preventive group was tested by Fulton County before the addition of testing support from the National Guard.
§ In both the preventive and response groups, fewer than 1% of staff members and residents eligible for testing on the day of the testing event declined.

for all staff members. Each LTCF's number and proportion of SARS-CoV-2–positive RT-PCR test results, hospitalizations, and deaths among residents and staff members were calculated based on the sum of cases identified through mass testing and throughout 4 weeks of follow-up symptom-based screening.[¶] Fisher's exact tests were used to test differences between facility groups; p-values <0.05 were considered to be statistically significant. This activity was reviewed by the Georgia Department of Public Health and determined to be consistent with public health surveillance as described in Title 45 Code of Federal Regulations 46.102(1)(2).

Overall, 5,671 persons from 28 LTCFs were tested, including 2,868 (50.6%) residents and 2,803 (49.4%) staff members. During the facility-wide testing events, 637 (11.2%) persons received positive test results for SARS-CoV-2, including 484 (16.9%) residents and 153 (5.5%) staff members.[**] At the end of the follow-up period, 348 additional positive SARS-CoV-2 test results were reported, for a total of 985 (17.4%) persons with positive SARS-CoV-2 test results (residents = 740 [25.8%]; staff members = 245 [8.7%]). At the time of initial testing, resident prevalence was 28.0% in the response group and 0.5% in the preventive group (p<0.01). Among staff members, prevalence at initial testing was 7.4% in the response group and 1.0% in the preventive group (p<0.01). Eight (61.5%) LTCFs in the preventive group reported at least one COVID-19 infection at the time of initial testing. After 4 weeks of follow-up, the overall resident prevalence was 42.4% and 1.5% in the response and preventive LTCFs, respectively, and prevalence among staff members was 11.8% and 1.7% in the response and preventive groups, respectively (p<0.001 for both residents and staff members) (Table).

Among the 985 persons who received a diagnosis of COVID-19 during and after the facility-wide testing, 164 (16.6%) required hospitalization, and 113 (11.5%) died. Most hospitalizations (158; 96.3%) occurred in the response group, but the proportion of residents hospitalized because of COVID-19 did not differ significantly between the response (19.9%) and preventive (29.4%) groups (p = 0.36). Similarly, the proportion of residents in the response group who died (15.1%) was similar to that in the preventive group (17.6%) (p = 0.73); however, 109 (96.5%) of all 113 deaths occurred in the response group LTCFs; only one death occurred in a staff member, and that was in the preventive group.

[¶] Symptom-based screening included temperature checks and a survey of symptoms consistent with COVID-19; staff member screening occurred at the beginning of every shift, and resident screening varied by facility, occurring 1–12 times per day.

[**] All SARS-CoV-2 infections identified in staff members of LTCFs in the preventive group were identified through facility-wide testing and were not linked to outbreaks in other LTCFs.

Discussion

In this analysis of facility-wide SARS-CoV-2 testing and follow-up at 28 LTCFs in Fulton County, Georgia, SARS-CoV-2 infection was identified in 25.8% of residents and 8.7% of staff members. Facilities which conducted testing after a known, confirmed case of COVID-19 were found to have significantly higher proportions of infected residents and staff members at initial testing and at follow-up, suggesting spread had already occurred by the time the first case was identified. Importantly, even in LTCFs that tested residents and staff members preemptively before a known infection, at least one case was identified in the majority of these facilities. However, the initial prevalence was significantly lower and fewer cases occurred during follow-up, supporting the potential for early testing to prevent outbreaks when combined with IPC recommendations (*6*,*7*). Although this analysis assessed a single mass testing event and subsequent follow-up period to identify new cases, the Center for Medicare & Medicaid Services currently requires routine testing with a 48-hour turnaround of LTCF residents and staff members[††] at varying frequencies contingent on the proportion of positive tests in the community of the facility (*9*).

The findings in this report are subject to at least four limitations. First, because LTCFs in the preventive group did not identify a COVID-19 case until later dates, they might have been at lower risk overall. Although risk for a COVID-19 outbreak at the beginning of the COVID-19 pandemic might have varied by facility, as of August 16, 2020, outbreaks continued to be reported in LTCFs where cases had not previously been identified, indicating that LTCFs not affected when COVID-19 was first introduced to Fulton County continued to be at risk for outbreaks. COVID-19 might have been introduced to some LTCFs in the response group before a shelter-in-place order was issued by the state of Georgia,[§§] which prohibited LTCF resident visitation, although it was likely introduced to remaining LTCFs after the shelter-in-place order.[¶¶] After the shelter-in-place order, the most likely mode of infection among residents was through exposure to an infected staff member, although several preventive group LTCFs reported COVID-19 cases in residents but not staff members. It is possible that these residents had been infected earlier in the pandemic but were asymptomatic and possibly no longer infectious at the time of testing (*10*). Second, guidance from CDC on IPC strategies was released on May 8, 2020, after some response group LTCFs were tested, possibly contributing to the lower prevalence of infection in LTCFs tested at later dates. Third, response group

[††] Centers for Medicaid & Medicare Services requirements apply to nursing homes but not to assisted living facilities, which are not Medicaid/Medicare certified.

[§§] A shelter-in-place order for the state of Georgia was instituted on April 2, 2020. https://gov.georgia.gov/executive-action/executive-orders/2020-executive-orders.

[¶¶] https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-guidance-management-patients.html.

TABLE. COVID-19 cases, hospitalizations, and deaths among long-term care facility residents and staff members — Fulton County, Georgia, March–May 2020

LTCF ID, date screened		Residents, no. (%)					Staff members, no. (%)				
		No. tested*	Cases identified through mass testing†	Total cases identified§	Hospitalized¶	Died¶	No. tested*	Cases identified through mass testing†	Total cases identified§	Hospitalized¶	Died¶
Response group¶,**											
1	3/31/20	176	36 (20.5)	106 (60.2)	18 (17.0)	21 (19.8)	74	22 (29.7)	40 (54.1)	0	0
2	4/3/20	63	32 (50.8)	50 (79.4)	17 (34.0)	15 (30.0)	81	15 (18.5)	32 (39.5)	6 (18.8)	0
3	4/5/20	69	14 (20.3)	17 (24.6)	4 (23.5)	2 (11.8)	135	9 (6.7)	11 (8.1)	0	0
4	4/8/20	67	45 (67.2)	49 (73.1)	16 (32.7)	10 (20.4)	56	27 (48.2)	31 (55.4)	2 (6.5)	0
5	4/11/20	38	12 (31.6)	16 (42.1)	4 (25.0)	2 (12.5)	61	7 (11.5)	13 (21.3)	0	0
6	4/13/20	78	6 (7.7)	10 (12.8)	2 (20.0)	6 (60.0)	199	2 (1.0)	12 (6.0)	0	0
7	4/15/20	112	40 (35.7)	45 (40.2)	5 (11.1)	1 (2.2)	116	13 (11.2)	17 (14.7)	0	0
8	4/16/20	88	17 (19.3)	20 (22.7)	3 (15.0)	1 (5.0)	126	6 (4.8)	7 (5.6)	2 (28.6)	0
9	4/19/20	167	104 (62.3)	117 (70.1)	20 (17.1)	10 (8.5)	130	10 (7.7)	16 (12.3)	0	0
10	4/22/20	96	24 (25.0)	24 (25.0)	5 (20.8)	3 (12.5)	104	3 (2.9)	4 (3.8)	0	0
11	4/28/20	196	39 (19.9)	50 (25.5)	4 (8.0)	3 (6.0)	150	4 (2.7)	4 (2.7)	0	0
12	4/30/20	196	10 (5.1)	48 (24.5)	6 (12.5)	2 (4.2)	252	2 (0.8)	3 (1.2)	0	0
13	5/7/20	94	8 (8.5)	28 (29.8)	8 (28.6)	4 (14.3)	75	2 (2.7)	4 (5.3)	0	0
14	5/11/20	81	39 (48.1)	46 (56.8)	6 (13.0)	6 (13.0)	106	6 (5.7)	10 (9.4)	1 (10.0)	0
15	5/14/20	184	52 (28.3)	97 (52.7)	26 (26.8)	23 (23.7)	279	16 (5.7)	26 (9.3)	3 (11.5)	0
Total response		**1,705**	**478 (28.0)**	**723 (42.4)**	**144 (19.9)**	**109 (15.1)**	**1944**	**144 (7.4)**	**230 (11.8)**	**14 (6.1)**	**0**
Preventive group††											
16§§	4/2/20	287	1 (0.3)	1 (0.3)	0	0	270	0	0	0	0
17¶¶	4/29/20	102	1 (1.0)	1 (1.0)	0	0	0	0	0	0	0
18	5/5/20	26	1 (3.8)	4 (15.4)	4 (100.0)	3 (75.0)	8	0	0	0	0
19	5/6/20	64	0	0	0	0	64	0	0	0	0
20	5/11/20	73	0	0	0	0	46	1 (2.2)	2 (4.3)	0	0
21	5/13/20	78	1 (1.3)	1 (1.3)	1 (100.0)	0	100	0	1 (1.0)	0	0
22	5/18/20	46	0	0	0	0	43	0	0	0	0
23	5/27/20	35	0	0	0	0	19	0	0	0	0
24	5/27/20	48	0	6 (12.5)	0	0	76	6 (7.9)	10 (13.2)	0	0
25	5/28/20	218	1 (0.5)	2 (0.9)	0	0	100	2 (2.0)	2 (2.0)	1 (50.0)	1 (50.0)
26	5/29/20	87	1 (1.1)	2 (2.3)	0	0	97	0	0	0	0
27	5/29/20	1	0	0	0	0	30	0	0	0	0
28	5/29/20	98	0	0	0	0	6	0	0	0	0
Total preventive		**1,163**	**6 (0.5)**	**17 (1.5)**	**5 (29.4)**	**3 (17.6)**	**859**	**9 (1.0)**	**15 (1.7)**	**1 (6.7)**	**1 (6.7)**
All facilities		**2,868**	**484 (16.9)**	**740 (25.8)**	**149 (20.1)**	**112 (15.1)**	**2803**	**153 (5.5)**	**245 (8.7)**	**15 (6.1)**	**1 (0.4)**
p-value***		—	**<0.01**	**<0.01**	**0.36**	**0.73**	—	**<0.01**	**<0.01**	**1**	**0.06**

Abbreviations: COVID-19 = coronavirus disease 2019; LTCF = long-term care facility.

* Residents and staff members who consented and were present on the day of testing.

† Percentage among all persons tested.

§ Total cases identified through mass screening and 4 weeks of symptom-based screening.

¶ Percentage among persons with positive test results for SARS-CoV-2, the virus that causes COVID-19.

** LTCFs in which facility-wide COVID-19 testing was initiated in response to identification of the index case through symptom-based screening. Cases after the mass-testing event were identified using symptom-based screening.

†† LTCFs in which facility-wide COVID-19 testing was initiated before identification of a COVID-19 case. Cases after the mass-testing event were identified using symptom-based screening.

§§ The only preventive group LTCF that was tested by Fulton County Board of Health before supplemental testing support was added by the National Guard.

¶¶ Declined testing for staff members.

*** p-value results of Fisher's exact test comparing all LTCFs in the preventive group to all LTCFs in the response group for the following indicators: COVID-19 diagnoses, hospitalizations and deaths.

Summary

What is already known about this topic?

Residents of long-term care facilities (LTCFs) are at risk for severe COVID-19. Facility-wide testing, even in the absence of a reported COVID-19 case, can identify asymptomatic and presymptomatic infection in LTCFs.

What is added by this report?

LTCFs in which testing was conducted after a confirmed case of COVID-19 were found to have significantly higher proportions of infected residents and staff members at initial testing and after 4 weeks of follow-up compared with those testing as a preventive measure. The majority of LTCFs testing as a preventive measure identified an infection, although initial prevalence was significantly lower and fewer cases occurred during follow-up.

What are the implications for public health practice?

Proactive testing of LTCF residents and staff members might prevent large COVID-19 outbreaks in LTCFs through early identification and timely infection prevention and control response.

LTCFs were tested based on reports of COVID-19 cases and were not selected at random to provide a representative sample. Nonetheless, these facilities represented 48.3% of licensed LTCFs and 44.4% of the total bed capacity of LTCFs in Fulton County (*4*). Finally, identification of cases during the follow-up period relied on reporting from LTCFs to the FCBOH. Census lists provided by LTCFs and case reports from hospitals and medical examiners were used to identify and retroactively link unreported outcomes to their respective LTCF. Because follow-up used symptom-based screening, persons infected after mass testing who remained asymptomatic could not be identified, leading to potential underrepresentation of the total number of SARS-CoV-2 infections in both groups.

The COVID-19 pandemic has highlighted the vulnerability of residents and staff members of LTCFs. Findings from this analysis of facility-wide testing efforts in Fulton County suggest that active testing of LTCF residents and staff members can identify some COVID-19 cases early, guide IPC response, and reduce the spread of SARS-CoV-2 (*7*,*9*).

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Association Between CMS Quality Ratings and COVID-19 Outbreaks in Nursing Homes — West Virginia, March 17–June 11, 2020

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Nursing homes are high-risk settings for outbreaks of SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19) (*1*,*2*). During the COVID-19 pandemic, U.S. health departments worked to improve infection prevention and control (IPC) practices in nursing homes to prevent outbreaks and limit the spread of COVID-19 in affected facilities; however, limited resources have hampered health departments' ability to rapidly provide IPC support to all nursing homes within their jurisdictions. Since 2008, the Centers for Medicare & Medicaid Services (CMS) has published health inspection results and quality ratings based on their Five-Star Quality Rating System for all CMS-certified nursing homes (*3*); these ratings might be associated with facility-level risk factors for COVID-19 outbreaks. On April 17, 2020, West Virginia became the first state to mandate and conduct COVID-19 testing for all nursing home residents and staff members to identify and reduce transmission of SARS-CoV-2 in these settings (*4*). West Virginia's census of nursing home outbreaks was used to examine associations between CMS star ratings and COVID-19 outbreaks. Outbreaks, defined as two or more cases within 14 days (with at least one resident case), were identified in 14 (11%) of 123 nursing homes. Compared with 1-star–rated (lowest rated) nursing homes, the odds of a COVID-19 outbreak were 87% lower among 2- to 3-star–rated facilities (adjusted odds ratio [aOR] = 0.13, 95% confidence interval [CI] = 0.03–0.54) and 94% lower among 4- to 5-star–rated facilities (aOR = 0.06, 95% CI = 0.006–0.39). Health departments could use star ratings to help identify priority nursing homes in their jurisdictions to inform the allocation of IPC resources. Efforts to mitigate outbreaks in high-risk nursing homes are necessary to reduce overall COVID-19 mortality and associated disparities. Moreover, such efforts should incorporate activities to improve the overall quality of life and care of nursing home residents and staff members and address the social and health inequities that have been recognized as a prominent feature of the COVID-19 pandemic in the United States (*5*).

COVID-19 surveillance data from the West Virginia Department of Health and Human Resources were used to identify all nursing home outbreaks during March 14–June 11, 2020. These outbreaks were identified through routine COVID-19 surveillance and by universal nursing home testing, which was conducted per the governor's executive order* during April 21–May 8, 2020 (*4*). For this report, an outbreak was defined as two or more laboratory-confirmed SARS-CoV-2 cases occurring within 14 days in a nursing home, with at least one of those cases in a resident.

Nursing home data were downloaded from the CMS Nursing Home Compare website† on June 11, 2020, and included data on all CMS-certified nursing homes (*3*). CMS-trained inspectors conduct annual unannounced health inspections of all nursing homes; inspection deficiencies are recorded, scored, and summarized into an overall five-star rating (1 star = lowest quality, 5 star = highest quality) that is adjusted based on nursing home staffing levels (e.g., nursing hours per resident) and quality of care measures (e.g., hospital readmissions). This analysis is based on star ratings from the most recent nursing home inspections in West Virginia, conducted during December 13, 2018–February 26, 2020, approximately 2 weeks before the first reported COVID-19 case in the state. Most inspections were conducted in 2019 (101 of 123; 82%) and 2020 (21; 17%); one inspection was conducted in 2018.

Wilcoxon rank-sum tests were used to evaluate continuous variables and Fisher's exact tests for categorical variables, to compare facilities with and without COVID-19 outbreaks (outbreak- and nonoutbreak facilities) on several CMS survey measures, including ownership type, average daily number of residents, average daily staffing hours per resident, cumulative county-level COVID-19 incidence, and number of CMS inspection deficiencies, fines, and penalties. P-values <0.05 were considered statistically significant. Logistic regression models were used to assess the association between overall star ratings and COVID-19 outbreaks, adjusting for county-level COVID-19 incidence (analyzed as continuous cases per 100,000 population) and average daily number of facility residents (analyzed as continuous number of facility residents per day). To facilitate interpretation of the OR for county-level incidence and average daily number of facility residents, the variables were rescaled by a factor of 10 (i.e., divided by 10). The overall star rating was analyzed as a three-level variable (1-star, 2–3-star, and 4–5-star). The outcome of interest was experiencing a COVID-19 outbreak, and the reference group was

* https://governor.wv.gov/Documents/2020%20Executive%20Orders/Executive-Order-April-17-2020-Nursing-Home-Testing.pdf.
† https://data.medicare.gov/data/nursing-home-compare.

1-star–rated nursing homes. ORs and 95% CIs were estimated with R statistical software (version 3.6.1; The R Foundation). This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.[§]

As of June 11, 2020, there were 123 CMS-certified nursing homes in West Virginia, including 18 (15%) rated as 5-star, 22 (18%) as 4-star, 28 (23%) as 3-star, 34 (28%) as 2-star, and 20 (16%) as 1-star; one (1%) nursing home was unrated (Table 1). Most (19 of 20, 95%) 1-star–rated nursing homes were for-profit operations and tended to have more residents than did higher rated nursing homes. Nurse staffing levels were generally lower in 1-star–rated facilities, compared with those in higher rated facilities (Table 1).

As of June 11, the West Virginia Department of Health and Human Resources reported COVID-19 outbreaks in 14 (11%) nursing homes, with 226 cases among residents (median = 2.5 per nursing home, range = 1–71) and 140 cases among staff members (median = 4, range = 0–39). Average daily resident census in outbreak facilities (92) was higher than that in nonoutbreak facilities (76) (p = 0.03) (Table 2). Total nurse staffing hours per resident per day were similar in outbreak and nonoutbreak facilities, but mean number of nurse aide hours per resident per day in outbreak facilities (1.9) was lower than was that in nonoutbreak facilities (2.2) (p = 0.02). COVID-19 incidence was higher in counties where outbreak facilities were located (mean = 178 per 100,000) compared with that in counties where nonoutbreak facilities were located (105 per 100,000) (p = 0.001). The mean number of health deficiencies was higher in outbreak facilities (mean = 15) than in nonoutbreak facilities (mean = 11) (p = 0.03) (Table 3).

Seven (50%) of 14 outbreak facilities had 1-star ratings compared with 13 (12%) of 109 nonoutbreak facilities (Table 3). One outbreak facility was a CMS-designated Special Focus Facility and did not receive a star rating and was not included in regression analysis. Special Focus Facility designation is reserved for the lowest rated facilities in the state with a history of serious inspection deficiencies (i.e., potential to harm residents). In unadjusted analyses, the odds of a COVID-19 outbreak in a nursing home increased by 5% for each additional 10 incident cases per 100,000 in the county (OR = 1.05, 95% CI = 1.00–1.09) and by 14% for each additional 10 facility residents (OR = 1.14; 95% CI = 0.98–1.33). Compared with 1-star–rated nursing homes, the unadjusted odds of a COVID-19 outbreak were significantly lower among 2- to 3-star–rated nursing homes (OR = 0.16; 95% CI = 0.04-0.59) and 4- to 5-star–rated nursing homes (OR = 0.05, 95% CI = 0.003). After adjusting for county-level COVID-19 incidence and the number of facility residents, odds of a COVID-19 outbreak were significantly lower in higher quality nursing homes, based on star rating. Compared with 1-star–rated nursing homes, the odds of a COVID-19 outbreak were 87% lower among 2- to 3-star–rated nursing homes (aOR = 0.13; 95% CI = 0.03–0.54) and 94% lower among 4- to 5-star–rated nursing homes (aOR = 0.06; 95% CI = 0.003–0.39); specifically, the odds of a COVID-19 outbreak among 1-star–rated nursing homes were approximately seven times higher than among 2- to 3-star–rated facilities and approximately 17 times higher than among 4- to 5-star–rated facilities after controlling for number of residents and county-level incidence.

Summary

What is already known about this topic?

Nursing homes are high-risk settings for COVID-19 outbreaks. The Centers for Medicare & Medicaid Services (CMS) publishes star quality ratings of all CMS-certified nursing homes.

What is added by this report?

During March–June 2020, 14 (11%) of 123 West Virginia nursing homes experienced COVID-19 outbreaks. Compared with 1-star–rated (lowest rating) nursing homes, the odds of a COVID-19 outbreak were 87% lower among 2- to 3-star–rated facilities and 94% lower among 4- to 5-star–rated facilities.

What are the implications for public health practice?

CMS star ratings can serve as proxy indicators for COVID-19 outbreak risk; health departments could use them to identify priority nursing homes and inform the allocation of infection prevention and control resources.

Discussion

West Virginia nursing homes located in counties with high incidences of COVID-19 and those with 1-star ratings have a higher risk of experiencing COVID-19 outbreaks. The odds of a COVID-19 outbreak in 1-star–rated nursing homes were approximately seven times higher than were those in 2- to 3-star–rated facilities and approximately 17 times higher than in 4- to 5-star–rated nursing homes. Early reports have shown that controlling SARS-CoV-2 transmission in nursing homes is challenging (*1*,*2*); however, rapid and early deployment of IPC strategies,[¶] such as visitor restrictions, use of face masks, staff member education, symptom screening, preparing and implementing outbreak plans, and facility-wide serial testing might successfully prevent or contain outbreaks (*6*). Lower rated nursing homes might struggle to implement effective IPC measures for COVID-19 and might require assistance. Health departments could evaluate the use of CMS star ratings for their

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

[¶] https://www.cdc.gov/coronavirus/2019-ncov/hcp/long-term-care.html.

TABLE 1. Nursing home characteristics, staffing levels, and county characteristics of all Centers for Medicare & Medicaid Services–certified nursing homes, by overall star rating — West Virginia, 2020

Characteristic	Overall star rating, mean (95% CI)					
	1–star n = 20	2–star n = 34	3–star n = 28	4–star n = 22	5–star n = 18	All* n = 123
For-profit nursing home, no. (%)	19 (95.0)	27 (79.4)	21 (75.0)	17 (77.3)	10 (55.6)	95 (77.2)
No. of certified beds	107 (88–126)	94 (80–107)	82 (71–93)	83 (65–101)	61 (40–81)	87 (80–93)
No. of facility residents per day	95 (78–111)	85 (73–97)†	75 (64–85)	70 (57–82)	56 (36–76)	77 (71–84)
Nurse staffing level						
Nurse aide hours per resident per day	2.0 (1.8–2.2)†	2.2 (2.1–2.4)†	2.1 (2.0–2.3)	2.2 (2.0–2.4)	2.4 (2.2–2.6)	2.2 (2.1–2.3)
Registered nurse hours per resident per day	0.5 (0.4–0.6)†	0.6 (0.5–0.7)†	0.6 (0.5–0.7)	0.6 (0.5–0.7)	1.2 (0.7–1.7)	0.7 (0.6–0.8)
Total nurse hours per resident per day	3.4 (3.2–3.6)†	3.7 (3.5–3.9)†	3.7 (3.4–3.9)	3.7 (3.5–4)	4.7 (3.9–5.5)	3.8 (3.6–4)
Facility county characteristic						
County population (x10,000)	9.6 (6.5–12.7)	5.5 (4.0–7.1)	4.1 (2.7–5.5)	4.4 (3.2–5.7)	5.0 (2.2–7.9)	5.6 (4.7–6.5)
County-level COVID–19 incidence§	113 (68–159)	109 (74–144)	143 (84–203)	101 (65–138)	92 (60–124)	113 (94–132)

Abbreviations: CI = confidence interval; COVID-19 = coronavirus disease 2019.
* One nursing home did not receive a star rating.
† One nursing home not reporting.
§ County level COVID-19 cases per 100,000 population; calculated based on cumulative county case counts as of June 11, 2020.

TABLE 2. Nursing home characteristics, staffing levels, and county characteristics, by COVID-19 outbreak status — West Virginia, March 17–June 11, 2020

Characteristic	Nursing home outbreak* status, mean (95% CI)			
	Nonoutbreak n = 109	Outbreak n = 14	All n = 123	P-value†
For-profit nursing home, no. (%)	82 (75.2)	13 (92.9)	95 (77.2)	0.19
No. of certified beds	84.6 (77.0–92.1)	104.1 (86.0–122.2)	86.8 (79.8–93.8)	0.05
No. of facility residents per day	75.6 (68.9–82.4)§	92.2 (79.6–104.8)	77.5 (71.3–83.7)	0.03
Nurse staffing level				
Nurse aide hours per resident per day	2.2 (2.1–2.3)¶	1.9 (1.7–2.1)	2.2 (2.1–2.3)	0.02
Registered nurse hours per resident per day	0.7 (0.6–0.8)¶	0.6 (0.5–0.7)	0.7 (0.6–0.8)	0.90
Total nurse staffing hours per resident per day	3.8 (3.7–4.0)¶	3.5 (3.2–3.8)	3.8 (3.6–4.0)	0.22
Facility county characteristic				
County population (x10,000)	5.1 (4.3–5.9)	9.3 (5.0–13.7)	5.6 (4.7–6.5)	0.08
County-level incidence**	105.1 (85.6–124.6)	177.8 (108.4–247.2)	113.4 (94.3–132.5)	0.001

Abbreviations: CI = confidence interval; COVID-19 = coronavirus disease 2019.
* An outbreak was defined as two or more confirmed cases detected in a nursing home within 14 days, with at least one case in a resident.
† P-values based on Wilcoxon rank-sum test (for continuous variables) and Fisher's exact test (for categorical variables).
§ One nursing home not reporting.
¶ Two nursing homes not reporting.
** County level COVID-19 cases per 100,000 population; calculated based on cumulative county case counts as of June 11, 2020.

facilities to identify priority nursing homes for IPC support and resource allocations to help prevent outbreaks or slow the spread of SARS-CoV-2. Health departments can use resources like the CDC's COVID-19 Infection Control Assessment and Response** tool to help nursing homes assess outbreak preparedness and implement recommended IPC measures.

Studies have found that nursing homes with low star ratings are associated with a higher risk of health care–associated infections (*7*), worse post-surgery outcomes (*8*), and higher readmission rates following hospitalization (*8*,*9*) compared with those with higher ratings. At least two studies have hypothesized that lower nursing staff levels might underlie the association between low star ratings and resident health outcomes (*8*,*9*). In this report, outbreak facilities had significantly lower nurse aide staffing levels, suggesting that staffing might also be an important factor in outbreak prevention. Low nurse staffing levels might contribute to lower quality of care and could pose challenges to implementing effective IPC strategies including symptom monitoring and rapid detection of COVID-19 in residents. Low nurse staffing levels also might be indicative of under-resourced nursing homes without financial resources to hire sufficient staff or purchase supplies needed for effective IPC, even with health department support.

The findings in this report are subject to at least four limitations. First, CMS star ratings are composite measures of inspection factors, and this study does not identify specific factors driving the association between star rating and outbreak risk; thus, recommendations cannot be made regarding which quality metrics to improve to prevent outbreaks. Therefore,

** https://www.cdc.gov/coronavirus/2019-ncov/hcp/assessment-tool-for-nursing-homes.html.

TABLE 3. Summary of overall star rating* and health inspection deficiencies† of nursing homes — West Virginia, 2020

Characteristic	Outbreak status			P-value§
	Nonoutbreak n = 109	Outbreak n = 14*	All n = 123	
Overall star rating, no. (%)				
1 Star	13 (12)	7 (50)	20 (16)	<0.001
2 Star	34 (31)	0 (0)	34 (28)	
3 Star	23 (21)	5 (36)	28 (23)	
4 Star	21 (19)	1 (7)	22 (18)	
5 Star	18 (17)	0 (0)	18 (14)	
Deficient infection prevention control program, no. (%)†,¶				
Within last year	69 (63)	12 (86)	81 (66)	0.14
Within last 2 years	90 (83)	14 (100)	104 (85)	0.12
Summary of complaints, fines, and deficiencies, mean (95% CI)†				
No. of substantiated complaints**	1.3 (0.8–1.8)	4.8 (1.6–8.0)	1.7 (1.1–2.3)	<0.001
No. of health inspection deficiencies	10.5 (9.2–11.9)	14.9 (10.5–19.2)	11.0 (9.7–12.3)	0.03
No. of penalties	0.2 (0.1–0.4)	0.5 (0.1–0.9)	0.3 (0.2–0.4)	0.06
No. of fines	0.2 (0.1–0.3)	0.4 (0.1–0.8)	0.2 (0.2–0.3)	0.17
Counts of health inspection deficiencies by category, mean (95% CI)†				
Quality of life and care	2.4 (2.0–2.8)	3.8 (2.6–5.0)	2.6 (2.2–2.9)	0.01
Resident assessment and care planning	2.2 (1.9–2.5)	3.5 (2.9–4.1)	2.3 (2.1–2.6)	<0.001
Nursing and physician services	0.4 (0.3–0.5)	0.6 (0.2–0.9)	0.4 (0.3–0.5)	0.15
Resident rights	1.9 (1.6–2.3)	1.8 (0.9–2.7)	1.9 (1.6–2.2)	0.89
Nutrition and dietary	0.8 (0.6–1.0)	1.4 (0.4–2.3)	0.9 (0.7–1.1)	0.24
Pharmacy service	1.0 (0.8–1.2)	1.2 (0.8–1.7)	1.0 (0.8–1.2)	0.21
Environmental	1.0 (0.8–1.1)	1.2 (0.8–1.7)	1.0 (0.9–1.1)	0.35
Administration	0.4 (0.2–0.5)	0.8 (0–1.6)	0.4 (0.3–0.6)	0.26

Abbreviation: CI = confidence interval.

* Only 13 outbreak facilities received a star rating; one outbreak nursing home was designated a Special Focus Facility and not rated because of a history of serious quality issues.

† These health inspection deficiencies were recorded during unannounced inspections conducted during December 13, 2018–February 26, 2020.

§ P-values based on Wilcoxon rank-sum test (for continuous variables) and Fisher's exact test (for categorical variables).

¶ This CMS inspection finding based on the requirement that "the facility must establish and maintain an infection prevention and control program designed to provide a safe, sanitary, and comfortable environment and to help prevent the development and transmission of communicable diseases and infections." Refer to 42 C.F.R. Sect. 483.80 for full requirements.

** Number of concerns or complaints (related to abuse, neglect, poor care, insufficient staffing, unsafe or unsanitary conditions, dietary problems, or mistreatment) reported to CMS that were investigated and substantiated; inspectors responsible for annual health inspections are federally required to investigate all complaints

although improving resident care is important, general quality improvement programs without a focus on metrics that strengthen IPC might not lead to reductions in outbreak risk. CMS has responded to the COVID-19 pandemic by guiding the Quality Innovation Network–Quality Improvement Organizations (part of a federal program charged with improving health care quality for Medicare beneficiaries) to low-rated nursing homes, which have a history of IPC challenges and rising incidence and prevalence rates, to address quality issues as well as to provide COVID-19–specific IPC support.†† Second, although the models used in these analyses are adjusted for county-level COVID-19 incidence and number of facility residents, there might be additional unaccounted-for confounding factors. For example, data about COVID-19 IPC measures and interventions in place in nursing homes and data on resident demographics were not available yet might be important confounding factors in the apparent association between nursing home quality and outbreak risk. However, confounding might not be a relevant issue if star ratings are used only for risk stratification. Third, the association between star rating and nursing home outbreaks is based on West Virginia's experience and might not be generalizable to other states or jurisdictions. Finally, staffing and resident estimates provided by CMS were based on annual daily averages and might not reflect actual staffing levels during the analytic period.

Low-rated nursing homes are more likely than are higher rated nursing homes to serve patients experiencing social and economic disadvantage, including dual Medicare-Medicaid enrollees, racial and ethnic minority populations, and persons with low income (*10*) who might already be at higher risk for severe COVID-19 illness and death, thus compounding the risk. The COVID-19 pandemic has highlighted the long-standing inequitable distribution of poor health among many U.S. communities, including among nursing home residents and staff members who shoulder a disproportionate burden of COVID-19 morbidity and mortality (*5*). Efforts to mitigate the risk for outbreaks in high-risk nursing homes are necessary to reduce overall COVID-19 mortality and associated disparities. Moreover, such efforts should incorporate activities

†† https://www.cms.gov/files/document/qso-20-31-all.pdf.

to improve the overall quality of life and care of nursing home residents and staff members and address the social and health inequities that have been recognized as a prominent feature of the COVID-19 pandemic in the United States (*5*).

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Decreased Influenza Activity During the COVID-19 Pandemic — United States, Australia, Chile, and South Africa, 2020

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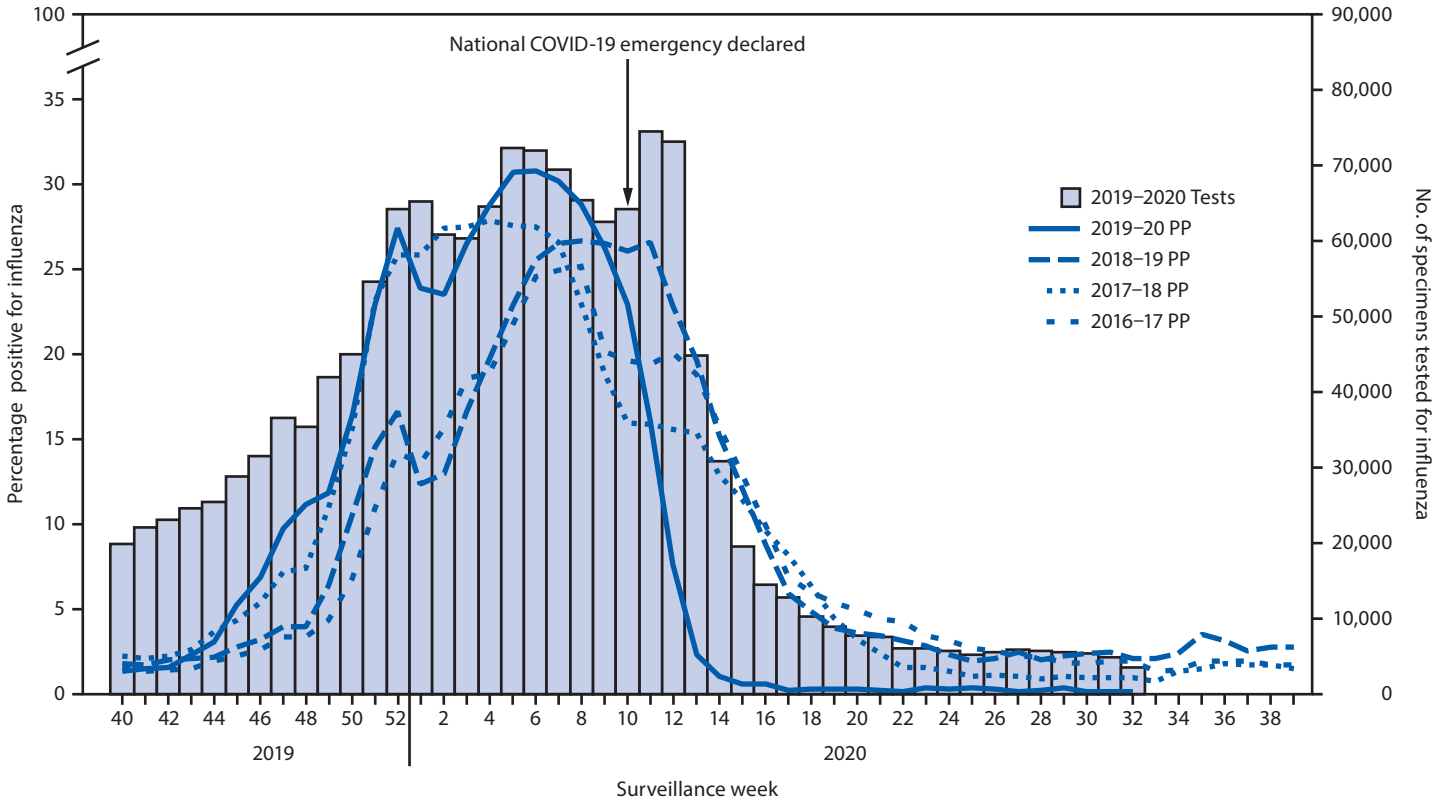
After recognition of widespread community transmission of SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19), by mid- to late February 2020, indicators of influenza activity began to decline in the Northern Hemisphere. These changes were attributed to both artifactual changes related to declines in routine health seeking for respiratory illness as well as real changes in influenza virus circulation because of widespread implementation of measures to mitigate transmission of SARS-CoV-2. Data from clinical laboratories in the United States indicated a 61% decrease in the number of specimens submitted (from a median of 49,696 per week during September 29, 2019–February 29, 2020, to 19,537 during March 1–May 16, 2020) and a 98% decrease in influenza activity as measured by percentage of submitted specimens testing positive (from a median of 19.34% to 0.33%). Interseasonal (i.e., summer) circulation of influenza in the United States (May 17–August 8, 2020) is currently at historical lows (median = 0.20% tests positive in 2020 versus 2.35% in 2019, 1.04% in 2018, and 2.36% in 2017). Influenza data reported to the World Health Organization's (WHO's) FluNet platform from three Southern Hemisphere countries that serve as robust sentinel sites for influenza from Oceania (Australia), South America (Chile), and Southern Africa (South Africa) showed very low influenza activity during June–August 2020, the months that constitute the typical Southern Hemisphere influenza season. In countries or jurisdictions where extensive community mitigation measures are maintained (e.g., face masks, social distancing, school closures, and teleworking), those locations might have little influenza circulation during the upcoming 2020–21 Northern Hemisphere influenza season. The use of community mitigation measures for the COVID-19 pandemic, plus influenza vaccination, are likely to be effective in reducing the incidence and impact of influenza, and some of these mitigation measures could have a role in preventing influenza in future seasons. However, given the novelty of the COVID-19 pandemic and the uncertainty of continued community mitigation measures, it is important to plan for seasonal influenza circulation in the United States this fall and winter. Influenza vaccination of all persons aged ≥6 months remains the best method for influenza prevention and is especially important this season when SARS-CoV-2 and influenza virus might cocirculate (*1*).

Data from approximately 300 U.S. clinical laboratories located throughout all 50 states, Puerto Rico, Guam, and the District of Columbia that participate in virologic surveillance for influenza through either the U.S. WHO Collaborating Laboratories System or the National Respiratory and Enteric Virus Surveillance System* were used for this analysis. Clinical laboratories primarily test respiratory specimens for diagnostic purposes, and data from these laboratories provide useful information on the timing and intensity of influenza activity. The median number of specimens tested per week and the median percentage of samples testing positive for influenza during September 29, 2019–February 29, 2020 (surveillance weeks 40–9, the period before the March 1, 2020 declaration of a national emergency related to COVID-19†) were compared with those tested during March 1–May 16, 2020 (weeks 10–20 after the declaration); data from three previous influenza seasons are presented as a comparison. To assess influenza virus activity in the Southern Hemisphere, influenza laboratory data from clinical and surveillance platforms reported from Australia, Chile, and South Africa to WHO's FluNet§ platform were analyzed. For each country, the percentage of samples testing positive for influenza for April–July (weeks 14–31) for four seasons (2017–2020) are presented. Selected measures implemented to respond to COVID-19 in these countries were ascertained from government websites. All data used were in the public domain.

In the United States, influenza activity (measured by percentage of respiratory specimens submitted for influenza testing that yielded positive results) began to increase in early November 2019, and >20% of specimens were positive during December 15, 2019–March 7, 2020 (weeks 51–10), after which activity declined sharply (Figure 1). Percent positivity peaked on week 6 at 30.25% and decreased 14.90% by week 9, compared with an 89.77% decrease during weeks 10–13. By the week of March 22, 2020 (week 13), when the number of samples tested remained very high, percent positivity dropped to 2.3%, and since the week of April 5, 2020 (week 15), has remained <1%. The median number of specimens

* https://www.cdc.gov/flu/weekly/overview.htm.
† https://www.whitehouse.gov/presidential-actions/proclamation-declaring-national-emergency-concerning-novel-coronavirus-disease-covid-19-outbreak/.
§ https://www.who.int/influenza/gisrs_laboratory/flunet/en/.

FIGURE 1. Number of respiratory specimens tested and percentage testing positive for influenza, by year — United States, 2016–17 through 2019–20 seasons



Source: FluView Interactive. https://www.cdc.gov/flu/weekly/fluviewinteractive.htm.
Abbreviation: PP = percentage positive.

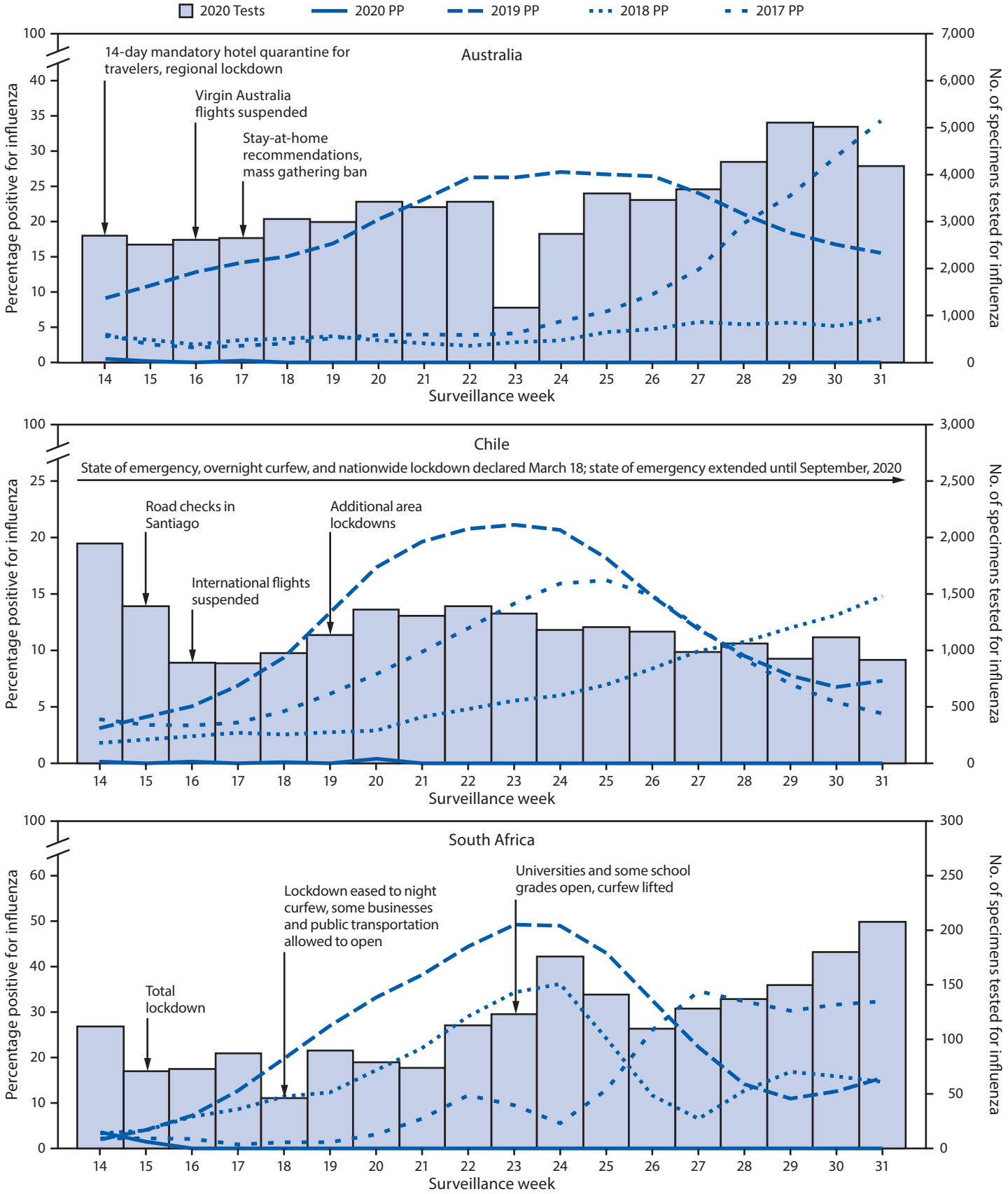
tested for influenza each week decreased from 49,696 during September 29, 2019–February 29, 2020 (weeks 40–9), to 19,537 during March 1–May 16, 2020 (weeks 10–20), representing a 61% decrease. During these same two periods, influenza activity decreased 98%, from a median of 19.34% to 0.33% of submitted respiratory specimens testing positive for influenza. Interseasonal circulation of influenza in the United States (May 17–August 8, 2020; weeks 21–32) is now at historical lows (weekly median 0.20% of samples testing positive in 2020 versus 2.35% in 2019, 1.04% in 2018 and 2.36% in 2017).

In the Southern Hemisphere countries of Australia, Chile, and South Africa, only 33 influenza positive test results were detected among 60,031 specimens tested in Australia, 12 among 21,178 specimens tested in Chile, and six among 2,098 specimens tested in South Africa, for a total of 51 influenza positive specimens (0.06%, 95% confidence interval [CI] = 0.04%–0.08%) among 83,307 tested in these three countries during April–July 2020 (weeks 14–31). In contrast, during April–July in 2017–2019, 24,512 specimens tested positive for influenza (13.7%, 95% CI = 13.6%–13.9%) among 178,690 tested in these three countries (Figure 2).

In the United States, the COVID-19 national emergency was declared on March 1, 2020, but states began implementing a range of COVID-19 mitigation measures in late February, including school closures, bans on mass gatherings, and stay-at-home orders (*2*). In addition, some emphasis was placed on individual measures, such as mask wearing, staying home while sick, and social distancing. In Australia, a 14-day mandatory hotel quarantine was introduced for all returned travelers on March 29; regional lockdowns began in early April, followed by a stay-at-home recommendation and bans on gatherings in mid-April. Some easing of measures began in late April.[¶] In Chile, the president declared a state of emergency on March 18, which remains in effect into September. In addition, in mid-March an overnight curfew and a nationwide lockdown were implemented. Since then, the lockdown has been lifted regionally, based on disease activity; however, recommendations to stay at home and socially distance, as well as mandatory use of masks are all still in place.[**] In South Africa, a

[¶] https://www.health.gov.au/news/health-alerts/novel-coronavirus-2019-ncov-health-alert/coronavirus-covid-19-restrictions.
[**] https://www.gob.cl/coronavirus/plandeaccion.
[††] https://sacoronavirus.co.za/; https://www.gov.za/coronavirus/alert-level-2.

FIGURE 2. Number of specimens tested and percentage testing positive for influenza, by year — Australia, Chile, and South Africa, April–August (weeks 14–31), 2017–20



Source: FluNet. https://www.who.int/influenza/gisrs_laboratory/flunet/en/.
Abbreviation: PP = percentage positive.

Summary

What is already known about this topic?

Influenza activity is currently low in the United States and globally.

What is added by this report?

Following widespread adoption of community mitigation measures to reduce transmission of SARS-CoV-2, the virus that causes COVID-19, the percentage of U.S. respiratory specimens submitted for influenza testing that tested positive decreased from >20% to 2.3% and has remained at historically low interseasonal levels (0.2% versus 1–2%). Data from Southern Hemisphere countries also indicate little influenza activity.

What are the implications for public health practice?

Interventions aimed against SARS-CoV-2 transmission, plus influenza vaccination, could substantially reduce influenza incidence and impact in the 2020–21 Northern Hemisphere season. Some mitigation measures might have a role in reducing transmission in future influenza seasons.

total lockdown was imposed on April 9, with some easing of measures starting on May 1.†† The community mitigation strategies implemented to prevent the spread of COVID-19, including both community and individual-level measures, appear to have substantially reduced transmission of influenza in all these countries.

Discussion

In the United States, influenza virus circulation declined sharply within 2 weeks of the COVID-19 emergency declaration and widespread implementation of community mitigation measures, including school closures, social distancing, and mask wearing, although the exact timing varied by location (*2*). The decline in influenza virus circulation observed in the United States also occurred in other Northern Hemisphere countries (*3*,*4*) and the tropics (*5*,*6*), and the Southern Hemisphere temperate climates have had virtually no influenza circulation. Although causality cannot be inferred from these ecological comparisons, the consistent trends over time and place are compelling and biologically plausible. Like SARS-CoV-2, influenza viruses are spread primarily by droplet transmission; the lower transmissibility of seasonal influenza virus (R_0 = 1.28) compared with that of SARS-CoV-2 (R_0 = 2–3.5) (*7*) likely contributed to a more substantial interruption in influenza transmission. These findings suggest that certain community mitigation measures might be useful adjuncts to influenza vaccination during influenza seasons, particularly for populations at highest risk for developing severe disease or complications.

Initially, declines in influenza virus activity were attributed to decreased testing, because persons with respiratory symptoms were often preferentially referred for SARS-CoV-2 assessment and testing. However, renewed efforts by public health officials and clinicians to test samples for influenza resulted in adequate numbers tested and detection of little to no influenza virus. Further, some countries, such as Australia, had less stringent criteria for testing respiratory specimens than in previous seasons and tested markedly more specimens for influenza but still detected few with positive results during months when Southern Hemisphere influenza epidemics typically peak. A new Food and Drug Administration–approved multiplex diagnostic assay for detection of both SARS-CoV-2 and influenza viruses could improve future surveillance efforts (https://www.cdc.gov/coronavirus/2019-ncov/lab/multiplex.html).

It is difficult to separate the effect that individual community mitigation measures might have had on influenza transmission this season. Although school-aged children can drive the spread of influenza, the effectiveness of school closures alone is not clear because adults have other exposures (*8*). There is evidence to support the use of face masks by infected persons to reduce transmission of viral respiratory illnesses to others and growing evidence to support their use (in the health care setting, in households, and in the community) to protect the healthy wearer from acquiring infection. More data are needed to assess effectiveness of different types of masks in different settings (9). Data from the current pandemic might help answer critical questions about the effect of community mitigation measures on transmission of influenza or other respiratory diseases. In addition, assessing acceptability of effective measures would be critical, because acceptability is likely to be inversely correlated with the stringency of the measure.

The findings in this report are subject to at least four limitations. First, an ecologic analysis cannot demonstrate causality, although the consistency of findings across multiple countries is compelling. Second, other factors, such as the sharp reductions in global travel or increased vaccine use, might have played a role in decreasing influenza spread; however, these were not assessed. Third, viral interference might help explain the lack of influenza during a pandemic caused by another respiratory virus that might outcompete influenza in the respiratory tract (*10*). This possibility is less likely in the United States because influenza activity was already decreasing before SARS-CoV-2 community transmission was widespread in most parts of the nation. Finally, it is possible that the declines observed in the United States were just the natural end to the influenza season. However, the change in the decrease percent positivity after March 1 was dramatic, suggesting other factors were at play.

The global decline in influenza virus circulation appears to be real and concurrent with the COVID-19 pandemic and its associated community mitigation measures. Influenza virus circulation continues to be monitored to determine if the low activity levels persist after community mitigation measures are

eased. If extensive community mitigation measures continue throughout the fall, influenza activity in the United States might remain low and the season might be blunted or delayed. In the future, some of these community mitigation measures could be implemented during influenza epidemics to reduce transmission, particularly in populations at highest risk for developing severe disease or complications. However, in light of the novelty of the COVID-19 pandemic and the uncertainty of continued community mitigation measures, it is important to plan for seasonal influenza circulation this fall and winter. Influenza vaccination for all persons aged ≥6 months remains the best method for influenza prevention and is especially important this season when SARS-CoV-2 and influenza virus might cocirculate *(1)*.

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E-cigarette Use Among Middle and High School Students — United States, 2020

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The use of any tobacco product by youths is unsafe, including electronic cigarettes (e-cigarettes) (*1*). Most e-cigarettes contain nicotine, which is highly addictive, can harm the developing adolescent brain, and can increase risk for future addiction to other drugs (*1*). E-cigarette use has increased considerably among U.S. youths since 2011 (*1*,*2*). Multiple factors have contributed to this increase, including youth-appealing flavors and product innovations (*1*–*3*). Amid the widespread use of e-cigarettes and popularity of certain products among youths, on February 6, 2020, the Food and Drug Administration (FDA) implemented a policy prioritizing enforcement against the manufacture, distribution, and sale of certain unauthorized flavored prefilled pod or cartridge-based e-cigarettes (excluding tobacco or menthol).*

CDC and FDA analyzed nationally representative data from the 2020 National Youth Tobacco Survey (NYTS),† a cross-sectional, school-based, self-administered survey of U.S. middle school (grades 6–8) and high school (grades 9–12) students conducted during January 16–March 16, 2020.§ The NYTS study protocol was approved by the CDC institutional review board. Current (past 30-day) e-cigarette use was assessed, overall and by device¶ and flavor** type. Weighted prevalence estimates and population totals†† were calculated. Analyses were conducted using SAS-callable SUDAAN (version 11.0.3; RTI International).

In 2020, 19.6% of high school students (3.02 million) and 4.7% of middle school students (550,000) reported current e-cigarette use. Among current e-cigarette users, 38.9% of high school students and 20.0% of middle school students reported using e-cigarettes on 20 or more of the past 30 days; 22.5% of high school users and 9.4% of middle school users reported daily use. Among all current e-cigarette users, 82.9% used flavored e-cigarettes, including 84.7% of high school users (2.53 million) and 73.9% of middle school users (400,000).

Among high school current e-cigarette users, the most commonly used device type was prefilled pods or cartridges (48.5%; 1.45 million), followed by disposables (26.5%; 790,000), and tanks (14.8%; 440,000). Among middle school current e-cigarette users, the most commonly used device type was prefilled pods or cartridges (41.3%; 220,000), followed by tanks (21.5%; 110,000), and disposables (15.2%; 80,000).

Among high school students who currently used any type of flavored e-cigarettes, the most commonly used flavor types were fruit (73.1%; 1.83 million); mint (55.8%; 1.39 million); menthol (37.0%; 920,000); and candy, desserts, or other sweets (36.4%; 910,000). Among middle school students who currently used any type of flavored e-cigarettes, the most commonly used flavor types were fruit (75.6%; 290,000); candy, desserts, or other sweets (47.2%; 180,000); mint (46.5%; 180,000); and menthol (23.5%; 90,000).

Among current users of flavored prefilled pods or cartridges, the most commonly used flavor types were fruit (66.0%; 920,000); mint (57.5%; 800,000); menthol (44.5%; 620,000); and candy, desserts, or other sweets (35.6%; 490,000) (Figure). Among current users of flavored disposable e-cigarettes, the most commonly used flavor types were fruit (82.7%; 650,000), mint (51.9%; 410,000); candy, desserts, or other sweets (41.7%; 330,000); and menthol (23.3%; 180,000).

In 2020, approximately one in five high school students and one in 20 middle school students currently used e-cigarettes. By comparison, in 2019, 27.5% of high school students (4.11 million) and 10.5% of middle school students

* https://www.fda.gov/news-events/press-announcements/fda-finalizes-enforcement-policy-unauthorized-flavored-cartridge-based-e-cigarettes-appeal-children.

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

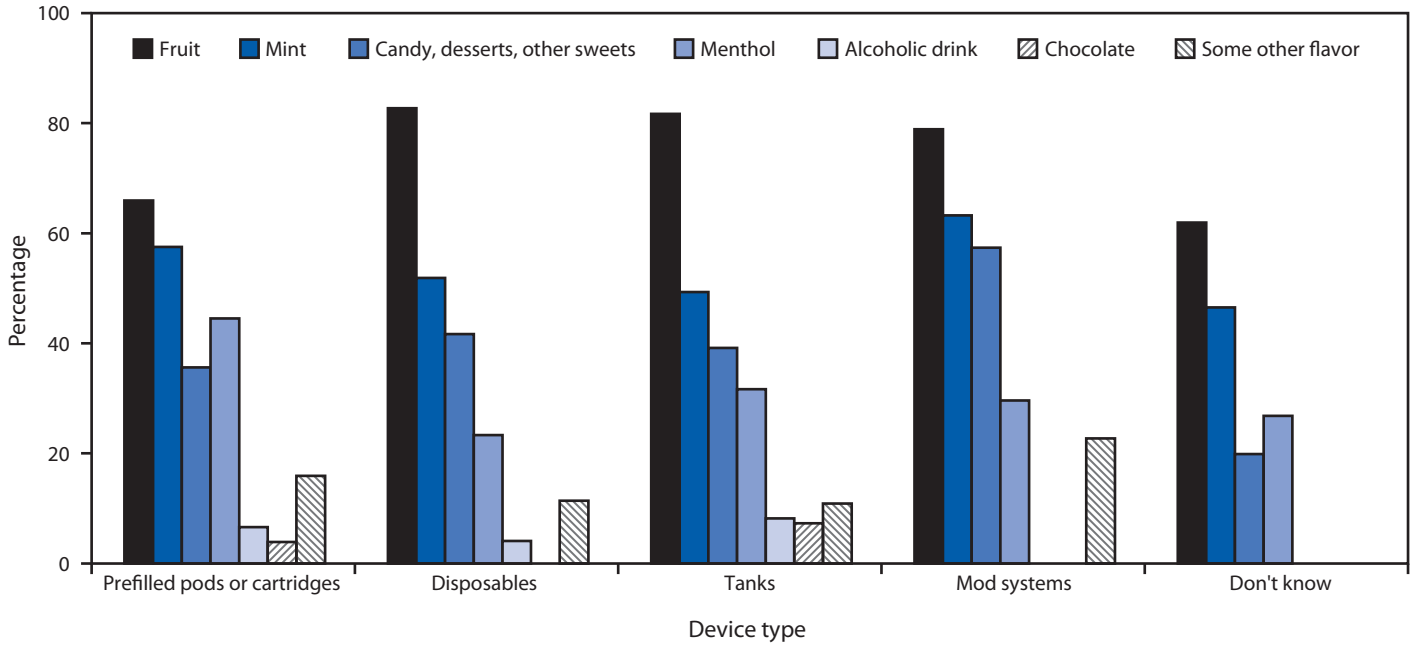
§ The data collection timeline was truncated because of widespread school closures during the coronavirus disease 2019 pandemic.

¶ Device type use among current e-cigarette users was determined by answers to the question "Which of the following best describes the type of e-cigarette you have used in the past 30 days? If you have used more than one type, please think about the one you use most often." Response options were "a disposable e-cigarette," "an e-cigarette that uses pre-filled pods or cartridges (e.g., JUUL)," "an e-cigarette with a tank that you refill with liquids," "a mod system (an e-cigarette that can be customized by the user with their own combination of batteries or other parts)," and "I don't know the type."

** Flavored e-cigarette use among current e-cigarette users was determined by answers to the question "Were any of the e-cigarettes that you used in the past 30 days flavored to taste like menthol, mint, clove or spice, alcohol (wine, cognac), candy, fruit, chocolate, or any other flavor?" Response options were "yes," "no," and "don't know." Flavor type use among current e-cigarette users who reported flavored e-cigarette use was determined by answers to the question "What flavors were the e-cigarettes that you have used in the past 30 days? (Select one or more)." Response options were: "menthol," "mint," "clove or spice," "fruit," "chocolate," "alcoholic drinks (such as wine, cognac, margarita, or other cocktails)," "candy, desserts, or other sweets," and "some other flavor not listed here" (write-in responses were not assessed).

†† Weighted population estimates are rounded down to the nearest 10,000 students.

FIGURE. Percentage of flavor types used by current (past 30-day) flavored e-cigarette users among U.S. middle and high school students,* by device type†,§ — National Youth Tobacco Survey, United States, 2020



* Flavor type use among current (past 30-day) users of flavored e-cigarettes was determined by answers to the question "What flavors were the e-cigarettes that you have used in the past 30 days? (Select one or more)." Response options were "menthol," "mint," "clove or spice," "fruit," "chocolate," "alcoholic drinks (such as wine, cognac, margarita, or other cocktails)," "candy, desserts, or other sweets," and "some other flavor not listed here" (write-in responses were not assessed). Data for "clove or spice" are not shown because of statistically unreliable estimates due to unweighted denominator <50 or relative standard error >30% across all device types.

† Device type use among current e-cigarette users was determined by answers to the question "Which of the following best describes the type of e-cigarette you have used in the past 30 days? If you have used more than one type, please think about the one you use most often." Response options were "a disposable e-cigarette," "an e-cigarette that uses pre-filled pods or cartridges (e.g., JUUL)," "an e-cigarette with a tank that you refill with liquids," "a mod system (an e-cigarette that can be customized by the user with their own combination of batteries or other parts)," and "I don't know the type."

§ The following data were statistically unreliable and not shown due to unweighted denominator <50 or relative standard error >30%: use of chocolate flavor types among current flavored e-cigarette users of disposable e-cigarettes, mod systems, or those who reported "I don't know the type" for device type; alcoholic drink flavor types among current flavored e-cigarette users of mod systems or those who reported "I don't know the type" for device type; and "some other flavor" among current flavored e-cigarette users who reported "I don't know the type" for device type.

(1.24 million) reported current e-cigarette use (*2*). Although these data reflect a decline in current e-cigarette use since 2019, 3.6 million U.S. youths still currently used e-cigarettes in 2020, and among current users, more than eight in 10 reported using flavored e-cigarettes.

Consistent with 2019, prefilled pods or cartridges were the most commonly used device type in 2020; however, during 2019–2020, disposable e-cigarette use increased approximately 1,000% (from 2.4% to 26.5%) among high school current e-cigarette users and approximately 400% (from 3.0% to 15.2%) among middle school current e-cigarette users. Although use of fruit flavored e-cigarettes was common among users in 2020, findings also suggest prominent menthol e-cigarette use, including among nearly one half of flavored prefilled pod or cartridge users and one quarter of flavored disposable product users.

Comprehensive implementation of evidence-based strategies at the national, state, and local levels, in coordination with FDA regulation, can prevent and reduce youth tobacco product use (*1*,*4*,*5*). Strategies to address factors driving youth e-cigarette use are particularly critical. In addition to FDA's enforcement policy that prohibits the sale of prefilled pod- or cartridge-based e-cigarettes in any flavor other than tobacco or menthol, several states and communities have restricted all flavored e-cigarette sales, including menthol.[§§]

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

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E-cigarette Unit Sales, by Product and Flavor Type — United States, 2014–2020

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Since electronic cigarettes (e-cigarettes) entered the U.S. marketplace in 2007, the landscape has evolved to include different product types (e.g., prefilled cartridge–based and disposable products) and flavored e-liquids (e.g., fruit, candy, mint, menthol, and tobacco flavors), which have contributed to increases in youth use (*1*,*2*). E-cigarettes have been the most commonly used tobacco product among U.S. youths since 2014; in 2019, 27.5% of high school students reported current e-cigarette use (*3*). To assess trends in unit sales of e-cigarettes in the United States by product and flavor type, CDC, CDC Foundation, and Truth Initiative analyzed retail scanner data during September 14, 2014–May 17, 2020, from Information Resources, Inc. (IRI). During this period, total e-cigarette sales increased by 122.2%, from 7.7 million to 17.1 million units per 4-week interval. By product type, the proportion of total sales that was prefilled cartridge products increased during September 2014–August 2019 (47.5% to 89.4%). During August 2019–May 2020, the proportion of total sales that was disposable products increased from 10.3% to 19.8%, while the proportion that was prefilled cartridge products decreased (89.4% to 80.2%). Among prefilled cartridge sales, the proportion of mint sales increased during September 2014–August 2019 (<0.1% to 47.6%); during August 2019–May 2020, mint sales decreased (47.6% to 0.3%), as menthol sales increased (10.7% to 61.8%). Among disposable e-cigarette sales during September 2014–May 2020, the proportion of mint sales increased (<0.1% to 10.5%), although tobacco-flavored (52.2% to 17.2%) and menthol-flavored (30.3% to 10.2%) sales decreased; during the same period, sales of all other flavors combined increased (17.2% to 62.1%). E-cigarette sales increased during 2014–2020, but fluctuations occurred overall and by product and flavor type, which could be attributed to consumer preferences and accessibility. Continued monitoring of e-cigarette sales and use is critical to inform strategies at the national, state, and community levels to minimize the risks of e-cigarettes on individual- and population-level health. As part of a comprehensive approach to prevent and reduce youth e-cigarettes use, such strategies could include those that address youth-appealing product innovations and flavors.

Retail sales data were licensed from IRI, Inc., which included Universal Product Code sales from convenience stores, gas stations, grocery stores, drugstores/pharmacies, mass merchandiser outlets, club stores, dollar stores, and military sales. Sales from the Internet and tobacco-specialty stores, including "vape shops," were not included. E-cigarette products were categorized as one of the following product types: prefilled cartridge devices, disposable devices, and e-liquids.* E-cigarette accessories and devices sold without e-liquids, which accounted for 9.4% of sales, were excluded. Products with explicit flavor names were categorized as tobacco, menthol, mint, or all other flavors (e.g., fruit, clove/spice, candy/desserts/other sweets, chocolate, alcoholic and nonalcoholic drinks). Ambiguous or concept flavors (e.g., "fusion") (5.6%) were searched for online and back-coded into one of the four flavor categories. E-cigarette unit sales were standardized and aggregated in 4-week intervals from September 14, 2014, through May 17, 2020† (*4*). Analyses were performed for total unit sales and the proportion of total unit sales by product type and flavor using Stata (version16; StataCorp). Trends during 2014–2020 were analyzed using Joinpoint (version 4.8.0.1; National Cancer Institute), and average 4-week interval percentage change (AIPC) with corresponding 95% confidence intervals (CIs) were calculated. Statistical significance was defined as $p<0.05$. This study did not involve human subjects, and thus, was not submitted for Institutional Review Board review.

During September 2014–May 2020, total unit sales increased by 122.2% ($p<0.05$), from 7.7 million to 17.1 million units per 4-week interval. (AIPC = 1.1; 95% CI = 0.6 to 1.6); however, within the context of this general increase, sales fluctuated (Figure 1). During November 2016–August 2019, sales increased by 294.3%, from 5.6 million to 22.0 million units per period (AIPC = 4.1; 95% CI = 3.2 to 5.1) ($p<0.05$). During August 2019–February 2020, sales decreased 32.7%, from 22.0 million to 14.8 million units per period (AIPC = −5.1; 95% CI = −7.2 to −2.8) ($p<0.05$). No significant change in total sales occurred during February–May 2020.

Among total e-cigarette unit sales during September 2014–August 2019, the proportion that were prefilled cartridges

* Prefilled cartridges include tanks, cartridges, and pods used in rechargeable and reusable e-cigarette device; the cartridges are not intended to be refilled after the liquid has been depleted. Disposable devices include nonrechargeable and nonreusable e-cigarette devices that are not intended to be refilled with e-liquid after being depleted; the device is disposed of once the e-liquid has been consumed. E-liquids are containers of the liquid used in e-cigarette devices, which typically contains a humectant (e.g., propylene glycol), nicotine, and flavoring.

† Consistent with previous studies, unit sales were standardized to reflect the most common package size for each product type. A standardized unit was equal to five prefilled cartridges, one disposable device, or one e-liquid bottle.

increased from 47.5% to 89.4% (AIPC = 1.0) (p<0.05) (Table). The proportion of total sales that were prefilled cartridges decreased thereafter (p<0.05), accounting for 80.2% of total sales in May 2020 (AIPC = −1.3). As the proportion of sales accounted for by prefilled cartridges decreased beginning August 2019, the proportion of sales that were disposable products increased from 10.3% of total sales in August 2019 to 19.8% in May 2020 (AIPC = 7.5) (p<0.05).

Among total e-cigarette unit sales during September 2014–August 2019, the proportion accounted for by mint products increased from 0.01% to 43.4% (AIPC = 10.5) (p<0.05) (Figure 1). During August 2019–May 2020, although mint sales declined from 43.4% to 2.3% of total e-cigarette sales (AIPC = −28.3), the proportion of menthol sales increased from 11.4% to 51.6% of total sales (AIPC = 18.9), and tobacco-flavored sales increased from 23.0% to 33.1% of total sales (AIPC = 4.6). During September 2014–October 2018, sales of all other flavored e-cigarettes increased from 17.6% to 52.4% of total sales (AIPC = 2.0) (p<0.05); however, sales of all other flavored e-cigarettes declined thereafter, from 52.4% to 12.8% of total sales by May 2020 (AIPC = −5.9) (p<0.05).

Among prefilled cartridge sales during September 2014–August 2019, the percentage that were mint increased from <0.1% to 47.6% (AIPC = 14.1) (p<0.05) (Figure 2). During August 2019–May 2020, although the mint sales declined from 47.6% to 0.3% of all prefilled cartridge sales (AIPC = −42.3), the proportion of menthol sales increased from 10.7% to 61.8% (AIPC = 22.3), and the percentage of tobacco-flavored sales increased from 22.8% to 37.1% (AIPC = 6.1). During September 2014–October 2018, sales of all other flavors increased from 12.9% to 54.4% of prefilled cartridge sales (AIPC = 3.3) (p<0.05); however, sales of these products declined thereafter to 0.8% of all prefilled cartridge sales by May 2020 (AIPC = −18.1) (p<0.05).

Among disposable e-cigarette sales during September 2014–May 2020, the percentage of sales of tobacco-flavored and menthol-flavored products decreased; sales of tobacco-flavored e-cigarettes accounted for 17.2% and menthol-flavored accounted for 10.2% of all disposable e-cigarette sales in May 2020, (p<0.05). (Figure 3). During the same period, mint-flavored sales increased from <0.1% to 10.5% of all disposable e-cigarette sales (AIPC = 7.4), and the proportion of all other flavors increased from 17.2% to 62.1% (AIPC = 1.6).

Discussion

During November 2016–August 2019, total e-cigarette unit sales in the U.S. increased nearly 300%. Although prefilled cartridges remained the leading product type sold, disposable sales increased beginning in August 2019, reaching 19.8% of total sales by May 2020. Among prefilled cartridge sales, the proportion of mint-flavored products declined beginning in August 2019; by May 2020, menthol (61.8%) and tobacco (37.1%) flavors dominated the market. Among disposable e-cigarette sales, tobacco-flavored and menthol-flavored sales decreased during September 2014–May 2020; during the same period, the proportion of sales that were mint and all other flavors increased, with mint reaching 10.5% and all other flavors reaching 62.1% of total sales by May 2020. Continued monitoring of e-cigarette sales could inform strategies to reduce use among U.S. youths, including strategies that address youth-appealing product innovations and flavors (*1*,*2*).

The increase in total e-cigarette sales that occurred during November 2016–August 2019 was driven by sales of prefilled cartridges, which made up nearly 90% of the market by August 2019. Previous research indicates this increase in total sales was primarily driven by JUUL (*5*), a prefilled cartridge-based e-cigarette that accounted for approximately 75% of total U.S. e-cigarette sales by December 2018.[§] The rise in JUUL sales occurred during the same period as when youth e-cigarette use increased considerably; during 2017–2018, current e-cigarette use increased 78% among U.S. high school students and 48% among middle school students (*6*). The decline in total e-cigarettes sales during August 2019–February 2020 might be attributable, in part, to shifts in consumer behaviors following the national outbreak of e-cigarette, or vaping, product use-associated lung injury (EVALI) (*7*).

Among prefilled cartridge e-cigarettes, sales of mint and other flavors declined beginning in August 2019, after which menthol and tobacco-flavored sales increased considerably. During the same period, overall disposable e-cigarette sales increased, particularly mint and other flavored (excluding menthol or tobacco) products. Flavored e-cigarette sales patterns by product type are likely influenced by multiple factors. For example, JUUL voluntarily removed mango, creme, fruit, and cucumber flavored cartridges from retail stores (November 2018) and online (October 2019)[¶] and removed mint-flavored cartridges entirely from the market in November 2019.[**] Moreover, on January 2, 2020, the Food and Drug Administration (FDA) finalized an enforcement policy that prohibits the sale of prefilled cartridge e-cigarettes in any flavor other than tobacco or menthol.[††]

The findings in this report are subject to at least three limitations. First, sales data did not include purchases from the

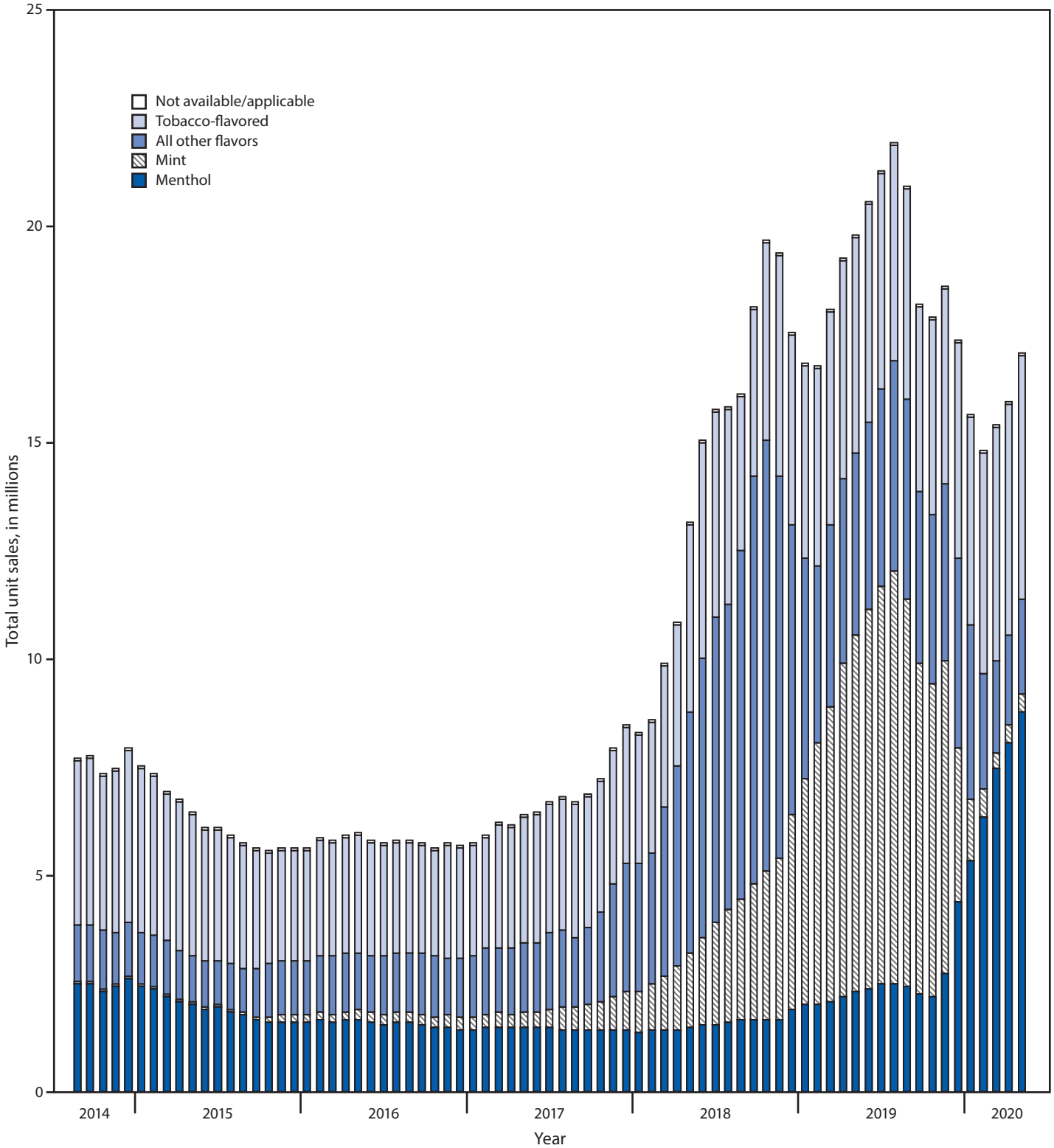
[§] https://truthinitiative.org/research-resources/emerging-tobacco-products/behind-explosive-growth-juul.

[¶] https://www.juullabs.com/juul-labs-suspends-sale-of-non-tobacco-non-menthol-based-flavors-in-the-u-s/.

[**] https://www.juullabs.com/juul-labs-stops-the-sale-of-mint-juulpods-in-the-united-states/.

[††] https://www.fda.gov/news-events/press-announcements/fda-finalizes-enforcement-policy-unauthorized-flavored-cartridge-based-e-cigarettes-appeal-children.

FIGURE 1. Total e-cigarette unit sales,* by flavor† — United States, September 14, 2014–May 17, 2020§



* Retail sales data were obtained from Information Resources, Inc. (IRI) for convenience stores, gas stations, grocery stores, drugstores/pharmacies, mass merchandiser outlets, club stores, dollar stores, and military sales; data from the Internet and vape shops were not collected.

† The "All other flavors" category includes fruit, clove/spice, chocolate, alcoholic drink (such as wine, cognac, or other cocktails), candy/desserts/other sweets, or some other flavor. Unknown flavors were excluded from this figure (<0.1%).

§ Each bar in the figure represents a 4-week aggregate interval.

TABLE. Trends in e-cigarette unit sales, by product and flavor type — United States, September 14, 2014–May 17, 2020

Sales type*	Period	AIPC (95% CI)†
Total sales, by product type		
Prefilled cartridges§	September 2014–August 2019	1.0 (0.8 to 1.2)
	August 2019–May 2020	−1.3 (−1.9 to −0.6)
Disposable devices¶	September 2014–August 2019	−2.4 (−3.1 to −1.6)
	August 2019–May 2020	7.5 (4.6 to 10.5)
E-liquid**	September 2014–May 2020	−5.8 (−7.0 to −4.5)
Total sales, by flavor type		
Mint	September 2014–August 2019	10.5 (8.1 to 13.0)
	August 2019–May 2020	−28.3 (−36.9 to −18.5)
Menthol	August 2019–May 2020	18.9 (12.5 to 25.7)
Tobacco	August 2019–May 2020	4.6 (2.7 to 6.6)
All other flavors ††	September 2014–October 2018	2.0 (1.3 to 2.7)
	October 2018–May 2020	−5.9 (−8.3 to −3.4)
Prefilled cartridge sales, by flavor type		
Mint	September 2014–August 2019	14.1 (8.5 to 20.1)
	August 2019–May 2020	−42.3 (−54.6 to −26.7)
Menthol	August 2019–May 2020	22.3 (14.9 to 30.1)
Tobacco	August 2019–May 2020	6.1 (3.6 to 8.7)
All other flavors	September 2014–October 2018	3.3 (2.3 to 4.2)
	October 2018–May 2020	−18.1 (−28.6 to −6.0)
Disposable sales, by flavor type		
Mint	September 2014–May 2020	7.4 (4.7 to 10.1)
Menthol	September 2014–May 2020	−1.4 (−2.5 to −0.3)
Tobacco	September 2014–May 2020	−1.5 (−2.1 to −0.9)
All other flavors	September 2014–May 2020	1.6 (1.3 to 1.9)
E-liquid sales, by flavor type		
Mint	September 2014–May 2020	−3.5 (−4.9 to −2.2)
Menthol	September 2014–May 2020	—§§
Tobacco	September 2014–May 2020	−4.5 (−6.7 to −2.3)
All other flavors	September 2014–May 2020	−4.2 (−5.9 to −2.4)

Abbreviations: AIPC = average 4-week interval percentage change; CI = confidence interval.

* Retail sales data were obtained from Information Resources, Inc. (IRI) for convenience stores, gas stations, grocery stores, drug stores/pharmacies, mass merchandiser outlets, club stores, dollar stores, and military sales; data from the Internet and vape shops were not collected.

† AIPC (CI) calculated using Joinpoint (version 4.8.0.1; National Cancer Institute).

§ Prefilled cartridges include tanks, cartridges, and pods used in rechargeable and reusable e-cigarette device; the cartridges are not intended to be refilled after the liquid has been depleted. Unit sales were standardized to reflect the most common package size for each product type; a standardized unit was equal to five prefilled cartridges.

¶ Disposable devices include nonrechargeable and nonreusable e-cigarette devices that are not intended to be refilled with e-liquid after being depleted; the device is disposed of once the e-liquid has been consumed. Unit sales were standardized to reflect the most common package size for each product type; a standardized unit was equal to 1 disposable device.

** E-liquids are containers of the liquid used in e-cigarette devices, which typically contains a humectant (e.g., propylene glycol), nicotine, and flavoring.

†† The "All other flavors" category includes fruit, clove/spice, chocolate, alcoholic drink (such as wine, cognac, or other cocktails), candy/desserts/other sweets, or some other flavor. Unknown flavors were excluded from this figure (<0.1%).

§§ The dash indicates that Joinpoint regression could not be conducted because of small sales values.

Internet or "vape shops," which accounted for approximately one half of U.S. e-cigarette sales in 2019;§§ a data source for Internet and "vape shop" sales does not currently exist. Second, the study could not assess purchaser age. These sales could reflect products purchased by adults or those obtained directly or indirectly by youths; however, three quarters of youths who use JUUL, the mostly commonly sold e-cigarette brand in the United States, reported obtaining it from a physical retail location.¶¶ Finally, ambiguous or concept flavors were back-coded using online searches and might be subject to misclassification; however, this only applied to 5.6% of total sales.

Youth use of tobacco products in any form, including e-cigarettes, is unsafe (*1*,*2*). In the U.S., e-cigarette use is markedly higher among youths than adults; in 2018, current use of e-cigarettes was 20.8% (past 30-day use) among high school students, 7.6% (everyday/someday use) among adults aged 18–24 years, and 3.2% (everyday/someday use) among adults aged ≥18 years (*6*,*8*). In addition to regulation of the manufacturing, marketing, and sale of e-cigarettes by FDA,*** strategies to reduce e-cigarette use among youths include increasing price, implementing comprehensive smoke-free policies that include e-cigarettes, restricting youths' access to e-cigarettes in retail settings, licensing retailers, developing educational initiatives targeting youths, curbing youth-appealing advertising and marketing, and implementing strategies to reduce youth access to flavored tobacco products (*1*,*2*,*9*).

Summary

What is already known about this topic?

Since electronic cigarettes (e-cigarettes) entered the U.S. marketplace in 2007, the landscape has evolved to include disposable e-cigarettes and rechargeable e-cigarettes with prefilled cartridges and flavored e-liquids (e.g., fruit, candy, and mint).

What is added by this report?

During September 2014–May 2020, e-cigarette sales increased by 122.2%. Sales of prefilled cartridges increased during September 2014–August 2019; since then, sales of disposable products have increased. Prefilled mint cartridge e-cigarette sales increased from September 2014 to August 2019, then decreased, as menthol sales increased during August 2019–May 2020.

What are the implications for public health practice?

Continued monitoring of e-cigarette sales and use is critical to inform strategies to minimize risks. As part of a comprehensive approach, such strategies could include those that address youth-appealing product innovations and flavors.

§§ http://www.natocentral.org/uploads/Wall_Street_Update_Slide_Deck_February_2019.pdf.

¶¶ https://truthinitiative.org/research-resources/emerging-tobacco-products/where-are-kids-getting-juul.

*** https://pubmed.ncbi.nlm.nih.gov/27192730/.

Acknowledgments

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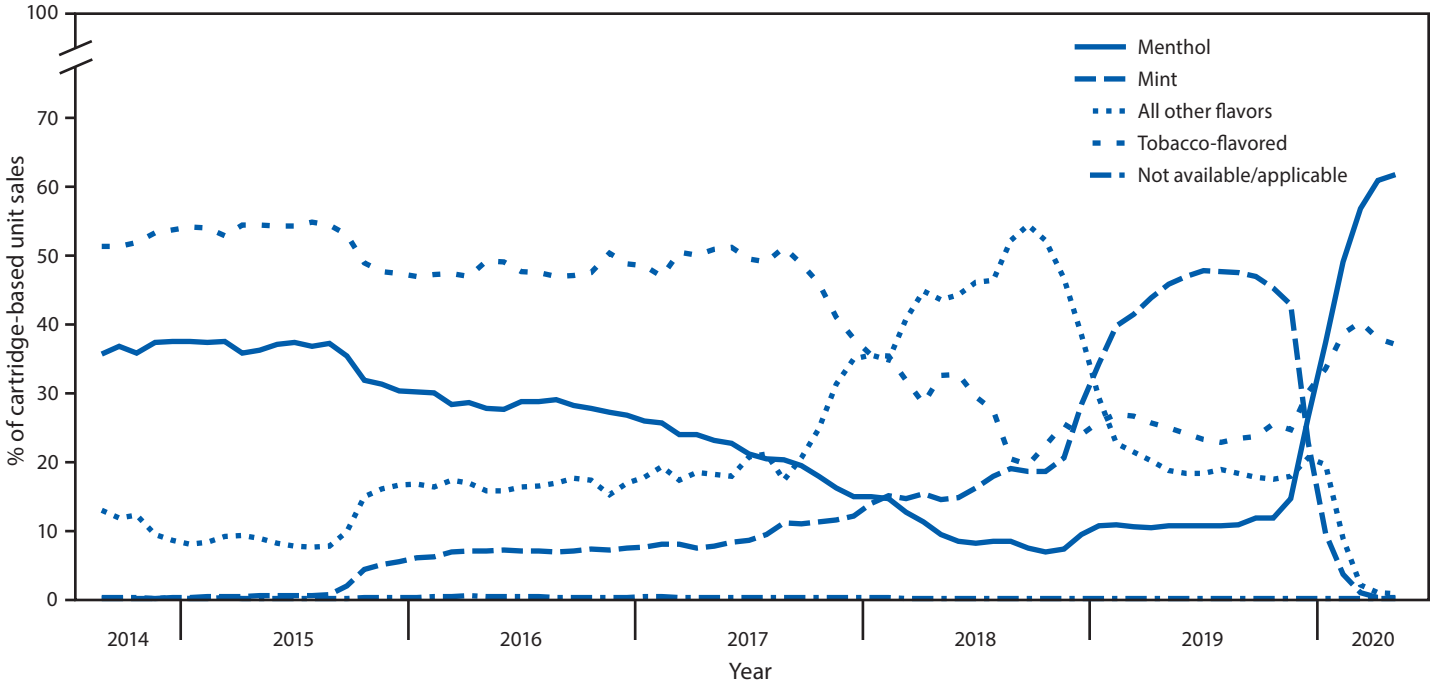
FIGURE 2. Percentage of prefilled cartridge* e-cigarette unit sales,† by flavor§ — United States, September 14, 2014–May 17, 2020



* Prefilled cartridges include tanks, cartridges, and pods used in rechargeable and reusable e-cigarette device; the cartridges are not intended to be refilled after the liquid has been depleted. Unit sales were standardized to reflect the most common package size for each product type; a standardized unit was equal to 5 prefilled cartridges.
† Retail sales data were obtained from Information Resources, Inc. (IRI) for convenience stores, gas stations, grocery stores, drugstores/pharmacies, mass merchandiser outlets, club stores, dollar stores, and military sales; data from the Internet and vape shops were not collected.
§ The "All other flavors" category includes fruit, clove/spice, chocolate, alcoholic drink (such as wine, cognac, or other cocktails), candy/desserts/other sweets, or some other flavor. Unknown flavors were excluded from this figure (<0.1%).

[1]CDC Foundation, Atlanta, GA; [2]Truth Initiative, Washington, DC; [3]Office on Smoking and Health, National Center for Chronic Disease Prevention and Health Promotion, CDC.

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

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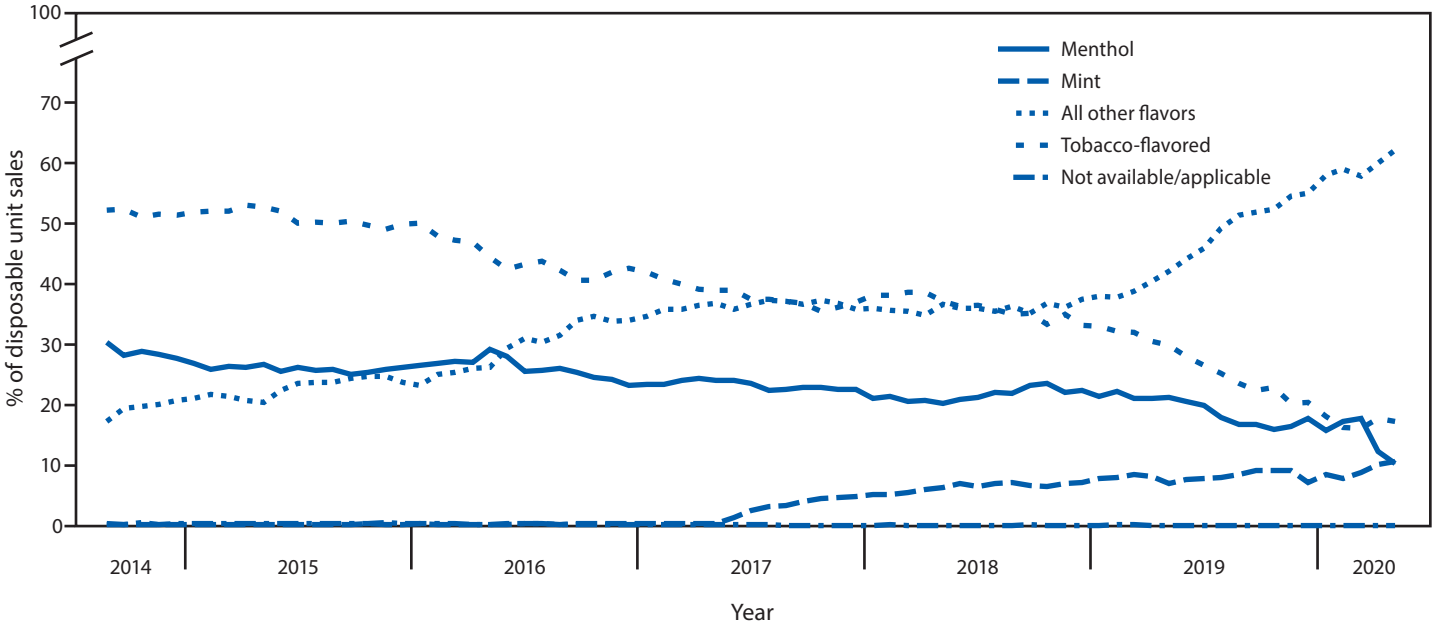
FIGURE 3. Percentage of disposable e-cigarette* unit sales,† by flavor§ — United States, September 14, 2014–May 17, 2020



* Disposable devices include nonrechargeable and nonreusable e-cigarette devices that are not intended to be refilled with e-liquid after being depleted; the device is disposed of once the e-liquid has been consumed. Unit sales were standardized to reflect the most common package size for each product type; a standardized unit was equal to 1 disposable device.

† Retail sales data were obtained from Information Resources, Inc. (IRI) for convenience stores, gas stations, grocery stores, drugstores/pharmacies, mass merchandiser outlets, club stores, dollar stores, and military sales; data from the Internet and vape shops were not collected.

§ The "All other flavors" category includes fruit, clove/spice, chocolate, alcoholic drink (such as wine, cognac, or other cocktails), candy/desserts/other sweets, or some other flavor. Unknown flavors were excluded from this figure (<0.1%).

Transmission Dynamics of COVID-19 Outbreaks Associated with Child Care Facilities — Salt Lake City, Utah, April–July 2020

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Reports suggest that children aged ≥10 years can efficiently transmit SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19) (*1*,*2*). However, limited data are available on SARS-CoV-2 transmission from young children, particularly in child care settings (*3*). To better understand transmission from young children, contact tracing data collected from three COVID-19 outbreaks in child care facilities in Salt Lake County, Utah, during April 1–July 10, 2020, were retrospectively reviewed to explore attack rates and transmission patterns. A total of 184 persons, including 110 (60%) children had a known epidemiologic link to one of these three facilities. Among these persons, 31 confirmed COVID-19 cases occurred; 13 (42%) in children. Among pediatric patients with facility-associated confirmed COVID-19, all had mild or no symptoms. Twelve children acquired COVID-19 in child care facilities. Transmission was documented from these children to at least 12 (26%) of 46 nonfacility contacts (confirmed or probable cases). One parent was hospitalized. Transmission was observed from two of three children with confirmed, asymptomatic COVID-19. Detailed contact tracing data show that children can play a role in transmission from child care settings to household contacts. Having SARS-CoV-2 testing available, timely results, and testing of contacts of persons with COVID-19 in child care settings regardless of symptoms can help prevent transmission. CDC guidance for child care programs recommends the use of face masks, particularly among staff members, especially when children are too young to wear masks, along with hand hygiene, frequent cleaning and disinfecting of high-touch surfaces, and staying home when ill to reduce SARS-CoV-2 transmission (*4*).

Contact tracing* data collected during April 1–July 10, 2020 through Utah's National Electronic Disease Surveillance System (EpiTrax) were used to retrospectively construct transmission chains from reported COVID-19 child care facility outbreaks, defined as two or more laboratory-confirmed COVID-19 cases within 14 days among staff members or attendees at the same facility. EpiTrax maintains records of epidemiologic linkage between index patients and contacts (defined as anyone who was within 6 feet of a person with COVID-19 for at least 15 minutes ≤2 days before the patient's symptom onset) and captures data on demographic characteristics, symptoms, exposures, testing, and the monitoring/isolation period. A confirmed case was defined as receipt of a positive SARS-CoV-2 real-time reverse transcription–polymerase chain reaction (RT-PCR) test result. A probable case was an illness with COVID-19–compatible symptoms,† epidemiologically linked to the outbreak, but with no laboratory testing. For this report, the index case was defined as the first confirmed case identified in a person at the child care facility, and the primary case was defined as the earliest confirmed case linked to the outbreak. Pediatric patients were aged <18 years; adults were aged ≥18 years.

Persons with confirmed or probable child care facility–associated COVID-19 were required to isolate upon experiencing symptoms or receiving a positive SARS-CoV-2 test result. Contacts were required to quarantine for 14 days after contact with a person with a confirmed case. Facility attack rates were calculated by including patients with confirmed and probable facility-associated cases (including the index patient) in the numerator and all facility staff members and attendees in the denominator. Overall attack rates include facility-associated cases (including the index case) and nonfacility contact (household and nonhousehold) cases in the numerator and all facility staff members and attendees and nonfacility contacts in the denominator; the primary case and cases linked to the primary case are excluded.

During April 1–July 10, Salt Lake County identified 17 child care facilities (day care facilities and day camps for school-aged children; henceforth, facilities) with at least two confirmed COVID-19 cases within a 14-day period. This report describes outbreaks in three facilities that experienced possible transmission within the facility and had complete contact investigation information. A total of 184 persons, including 74 (40%) adults (median age = 30 years; range = 19–78 years) and 110 (60%)

* https://www.cdc.gov/coronavirus/2019-ncov/php/contact-tracing/contact-tracing-plan/contact-tracing.html.

† https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html.

children (median age = 7 years; range = 0.2–16 years), had a known epidemiologic link to one of these three facilities with an outbreak; 54% were female and 40% were male. Among these persons, 31 confirmed COVID-19 cases occurred (Table 1); 18 (58%) cases occurred in adults and 13 (42%) in children. Among all contacts, nine confirmed and seven probable cases occurred; the remaining 146 contacts had either negative test results (50; 27%), were asymptomatic and were not tested (94; 51%) or had unknown symptoms and testing information (2; 1%).

Among the 101 facility staff members and attendees, 22 (22%) confirmed COVID-19 cases (10 adult and 12 pediatric) were identified (Table 2), accounting for 71% of the 31 confirmed cases; the remaining nine (29%) cases occurred in contacts of staff members or attendees. Among the 12 facility-associated pediatric patients with confirmed COVID-19, nine had mild symptoms, and three were asymptomatic. Among 83 contacts of these 12 pediatric patients, 46 (55%) were nonfacility contacts, including 12 (26%) who had confirmed (seven) and probable (five) COVID-19. Six of these cases occurred in mothers and three in siblings of the pediatric patients. Overall, 94 (58%) of 162 contacts of persons with facility-associated cases had no symptoms of COVID-19 and were not tested. Staff members at two of the facilities had a household contact with confirmed or probable COVID-19 and went to work while their household contact was symptomatic. These household contacts represented the primary cases in their respective outbreaks.

TABLE 1. Characteristics of all staff members, attendees, and their contacts associated with COVID-19 outbreaks at three child care facilities — Salt Lake County, Utah, April 1–July 10, 2020

Characteristic	No. (% with available information) Total*	Adult*	Pediatric*
Facility staff members, attendees, and contacts	184 (100)	74 (100)	110 (100)
Age, yrs, median (range)†	9 (0.2–78)	30 (19–78)	7 (0.2–16)
Sex			
Female	100 (54)	42 (57)	58 (53)
Male	74 (40)	31 (42)	43 (39)
Unavailable	10 (5)	1 (1)	9 (8)
Linkage to facility			
Facility staff member or attendee	101 (55)	18 (24)	83 (75)
Nonfacility contact§	83 (45)	56 (76)	27 (25)
Confirmed¶ COVID-19 cases			
Total	31 (17)	18 (24)	13 (12)
Symptomatic	24 (13)	15 (24)	9 (8)
Index case at facility	3 (2)	3 (4)	0 (–)
Asymptomatic	4 (2)	0 (–)	4 (4)
Probable¶ COVID-19 cases	7 (4)	5 (7)	2 (2)
Contacts§			
Total	146 (79)	51 (60)	95 (86)
Contacts with a negative test result	50 (27)	27 (36)	23 (21)
Asymptomatic contacts, not tested	94 (51)	22 (30)	72 (65)
Contacts with unknown symptoms and testing	2 (1)	2 (3)	0 (—)

Abbreviation: COVID-19 = coronavirus disease 2019.
* Does not include two persons with primary cases or their six contacts; two adult contacts had unknown symptom and testing information. Percent is calculated as a percentage of the total.
† Age data were missing for 11 contacts.
§ Includes pediatric and adult household and nonhousehold contacts.
¶ A confirmed case was defined as a positive SARS-CoV-2 reverse transcription–polymerase chain reaction test result. A probable case was an illness with symptoms consistent with COVID-19 and linked to the outbreak but without laboratory testing.

Facility A Outbreak

Facility A, which had been deemed an essential business and had not closed before the outbreak occurred, required daily temperature and symptom screening for the 12 staff members and children and more frequent cleaning and disinfection; staff members were required to wear masks. Two COVID-19 cases in staff members were associated with facility A (Figure). The index case at facility A (patient A1) occurred in a staff member who reported symptom onset on April 2, self-isolated on April 3, and had a positive SARS-CoV-2 RT-PCR test result from a nasopharyngeal (NP) swab specimen obtained on April 6. Three days after patient A1's symptom onset, a second staff member (patient A2) experienced symptoms and had a positive SARS-CoV-2 test result 1 day later. Ten facility contacts (nine children aged 1–5 years and one staff member) remained asymptomatic during the monitoring period and were not tested. The last reported exposure at facility A was on April 3, when the facility closed. Among the 15 nonfacility contacts of patients A1 and A2 (including four children aged 1–13 years), 10 remained asymptomatic throughout their monitoring period and were not tested, and three received negative test results; the symptom and testing information for two nonfacility contacts was unknown. The primary patient, a household contact of the index patient, reported symptom onset 9 days before symptom onset in patient A1 and received a positive SARS-CoV-2 test result from an NP specimen collected on April 6. The facility attack rate (excluding the primary case) for facility A was 17% (two of 12) and was 7% overall (including contacts) (two of 27).

Facility B Outbreak

Facility B was closed during March 13–May 4. Upon reopening, temperatures of the five staff members and children were checked daily, and more frequent cleaning was conducted; only staff members were required to wear masks. Five COVID-19 cases in three staff members and two children were associated with facility B (Figure). The index case (B1) occurred in a staff member who was tested on May 31 while presymptomatic (because of a household contact with COVID-19) and received a SARS-CoV-2-positive test result; patient B1 experienced mild COVID-19 symptoms on June 3 and last worked on May 29. A second staff member (patient B2), experienced symptoms on June 8, was tested, and received a positive test result 2 days later. Patients B3 and B4, children aged 8 months

TABLE 2. Classification of contacts with known linkage to facility-associated confirmed adult and pediatric cases* at three child care facilities — Salt Lake County, Utah, April 1–July 10, 2020

	No. (%)					
				Facility		
Classification	Total†	Adult†	Pediatric	A	B	C
COVID-19 cases at facilities§	22	10	12	2	5	15
Contacts¶ linked to cases at facilities	162	79	83	25	28	109
Contacts¶ with confirmed COVID-19	9 (6)	2 (3)	7 (8)	0 (—)	4 (14)	5 (5)
Contacts¶ with probable COVID-19	7 (4)	2 (3)	5 (6)	0 (—)	3 (11)	4 (4)
Contacts¶ with negative test results	50 (31)	25 (32)	25 (30)	3 (12)	13 (46)	34 (31)
Asymptomatic contacts, not tested	94 (58)	48 (61)	46 (55)	20 (80)	8 (29)	66 (61)
Contacts with unknown symptoms and testing	2 (1)	2 (3)	0 (—)	2 (1)	0 (—)	0 (—)
Interval (days)						
Facility case onset to contact onset, median (range)**	4 (1–8)	6 (4–6)	3 (1–8)	1 (1–1)	4.5 (1–6)	4 (3–8)
Facility case onset to testing, median (range)††	2.5 (0–6)	1 (0–4)	4 (1–6)	2.5 (1–4)	1 (0–3)	2 (0–10)

Abbreviation: COVID-19 = coronavirus disease 2019.
* A confirmed case was defined as a positive SARS-CoV-2 reverse transcription–polymerase chain reaction test result. A probable case was an illness with symptoms consistent with COVID-19 and linked to the outbreak but without laboratory testing.
† A positive adult case linked to facility attendee from Facility B is included because they were a staff member.
§ Includes index cases.
¶ Includes pediatric and adult household and nonhousehold contacts.
** For cases in persons who were asymptomatic, onset for contact is date of receipt of positive test result.
†† Does not include three pediatric facility cases in persons who were asymptomatic who did not have symptom onset dates.

and 8 years, respectively, experienced mild signs and symptoms (fever, fatigue, runny nose) 7 and 8 days, respectively, after symptom onset in patient B2; both children were tested and received positive test results the day after their symptoms commenced. A third staff member, patient B5, experienced symptoms 9 days after symptoms occurred in patient B4, was tested, and received a positive test result 1 day later. The two children likely transmitted SARS-CoV-2 to their contacts including two confirmed cases (in one child's mother and father, both symptomatic 2 and 3 days, respectively, following the child's illness onset) and three probable cases (in two adults, including one mother and a child). The index patient (B1) was a household contact of the primary patient who had symptom onset May 26, was tested on May 29, and received a positive SARS-CoV-2 test result. The facility attack rate for facility B was 100% (five of five) and the overall attack rate was 36% (12 of 33).

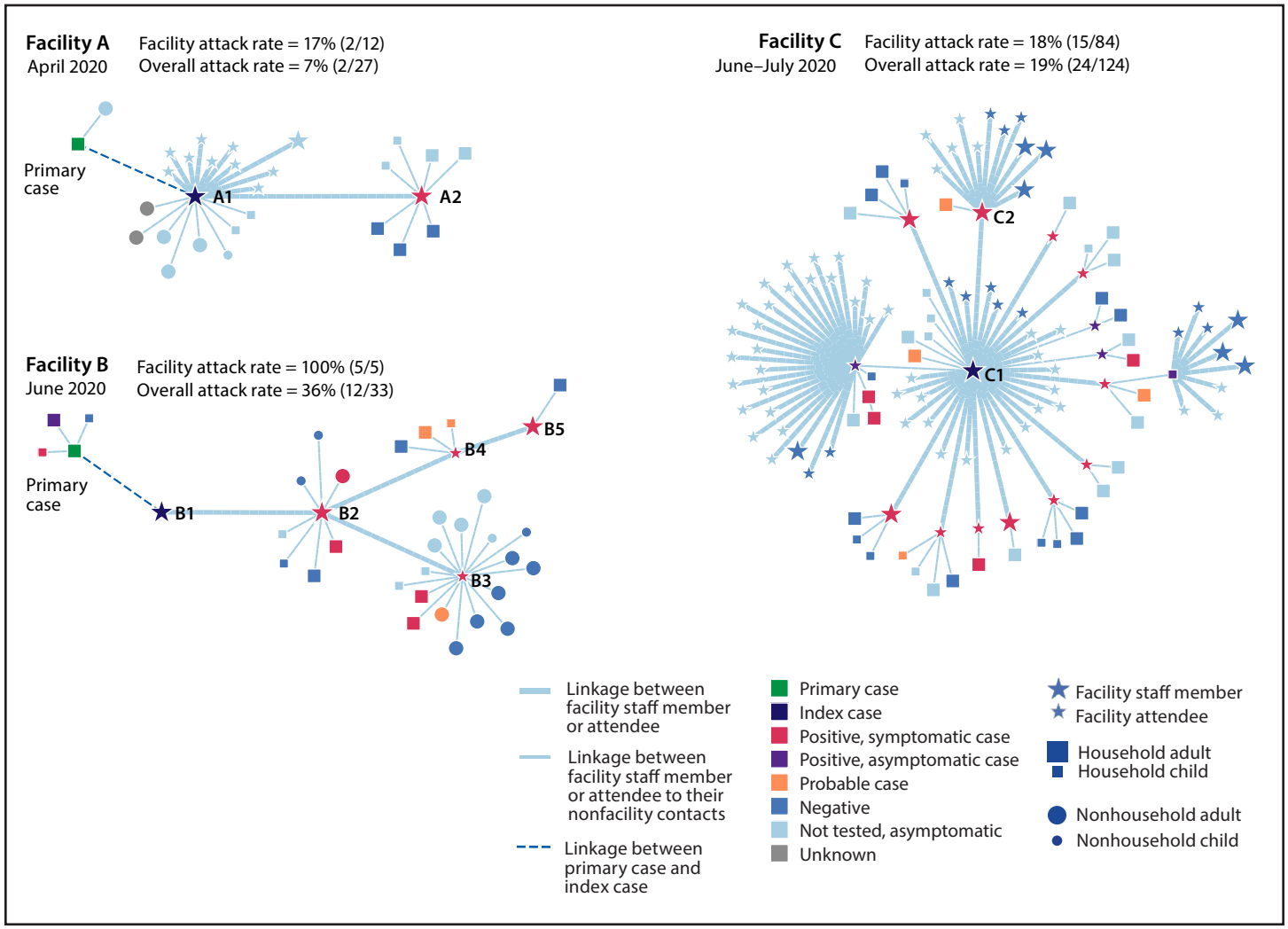
Facility C Outbreak

Facility C was closed during March 13–June 17. Upon reopening, the facility requested that 84 staff members and children check their temperature and monitor their symptoms daily; masks were not required for staff members or children. Fifteen COVID-19 cases (in five staff members and 10 children) were associated with facility C (Figure). Two staff members and two students reported symptoms on June 24 and self-isolated. The index case occurred in a staff member (patient C1), who had a positive test result from an NP specimen obtained on June 25. The second staff member, patient C2, was tested 2 days later and received a positive SARS-CoV-2 test result, and the two students (aged 7 and 8 years) were tested on June 28 and 29, respectively and received positive test results. Over the subsequent 8 days, an additional eight students (aged 6–10 years), three of whom were asymptomatic, and three staff members (all symptomatic) received positive SARS-CoV-2 test results. Pediatric patients at the facility likely transmitted SARS-CoV-2 to their contacts, including five confirmed cases in household contacts (three mothers, one aunt, and one child) and two probable household cases (one mother and one child). Symptoms developed 3 and 5 days following the child's illness onset when onset date was known. One mother who was presumably infected by her asymptomatic child was subsequently hospitalized. Among the seven cases in symptomatic children, fever was the most common sign, followed by symptoms of headache and sore throat. The source for this cluster was not identified. The facility attack rate for facility C was 18% (15 of 84) and the overall attack rate was 19% (24 of 124).

Discussion

Analysis of contact tracing data in Salt Lake County, Utah, identified outbreaks of COVID-19 in three small to large child care facilities linked to index cases in adults and associated with transmission from children to household and nonhousehold contacts. In these three outbreaks, 54% of the cases linked to the facilities occurred in children. Transmission likely occurred from children with confirmed COVID-19 in a child care facility to 25% of their nonfacility contacts.

FIGURE. Transmission chains* and attack rates†,§ in three COVID-19 child care center outbreaks¶,,†† — Salt Lake County, Utah, April 1–July 10, 2020**



Abbreviation: COVID-19 = coronavirus disease 2019.

* Transmission chains developed using Microbe Trace software. https://www.biorxiv.org/content/10.1101/2020.07.22.216275v1.

† Facility attack rates include index cases and all facility staff members and attendees.

§ Overall attack rates include all facility staff members and attendees (including the index case) and nonfacility contacts (household and nonhousehold). It does not include the primary case or the cases linked to the primary case.

¶ A confirmed case was defined as a positive SARS-CoV-2 reverse transcription–polymerase chain reaction test result. A probable case was an illness with symptoms consistent with COVID-19 and linked to the outbreak but without laboratory testing.

** The index case was defined as the earliest confirmed case in a person at the child care facility.

†† A primary case was defined as the earliest confirmed case linked to the outbreak.

Mitigation strategies§ could have helped limit SARS-CoV-2 transmission in these facilities. To help control the spread of COVID-19, the use of masks is recommended for persons aged ≥2 years.¶ Although masks likely reduce the transmission risk (*5*), some children are too young to wear masks but can transmit SARS-CoV-2, as was seen in facility B when a child aged 8 months transmitted SARS-CoV-2 to both parents.

The findings in the report are subject to at least three limitations. First, guidance for contact tracing methodology changed during the pandemic and could have resulted in differences in data collected over time. Second, testing criteria initially included only persons with typical COVID-19 signs and symptoms of fever, cough, and shortness of breath, which

§ https://www.cdc.gov/coronavirus/2019-ncov/if-you-are-sick/isolation.html; https://www.cdc.gov/coronavirus/2019-ncov/if-you-are-sick/quarantine.html.

¶ https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/cloth-face-cover-guidance.html.

Summary

What is already known about this topic?

Children aged ≥10 years have been shown to transmit SARS-CoV-2 in school settings.

What is added by this report?

Twelve children acquired COVID-19 in child care facilities. Transmission was documented from these children to at least 12 (26%) of 46 nonfacility contacts (confirmed or probable cases). One parent was hospitalized. Transmission was observed from two of three children with confirmed, asymptomatic COVID-19.

What are the implications for public health practice?

SARS-CoV-2 Infections among young children acquired in child care settings were transmitted to their household members. Testing of contacts of laboratory-confirmed COVID-19 cases in child care settings, including children who might not have symptoms, could improve control of transmission from child care attendees to family members.

could have led to an underestimate of cases and transmission. Finally, because the source for the outbreak at facility C was unknown, it is possible that cases associated with facility C resulted from transmission outside the facility.

COVID-19 is less severe in children than it is in adults (*6*,*7*), but children can still play a role in transmission (*8*–*9*). The infected children exposed at these three facilities had mild to no symptoms. Two of three asymptomatic children likely transmitted SARS-CoV-2 to their parents and possibly to their teachers. Having SARS-CoV-2 testing available, timely results, and testing of contacts of patients in child care settings regardless of symptoms can help prevent transmission and provide a better understanding of the role played by children in transmission. Findings that staff members worked while their household contacts were ill with COVID-19–compatible symptoms support CDC guidance for child care programs recommendations that staff members and attendees quarantine and seek testing if household members are symptomatic (*4*). This guidance also recommends the use of face masks, particularly among staff members, especially when children are too young to wear masks, along with hand hygiene, frequent cleaning and disinfecting of high-touch surfaces, and staying home when ill to reduce SARS-CoV-2 transmission.

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SARS-CoV-2–Associated Deaths Among Persons Aged <21 Years — United States, February 12–July 31, 2020

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Since February 12, 2020, approximately 6.5 million cases of SARS-CoV-2 infection, the cause of coronavirus disease 2019 (COVID-19), and 190,000 SARS-CoV-2–associated deaths have been reported in the United States (*1*,*2*). Symptoms associated with SARS-CoV-2 infection are milder in children compared with adults (*3*). Persons aged <21 years constitute 26% of the U.S. population (*4*), and this report describes characteristics of U.S. persons in that population who died in association with SARS-CoV-2 infection, as reported by public health jurisdictions. Among 121 SARS-CoV-2–associated deaths reported to CDC among persons aged <21 years in the United States during February 12–July 31, 2020, 63% occurred in males, 10% of decedents were aged <1 year, 20% were aged 1–9 years, 70% were aged 10–20 years, 45% were Hispanic persons, 29% were non-Hispanic Black (Black) persons, and 4% were non-Hispanic American Indian or Alaska Native (AI/AN) persons. Among these 121 decedents, 91 (75%) had an underlying medical condition,* 79 (65%) died after admission to a hospital, and 39 (32%) died at home or in the emergency department (ED).† These data show that nearly three quarters of SARS-CoV-2–associated deaths among infants, children, adolescents, and young adults have occurred in persons aged 10–20 years, with a disproportionate percentage among young adults aged 18–20 years and among Hispanics, Blacks, AI/ANs, and persons with underlying medical conditions. Careful monitoring of SARS-CoV-2 infections, deaths, and other severe outcomes among persons aged <21 years remains particularly important as schools reopen in the United States. Ongoing evaluation of effectiveness of prevention and control strategies will also be important to inform public health guidance for schools and parents and other caregivers.

Public health jurisdictions in the United States use standard definitions to identify cases of COVID-19§ and multisystem inflammatory syndrome in children (MIS-C),¶ a severe illness characterized by fever, multiorgan system involvement, laboratory evidence of inflammation, and laboratory or epidemiologic evidence of SARS-CoV-2 infection or exposure. SARS-CoV-2–associated deaths were defined as deaths associated with COVID-19 or MIS-C per the determination of the jurisdiction. Persons aged <21 years who met the definition for a SARS-CoV-2–associated death and died during February 12–July 31, 2020, were included in this study. Fifty states, New York City, the District of Columbia, Puerto Rico, Guam, and the U.S. Virgin Islands were asked to submit information on SARS-CoV-2–associated deaths among persons aged <21 years, including COVID-19 or MIS-C case status (as determined by each jurisdiction), demographics, dates of illness onset and hospitalization, underlying medical conditions, and location of death. Number of days from illness onset to hospitalization, days from hospitalization until date of death, and days from onset to date of death were calculated for decedents with available data.

Cases of SARS-CoV-2 infection among persons aged <21 years in the United States were first reported in

* https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-with-medical-conditions.html.

† Location of death for all cases (121): hospital (79 [65.3%]), home (16 [13.2%]), ED (23 [19.0%]), hospice (one [0.8%]), and unknown (2 [1.7%]).

§ https://wwwn.cdc.gov/nndss/conditions/coronavirus-disease-2019-covid-19/case-definition/2020/.

¶ https://www.cdc.gov/mis-c/hcp/.

March 2020 (Figure 1); the first SARS-CoV-2–associated fatality among persons in that age group also occurred in March. During February 12–July 31, a total of 391,814 cases of confirmed or probable COVID-19 or MIS-C in persons aged <21 years were reported through case-based surveillance in the United States.

Among the 55 health jurisdictions invited to submit information on SARS-CoV-2–associated deaths among persons aged <21 years, 47 responded; 20 reported no deaths,** and 27 identified 121 deaths†† that met inclusion criteria. Overall, 120 (99%) decedents met the confirmed or probable COVID-19 case definition, and 15 (12%) met the MIS-C case definition, including 14 (12%) who met both case definitions. Twelve (10%) deaths were in infants aged <1 year, 24 (20%) in children aged 1–9 years, and 85 (70%) in persons aged 10–20 years; the median age at death was 16 years (interquartile range [IQR] = 7–19 years) (Figure 2) (Table). Among the 121 decedents, 76 (63%) were male, 54 (45%) were Hispanic, 35 (29%) were Black, and five (4%) were AI/AN.

Among the 121 decedents, 30 (25%) were previously healthy (no reported underlying medical condition), 91 (75%) had at least one underlying medical condition, and 54 (45%) had two or more underlying medical conditions. The most frequently reported medical conditions were chronic lung disease, including asthma (34 [28%]), obesity (33 [27%]), neurologic and developmental conditions (26 [22%]), and cardiovascular conditions (22 [18%]).

Overall, 79 (65%) deaths occurred after hospital admission. Among the remaining 42 decedents, 16 (38%) died at home, 23 (55%) were critically ill and died in the ED, one (2%) died in hospice care, and the location of death was unknown for two (5%). Out-of-hospital deaths occurred in all age groups; however, the highest proportions of deaths at home or in the ED occurred in infants (33%) and adolescents and young adults aged 14–20 years (37%)§§ (Supplementary figure, https://stacks.cdc.gov/view/cdc/93381). Among the 79 decedents who died in the hospital, the median interval from onset of symptoms until admission was 3 days (IQR = 1–7 days),¶¶ and the median interval from hospital admission until death was 8 days (IQR = 4–21.5 days).*** Among 94 decedents with known illness onset date, median interval from onset of symptoms until death was 11 days (IQR = 6–24 days).

Summary

What is already known about this topic?

Symptoms associated with SARS-CoV-2 infection are milder in children compared with adults.

What is added by this report?

Among 121 SARS-CoV-2–associated deaths among persons aged <21 years reported to CDC by July 31, 2020, 12 (10%) were infants and 85 (70%) were aged 10–20 years. Hispanic, non-Hispanic Black and non-Hispanic American Indian/Alaskan Native persons accounted for 94 (78%) of these deaths; 33% of deaths occurred outside of a hospital.

What are the implications for public health practice?

Persons aged <21 years exposed to SARS-CoV-2 should be monitored for complications. Ongoing surveillance for SARS-CoV-2–associated infection, hospitalization, and death among persons aged <21 years should be continued as schools reopen in the United States.

Discussion

During February 12–July 31, 2020, a total of 391,814 cases of COVID-19 and MIS-C (representing approximately 8% of all reported cases) (*1*,*2*) and 121 deaths (approximately 0.08% of all deaths) (*1*,*2*) were identified among persons aged <21 years in the United States. Four important findings were identified. First, although Hispanic, Black, and AI/AN persons represent 41% of the U.S. population aged <21 years (*4*), these groups accounted for approximately 75% of deaths in persons aged <21 years. Second, deaths were more prevalent among males and among persons aged 10–20 years; young adults aged 18–20 years accounted for nearly half of all deaths in this population. Third, 75% of decedents had at least one underlying condition, and 45% had two or more underlying conditions. Fourth, a substantial proportion of out-of-hospital deaths in association with SARS-CoV-2 infection occurred among all age groups in this analysis.

Among infants, children, and adolescents hospitalized with laboratory-confirmed COVID-19 (*5*) and cases of MIS-C (*6*), persons from racial and ethnic minority groups are overrepresented. These racial/ethnic groups are also disproportionately

** Jurisdictions reporting no deaths included Alaska, Delaware, District of Columbia, Guam, Hawaii, Idaho, Kentucky, Massachusetts, Missouri, Montana, New Mexico, Oregon, South Dakota, Vermont, Virginia, U.S. Virgin Islands, Washington, West Virginia, Wisconsin, and Wyoming.

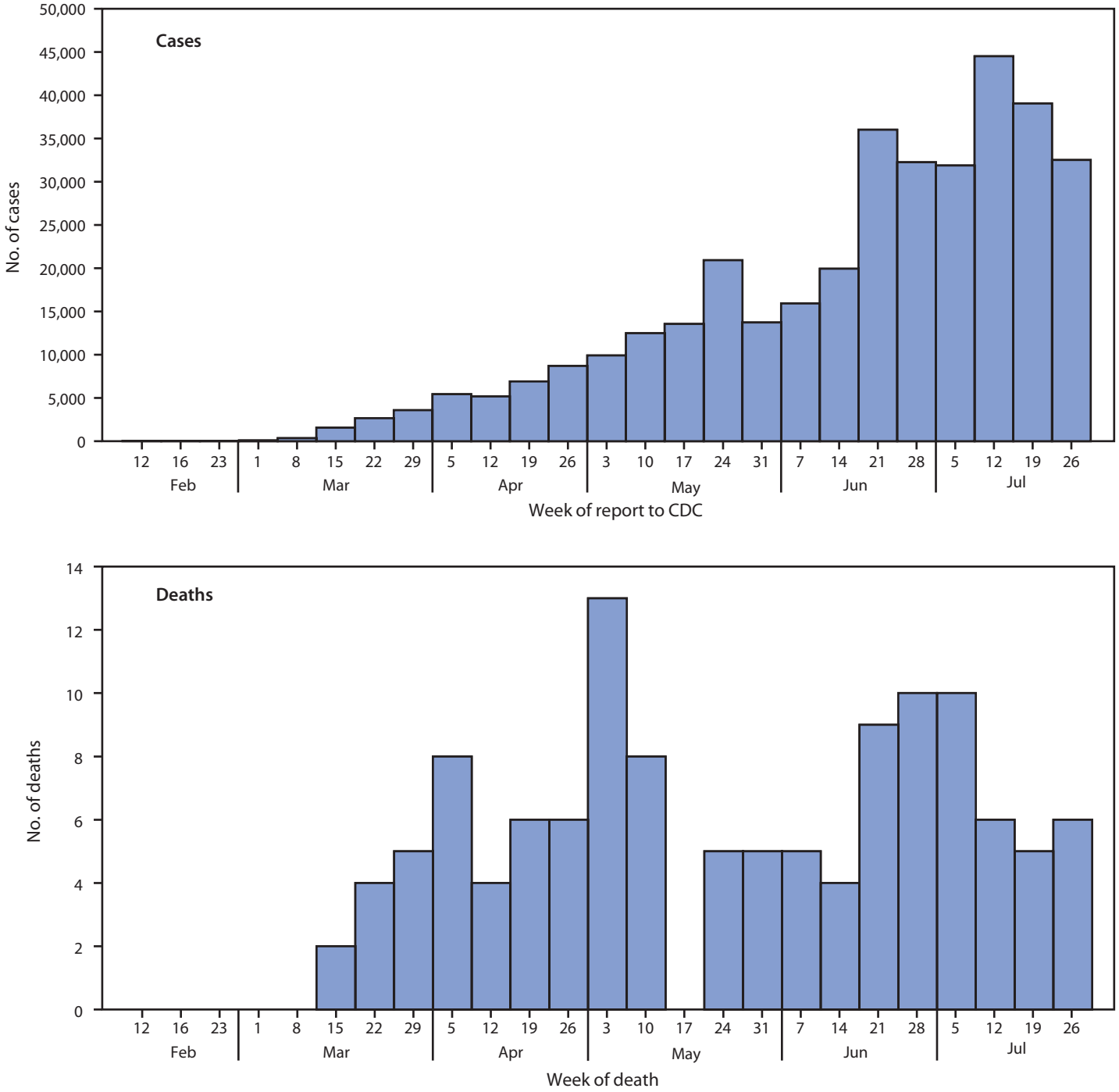
†† Jurisdictions reporting one or more deaths included: Alabama, Arizona, California, Colorado, Connecticut, Florida, Georgia, Illinois, Indiana, Kansas, Louisiana, Maryland, Michigan, Minnesota, Mississippi, Nevada, New Jersey, New York City, New York State, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, and Utah.

§§ By age group the following decedents died at home or in the ED: infants (four of 12 [33%]), age 1–4 years (three of 11 [27%], age 5–9 years (two of 13 [15%]), 10–13 years (three of 12 [25%]), 14–17 years (nine of 23 [39%]), and 18–20 years (18 of 50 [36%]); overall, 39 (32%) of 121 decedents died at home or in the ED.

¶¶ Calculation is based on data from 72 decedents for whom information on onset date and hospital admission date were available.

*** Calculation is based on data from 60 decedents for whom information on hospital admission date and death date were available.

FIGURE 1. SARS-CoV-2–associated cases,*,† by week of case report to CDC, and deaths,§,¶ by week of death, among persons aged <21 years — United States, February 12–July 31, 2020**



* https://wwwn.cdc.gov/nndss/conditions/coronavirus-disease-2019-covid-19/case-definition/2020/.

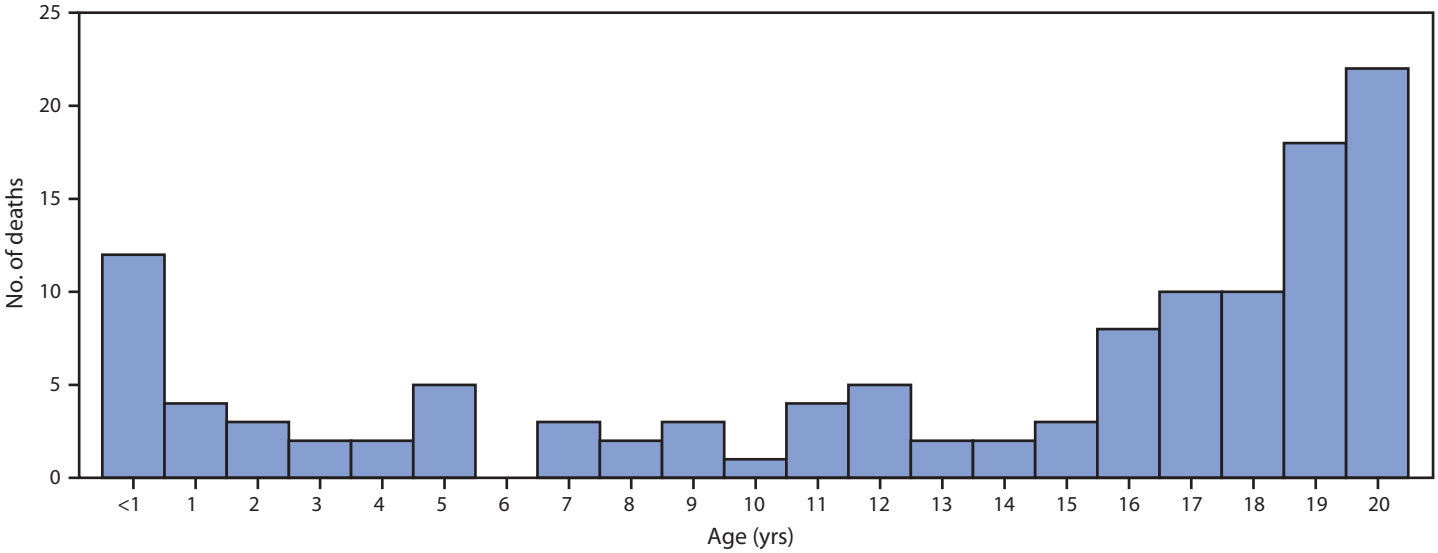
† During February 12–July 31, 2020, 391,814 cases of coronavirus disease 2019 (COVID-19) in persons age <21 years were reported to CDC. Among these, date of report to CDC was missing for 34,538 cases not shown here. Weeks beginning February 12 and July 26 represent partial weeks, February 12–15 and July 26–31, respectively.

§ The first SARS-CoV-2–associated death in a person aged < 21 years in the United States occurred during the week beginning March 15, 2020.

¶ Includes 121 total decedents, 120 persons who met the case definition for COVID-19, 15 persons who met the case definition for multisystem inflammatory syndrome in children, and 14 persons who met both case definitions.

** Among 121 decedents, 94 had a recorded symptom onset date; median interval from symptom onset to death was 11 days (interquartile range = 6–24 days).

FIGURE 2. Age at death among persons aged <21 years with SARS-CoV-2–associated deaths*,† — United States, February 12–July 31, 2020§



* https://wwwn.cdc.gov/nndss/conditions/coronavirus-disease-2019-covid-19/case-definition/2020/.
† https://www.cdc.gov/mis-c/hcp/.
§ Includes 121 total decedents, 120 persons who met the case definition for coronavirus disease 2019, 15 who met the case definition for multisystem inflammatory syndrome in children, and 14 persons who met both case definitions.

represented among essential workers unable to work from their homes (*7*), resulting in higher risk for exposure to SARS-CoV-2 with potential secondary transmission among household members, including infants, children, adolescents, and young adults. In addition, disparities in social determinants of health, such as crowded living conditions, food and housing insecurity, wealth and educational gaps, and racial discrimination, likely contribute to racial and ethnic disparities in COVID-19 and MIS-C incidence and outcomes (*7*). Finally, higher rates of adverse outcomes among racial and ethnic minorities are likely related to challenges in seeking care for various reasons, including difficulty and delays in accessing health care services because of lack of insurance, child care, transportation, or paid sick leave, and social determinants of health that contribute to higher prevalence of medical conditions (*7*).

Thirty-nine out-of-hospital SARS-CoV-2–associated deaths occurred at home or in the ED among persons aged <21 years. In the United States, significant reductions in ED visits (*8*) and childhood immunizations (*9*) occurred during March–April 2020, suggesting that necessary care might be delayed or deferred during the pandemic. Although infants, children, and adolescents are more likely to have milder COVID-19 illness than are adults (*3*), complications, including MIS-C (*6*) and respiratory failure (*5*,*6*), do occur in these populations. Persons infected with or exposed to SARS-CoV-2 should be followed closely so that clinical deterioration can be detected early. In this analysis, the number of deaths was highest in persons aged 14–20 years. Adolescents especially need patient-centered follow-up services that are developmentally appropriate (*10*).

The findings in this report are subject to at least five limitations. First, case-based surveillance data††† underestimate cases of COVID-19 compared with aggregate case reports§§§ from states, and data for some variables in case-based surveillance (e.g., demographic variables) are missing. Therefore, data on cases and deaths by race/ethnicity are not comparable and case fatality rates by race/ethnicity cannot be calculated. Second, the possibility exists that all deaths were not recognized or reported, in part because of incomplete testing, failure to update vital status after death of a previously reported case of COVID-19 or MIS-C, or delays in reporting SARS-CoV-2–associated deaths because of the lengthy process for cause of death ascertainment. Third, autopsy findings and death certificates were not available to verify cause of death for this report. More detailed review of available medical and death records is currently underway in collaboration with public health jurisdictions. Fourth, although guidance for death certificate coding for COVID-19 is available,¶¶¶ a standard surveillance case definition for SARS-CoV-2–associated death is not in use in the United States; case ascertainment and data collection procedures were nonuniform among jurisdictions. Finally, during

††† https://covid.cdc.gov/covid-data-tracker/#demographics.
§§§ https://covid.cdc.gov/covid-data-tracker/#cases_totalcases.
¶¶¶ https://www.rheumatology.org/Portals/0/Files/ACR-COVID-19-Clinical-Guidance-Summary-MIS-C-Hyperinflammation.pdf.

TABLE. Demographic and clinical characteristics of SARS-CoV-2–associated deaths among persons aged <21 years — United States, February 12–July 31, 2020*

Characteristic	No. (%)
Total	**121 (100)**
Age group, yrs	
<1	12 (9.9)
1–4	11 (9.1)
5–9	13 (10.7)
10–13	12 (9.9)
14–17	23 (19.0)
18–20	50 (41.3)
Age, yrs, median (IQR)	16 (7–19)
Sex	
Female	45 (37.2)
Male	76 (62.8)
Race/Ethnicity	
Hispanic	54 (44.6)
American Indian/Alaska Native, non-Hispanic	5 (4.1)
Asian or Pacific Islander, non-Hispanic	5 (4.1)
Black, non-Hispanic	35 (28.9)
White, non-Hispanic	17 (14.0)
Multiple/Other†	2 (1.7)
Missing/Unknown	3 (2.5)
SARS-CoV-2–associated condition§	
COVID-19	120 (99.2)
MIS-C	15 (12.4)
Underlying medical condition¶	
No underlying condition	30 (24.8)
≥1 underlying condition	91 (75.2)
≥2 underlying conditions	54 (44.6)
Chronic lung disease**	34 (28.1)
Obesity††	33 (27.3)
Neurologic and developmental§§	26 (21.5)
Cardiovascular disease¶¶	22 (18.2)
Cancer or immunosuppressive condition***	17 (14.0)
Diabetes mellitus†††	11 (9.1)
Chronic kidney disease	5 (4.1)
Chronic liver disease	3 (2.5)
Other¶¶¶	37 (30.6)
Location of death	
Home	16 (13.2)
Emergency department	23 (19.0)
Hospital	79 (65.3)
Other/Unknown	3(2.5)
Median interval from symptom onset to hospital admission, days (IQR)**	3 (1–7)
Median interval from hospital admission to death, days (IQR)†††	8 (4–21.5)
Median interval from symptom onset to death, days (IQR)§§§	11 (6–24)

TABLE. (*Continued*) Demographic and clinical characteristics of SARS-CoV-2–associated deaths among persons aged <21 years — United States, February 12–July 31, 2020*

Abbreviations: COVID-19 = coronavirus disease 2019; IQR = interquartile range; MIS-C = multisystem inflammatory syndrome in children.

* Persons aged <21 years were included if they were reported by state and local health departments as meeting case definitions for COVID-19 (https://wwwn.cdc.gov/nndss/conditions/coronavirus-disease-2019-covid-19/case-definition/2020/) or MIS-C (https://www.cdc.gov/mis-c/hcp/) with a fatal outcome that occurred before August 1, 2020. Denominator for calculation of all percentages was total decedents with COVID-19 or MIS-C (121).

† Includes persons reported as multiracial and persons reported as being of another race without further specification.

§ Individual decedents could meet both definitions. Both confirmed (114) and probable (six) cases of COVID-19 are included in totals.

¶ Decedents could have more than one underlying condition. Categories include only decedents for whom the condition within the specified category was present at the time of illness onset as reported from state and local health departments.

** Among 34 decedents with chronic lung disease, 21 had additional information, including 19 with asthma and three with other lung disease. Decedents could have more than one chronic lung condition.

†† Decedents with body mass index ≥30 kg/m^2 at or above the 95th percentile for age and sex.

§§ Among 26 decedents with neurologic or developmental disorders, 26 had additional information, including 10 with seizure disorders, 11 with neuromuscular disorders, and 20 with other neurologic and developmental conditions. Decedents could have more than one neurologic or developmental condition.

¶¶ Among 22 decedents with cardiovascular disease, 14 had additional information, including five with hypertension, three with lipid disorders, three with congenital heart disease, and six with other cardiovascular diseases. Decedents could have more than one cardiovascular condition.

*** Among 17 decedents with cancer and immunosuppressive conditions, 14 had additional information, including 10 with any history of cancer, two with immunosuppressive therapy, one with solid organ transplantation and three with other conditions. Decedents could have more than one condition in this category.

††† Includes decedents with type 1 and type 2 diabetes mellitus.

¶¶¶ Includes decedents with history of hematologic disorders (three), rheumatologic disorders (four), metabolic disorders (five), gastrointestinal disorders (five), endocrine disorders (six), dermatologic conditions (three), congenital disorders (14), psychiatric conditions (five), substance use disorder (three), smoking or vaping (two), pregnancy (one), and other medical conditions (nine). Decedents could have more than one condition in this category.

**** Calculation is based on decedents for whom information on symptom onset date and hospital admission date were available (72).

†††† Calculation is based on decedents for whom information on hospital admission date and date of death were available (60).

§§§§ Calculation is based on decedents for whom information on symptom onset date and date of death were available (94).

most of the time between February 12 and July 31, 2020, the majority of U.S. early child care providers, schools, and other educational institutions were closed, gatherings of children and adolescents were reduced, and testing and treatment protocols changed.**** As early child care providers, schools, and other educational institutions reopen for in-person learning and treatment protocols continue to evolve, the incidence of pediatric SARS-CoV-2–associated deaths might change, and pediatric case and death surveillance should continue.

Adolescents and young adults, Hispanic, Black, and AI/AN persons, and persons with underlying medical conditions are disproportionately represented among deaths associated with SARS-CoV-2 in persons aged <21 years reported to CDC. Infants, children, adolescents, and young adults, particularly those from racial and ethnic minority groups at higher risk, those with underlying medical conditions, and their caregivers, need clear, consistent, and developmentally, linguistically, and culturally appropriate COVID-19 prevention messages (e.g., related

**** https://www.rheumatology.org/Portals/0/Files/ACR-COVID-19-Clinical-Guidance-Summary-MIS-C-Hyperinflammation.pdf.

to mask wearing, physical distancing, hand hygiene). To ensure accurate surveillance, it is important that health care providers and health departments assure follow-up for infants, children, adolescents, and young adults infected with or exposed to SARS-CoV-2 and document and report underlying medical conditions and cause of death related to COVID-19. Health departments, in collaboration with school districts and the communities they serve, can evaluate and improve health promotion, health access, and health equity for all infants, children, adolescents, and young adults. Ultimately, health departments, health providers, and community partners can mobilize to remove systemic barriers that contribute to health disparities.††††

†††† https://www.cdc.gov/coronavirus/2019-ncov/community/health-equity/what-we-can-do.html.

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Progress Toward Poliovirus Containment Implementation — Worldwide, 2019–2020

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Since 1988, when World Health Organization (WHO) Member States and partners launched the Global Polio Eradication Initiative, the number of wild poliovirus (WPV) cases has declined from 350,000 in 125 countries to 176 in only two countries in 2019 (*1*). The Global Commission for the Certification of Poliomyelitis Eradication (GCC) declared two of the three WPV types, type 2 (WPV2) and type 3 (WPV3), eradicated globally in 2015 and 2019, respectively (*1*). Wild poliovirus type 1 (WPV1) remains endemic in Afghanistan and Pakistan (*1*). Containment under strict biorisk management measures is vital to prevent reintroduction of eradicated polioviruses into communities from poliovirus facilities. In 2015, Member States committed to contain type 2 polioviruses (PV2) in poliovirus-essential facilities (PEFs) certified in accordance with a global standard (*2*). Member states agreed to report national PV2 inventories annually, destroy unneeded PV2 materials, and, if retaining PV2 materials, establish national authorities for containment (NACs) and a PEF auditing process. Since declaration of WPV3 eradication in October 2019, these activities are also required with WPV3 materials. Despite challenges faced during 2019–2020, including the coronavirus disease 2019 (COVID-19) pandemic, the global poliovirus containment program continues to work toward important milestones. To maintain progress, all WHO Member States are urged to adhere to the agreed containment resolutions, including officially establishing legally empowered NACs and submission of PEF Certificates of Participation.

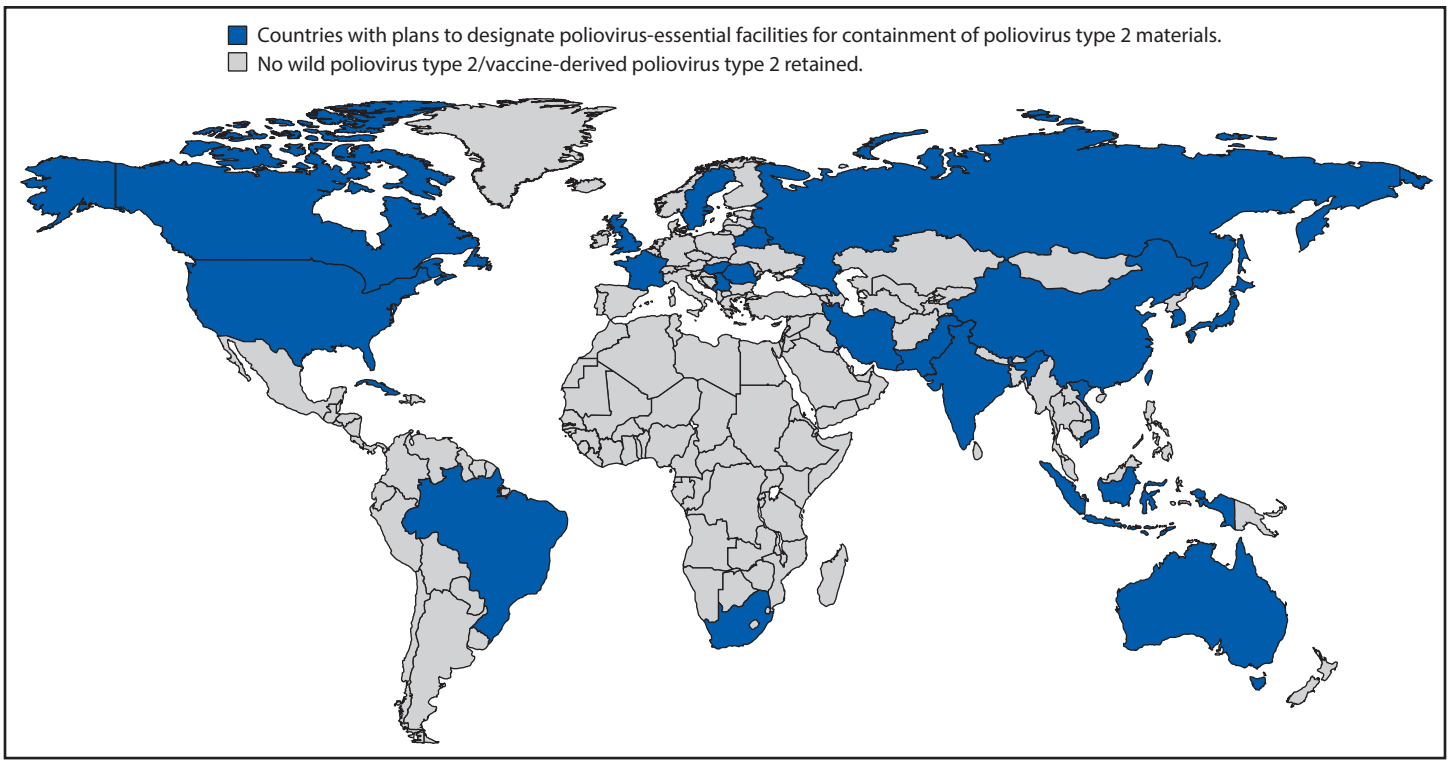
Background

The Global Polio Eradication Initiative has achieved its progress through extensive use of trivalent oral poliovirus vaccine (tOPV, which consists of live, attenuated Sabin vaccine strain types 1, 2, and 3). Despite the substantial advancement toward eradication attained using this vaccine, in areas with low population immunity, prolonged transmission of Sabin vaccine virus can lead to viral mutations that result in development of neurovirulent vaccine-derived polioviruses (VDPVs) (*1*). Outbreaks can result from VDPVs that are transmitted in a community and are known as circulating VDPVs (cVDPVs). Since the majority of cVDPV outbreaks were caused by the type 2 oral poliovirus vaccine strain (OPV2), a coordinated global switch in vaccines was conducted in 2016, replacing the use of tOPV with bivalent OPV (bOPV, which consists of Sabin strain types 1 and 3) (*3*). PV2 disease immunity in the community was to be provided by high coverage with tOPV before the switch as well as a recommended single dose of injectable inactivated polio vaccine (IPV) to help protect against paralysis; however, suboptimal vaccination coverage and IPV manufacturing shortages have led to substantial PV2 immunity gaps in many countries (*4*). Since the switch, many countries, particularly in Africa, have experienced cVDPV2 outbreaks (*1*). To combat these outbreaks, vaccination responses with monovalent OPV2 (mOPV2) have been implemented in approximately two dozen countries. However, waning type 2 immunity and delayed and low-quality outbreak responses have resulted in spread of existing outbreaks and emergence of new cVDPV2 outbreaks, leading to a significant increase in areas affected by cVDPV2 across parts of Africa and Asia (*5*). A novel OPV type 2, (nOPV2) engineered to be more genetically stable to prevent seeding of cVDPV2 outbreaks, is expected to be available for initial use in cVDPV2 outbreak response vaccination campaigns in October 2020 under WHO's Emergency Use Listing (*5*).

Global Poliovirus Containment Certification Status

In 2015, WHO Member States resolved to contain all PV2 viruses (i.e., wild, VDPV2, and OPV2/Sabin2) in designated PEFs certified by the WHO Global Action Plan to minimize poliovirus facility–associated risk after type-specific eradication of WPVs and sequential cessation of oral polio vaccine use (GAPIII) (*2*). As of August 2020, a total of 25 countries planned to retain PV2 materials in 73 designated PEFs (Figure). However, no facilities have yet been certified as GAPIII compliant. NACs have been established in 22 of these countries. Some countries, including China, Romania, and the United Kingdom have not yet delegated legal responsibility to their NACs. Of the 73 designated PEFs, 32 have been awarded GCC-endorsed Certificates of Participation (which validate successful enrollment in the WHO GAPIII-Containment Certification Scheme) (*6*). The deadline for PV2 PEFs to submit Certificate of Participation applications to NACs was

FIGURE. Twenty-five countries that currently plan to retain all type 2 polioviruses in 73 designated poliovirus-essential facilities



December 31, 2019 (*7*). PV2 facilities and the respective NACs that have missed this deadline are urged to expeditiously submit these applications. The Certificates of Participation that have been awarded are due to expire in April 2021, by which time facilities were expected to have interim or full certificates of containment awarded after full GAPIII audits. Challenges in auditor qualification and delays related to COVID-19 might require revision of deadlines.

Although the first GAPIII certification audits were planned for 2020, the COVID-19 pandemic has delayed in-person audit activities. Qualification of 10 GAPIII-Containment Certification Scheme lead auditors, anticipated by the end of 2020, has been postponed because of challenges in creating a global auditor qualification program and disruptions caused by the global COVID-19 crisis. In response to current challenges, a revised multiyear plan, which includes the qualification of auditors and the certification of facilities, is currently being prepared. In 2019, the Global Polio Eradication Initiative facilitated four GAPIII PEF webinars, and six GAPIII in-depth weeklong in-person trainings were conducted worldwide to help prepare PEFs to implement strict GAPIII requirements. In addition, the WHO secretariat and members of the GCC Containment Working Group have engaged in multiple NAC network and bilateral meetings to expedite the certification process.

Advisory Group Decisions

The Containment Advisory Group (CAG) was established in 2017 to advise the WHO Director-General regarding technical considerations for the implementation of GAPIII. In July 2019, CAG discussed revision of GAPIII,* which has undergone major and minor revisions since it was written in 2015, including 1) the replacement of Annex 4 of GAPIII with the GAPIII-Containment Certification Scheme† and 2) a shift from OPV/Sabin potentially infectious materials being subject to GAPIII PEF containment requirements to other guidance requirements.§ WHO anticipates publishing an updated document in 2021 that will include all relevant revisions. In its March 2020 meeting, CAG agreed that, although nOPV types 1 and 3 contain a modified type-2 nonstructural region, nOPV1 and nOPV3 should be considered as PV type 1 or 3 for purposes of containment.¶

* http://polioeradication.org/wp-content/uploads/2020/04/Fourth-meeting-of-the-Containment-Advisory-Group-2019071516.pdf.
† Annex 4 of GAPIII stated that PEF certification audits would be performed by WHO. The GPIII-Containment Certification Scheme was later developed that shifted the responsibility to countries to ensure GAPIII audits were performed by auditors qualified per the requirements of the scheme.
§ http://polioeradication.org/wp-content/uploads/2018/06/polio-containment-guidance-for-non-poliovirus-facilities-20180614-en.pdf.
¶ http://polioeradication.org/wp-content/uploads/2020/04/CAG-TC-20-March-2020-NFR.pdf.

Evolving Use of Live Poliovirus Vaccines

Since the 2016 global switch from tOPV to bOPV, the WHO Global Polio Laboratory Network detected 41 cVDPV2 outbreaks, many of which were likely seeded by mOPV2 use in outbreak responses (*4*). nOPV2 is predicted to have a substantially lower risk of seeding cVDPV2 outbreaks compared with mOPV2. Based on all available safety data, CAG has granted nOPV2 a waiver to be manufactured and used in outbreak response outside GAPIII containment conditions. However, nOPV2 is subject to other containment and safety requirements including rigorous inventorying, vial tracking, and enhanced environmental surveillance in countries where it is deployed. Once Phase III clinical trial data are available, CAG will review together with surveillance data from outbreak response countries to monitor any need to modulate GAPIII containment in facilities handling nOPV2.

Because of ongoing challenges in control of WPV1 transmission in Afghanistan and Pakistan coupled with expanding cVDPV2 outbreaks, the Global Polio Eradication Initiative and country ministries of health have agreed to use tOPV for outbreak response in areas where more than one serotype is circulating (*8*). The return to tOPV use is anticipated to quickly raise population intestinal immunity against all three polio virus types and address the dual challenges of WPV1 and cVDPV2 transmissions in those countries.

Approval for release of tOPV for selected outbreak response in areas with cocirculation will be granted from the WHO director general if recommended by the mOPV2 Advisory Group (*8*). National EPI teams should report to their national containment authorities on the use and management of tOPV and nOPV2 vaccines. As is currently required for mOPV2, national containment authorities will also be required to report any tOPV and nOPV2 inventories and relevant materials to their respective polio eradication National Certification Committee each year.

Discussion

In 2018, the 71st World Health Assembly resolution urged all Member States to accelerate poliovirus containment efforts. Since then, global progress toward poliovirus containment has continued despite challenges and delays. As with all global programs, the COVID-19 pandemic has disrupted some poliovirus containment activities, including planned GAPIII certification audits, a vital component of the program. WHO Member States with proposed PV2 PEFs are urged to reassess the necessity of retaining materials. Upon declaration of the eradication of WPV3 in 2019, WPV3/cVDPV3 materials became subject to the same containment requirements as those for PV2. Because there are no immediate plans to remove the type 3 vaccine strain from use, OPV3 is not currently subject to containment requirements.

Ongoing cVDPV2 outbreaks continue to complicate global polio outbreak responses and poliovirus containment activities. Once a cVDPV2 outbreak is closed in outbreak countries, repeat inventories of cVDPV2 materials and destruction or transfer to a PEF should be documented. In addition, for all OPV2 materials (including retained stool specimens), mOPV2, tOPV, and nOPV2 vials should be tracked from point of release to use or destruction. Even with current disruptions in other aspects of poliovirus containment, all WHO Member States with PEFs need to adhere to World Health Assembly resolutions, including officially establishing legally empowered NACs and submission of PEF Certificates of Participation.

Summary

What is already known about this topic?

Containment of poliovirus materials is essential to establishing and maintaining global poliovirus eradication.

What is added by this report?

Wild poliovirus type 2 was declared eradicated in 2015; 25 countries have designated 73 poliovirus-essential facilities to retain poliovirus type 2 materials. Wild poliovirus type 3 materials have been subject to containment requirements since the virus was declared eradicated in 2019. Just as with type 2 monovalent Sabin oral poliovirus vaccine (OPV), countries using novel type 2 OPV or trivalent Sabin OPV for outbreak response should track and report related materials according to poliovirus containment requirements.

What are the implications for public health practice?

Countries are urged to expedite vital poliovirus containment activities, globally agreed upon in 2015, that have been delayed.

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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.

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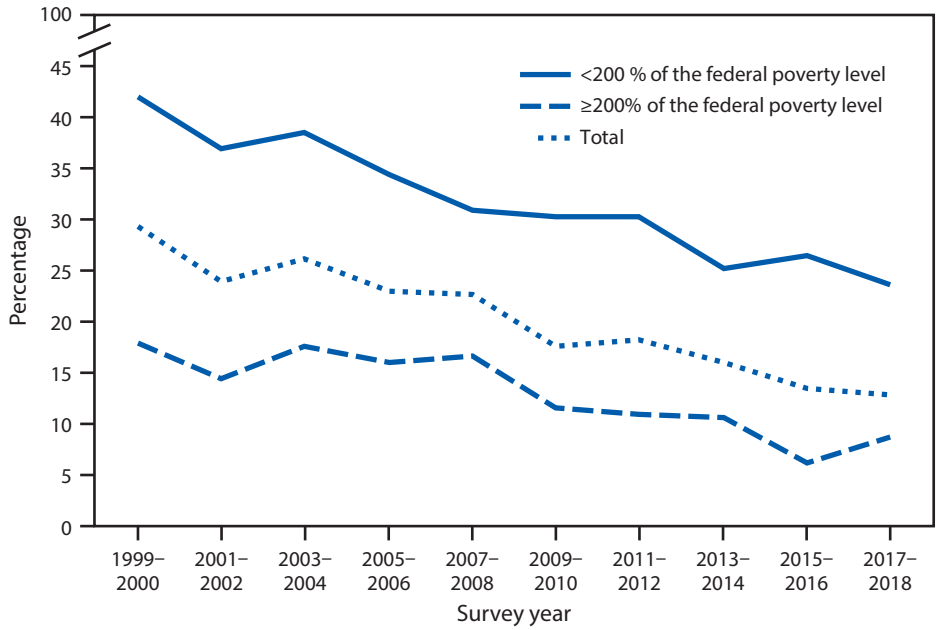
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Prevalence of Complete Tooth Loss* Among Adults Aged ≥65 Years,† by Federal Poverty Level§ — National Health and Nutrition Examination Survey, United States, 1999–2018



* Defined as the loss of all natural, permanent teeth.
† Estimates for the category of persons aged ≥65 years were age-adjusted by the direct method to the year 2000 U.S. Census population using the age groups 65–69, 70–74, and ≥75 years.
§ Poverty index category was calculated by dividing family income by a poverty threshold specific for family size using the U.S. Department of Health and Human Services poverty guidelines. https://aspe.hhs.gov/poverty-guidelines.

The age-adjusted prevalence of complete tooth loss among adults aged ≥65 years decreased from 29.3% during 1999–2000 to 12.6% during 2017–2018. For the same period, the prevalence decreased from 42.1% to 23.5% for adults living at <200% of the federal poverty level and from 17.7% to 8.5% for adults living at ≥200% of the federal poverty level. Throughout the period, the prevalence of complete tooth loss was higher among those living at <200% of the federal poverty level.

Sources: Fleming E, Afful J, Griffin SO. Prevalence of tooth loss among older adults: United States, 2015–2018. NCHS data brief, no. 368. https://www.cdc.gov/nchs/products/databriefs/db368.htm. National Center for Health Statistics, National Health and Nutrition Examination Survey, 2015–2018. https://www.cdc.gov/nchs/nhanes.htm.

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