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Mental Health, Substance Use, and Suicidal Ideation During the COVID-19 Pandemic — United States, June 24–30, 2020

Mark É. Czeisler[1,2]; Rashon I. Lane MA[3]; Emiko Petrosky, MD[3]; Joshua F. Wiley, PhD[1]; Aleta Christensen, MPH[3]; Rashid Njai, PhD[3]; Matthew D. Weaver, PhD[1,4,5]; Rebecca Robbins, PhD[4,5]; Elise R. Facer-Childs, PhD[1]; Laura K. Barger, PhD[4,5]; Charles A. Czeisler, MD, PhD[1,4,5]; Mark E. Howard, MBBS, PhD[1,2,6]; Shantha M.W. Rajaratnam, PhD[1,4,5]

The coronavirus disease 2019 (COVID-19) pandemic has been associated with mental health challenges related to the morbidity and mortality caused by the disease and to mitigation activities, including the impact of physical distancing and stay-at-home orders.* Symptoms of anxiety disorder and depressive disorder increased considerably in the United States during April–June of 2020, compared with the same period in 2019 (*1*,*2*). To assess mental health, substance use, and suicidal ideation during the pandemic, representative panel surveys were conducted among adults aged ≥18 years across the United States during June 24–30, 2020. Overall, 40.9% of respondents reported at least one adverse mental or behavioral health condition, including symptoms of anxiety disorder or depressive disorder (30.9%), symptoms of a trauma- and stressor-related disorder (TSRD) related to the pandemic† (26.3%), and having started or increased substance use to cope with stress or emotions related to COVID-19 (13.3%). The percentage of respondents who reported having seriously considered suicide in the 30 days before completing the survey (10.7%) was significantly higher among respondents aged 18–24 years (25.5%), minority racial/ethnic groups (Hispanic respondents [18.6%], non-Hispanic black [black] respondents [15.1%]), self-reported unpaid caregivers for adults§ (30.7%), and essential workers¶ (21.7%).

* https://www.medrxiv.org/content/10.1101/2020.04.22.20076141v1.

† Disorders classified as TSRDs in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM–5) include posttraumatic stress disorder (PTSD), acute stress disorder (ASD), and adjustment disorders (ADs), among others.

§ Unpaid adult caregiver status was self-reported. The definition of an unpaid caregiver for adults was a person who had provided unpaid care to a relative or friend aged ≥18 years to help them take care of themselves at any time in the last 3 months. Examples provided included helping with personal needs, household chores, health care tasks, managing a person's finances, taking them to a doctor's appointment, arranging for outside services, and visiting regularly to see how they are doing.

¶ Essential worker status was self-reported. The comparison was between employed respondents (n = 3,431) who identified as essential versus nonessential. For this analysis, students who were not separately employed as essential workers were considered nonessential workers.

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Community-level intervention and prevention efforts, including health communication strategies, designed to reach these groups could help address various mental health conditions associated with the COVID-19 pandemic.

During June 24–30, 2020, a total of 5,412 (54.7%) of 9,896 eligible invited adults** completed web-based surveys†† administered by Qualtrics.§§ The Monash University Human Research Ethics Committee of Monash University (Melbourne, Australia) reviewed and approved the study protocol on human subjects research. Respondents were informed of the study purposes and provided electronic consent before commencement, and investigators received anonymized responses. Participants included 3,683 (68.1%) first-time respondents and 1,729 (31.9%) respondents who had completed a related survey during April 2–8, May 5–12, 2020, or both intervals; 1,497 (27.7%) respondents participated during all three intervals (*2*,*3*). Quota sampling and survey weighting were employed to improve cohort representativeness of the U.S. population by gender, age, and race/ethnicity.¶¶ Symptoms of anxiety disorder and depressive disorder were assessed using the four-item Patient Health Questionnaire*** (*4*), and symptoms of a COVID-19–related TSRD were assessed using the six-item Impact of Event Scale††† (*5*). Respondents also reported

** A minimum age of 18 years and residence within the United States as of April 2–8, 2020, were required for eligibility for the longitudinal cohort to complete a survey during June 24–30, 2020. Residence was reassessed during June 24–30, 2020, and one respondent who had moved from the United States was excluded from the analysis. A minimum age of 18 years and residence within the United States were required for eligibility for newly recruited respondents included in the cross-sectional analysis. For both the longitudinal cohort and newly recruited respondents, respondents were required to provide informed consent before enrollment into the study. All surveys underwent data quality screening procedures including algorithmic and keystroke analysis for attention patterns, click-through behavior, duplicate responses, machine responses, and inattentiveness. Country-specific geolocation verification via IP address mapping was used to ensure respondents were from the United States. Respondents who failed an attention or speed check, along with any responses identified by the data-scrubbing algorithms, were excluded from analysis.

†† The surveys contained 101 items for first-time respondents and 86 items for respondents who also participated in later surveys, with the 15 additional items for first-time respondents consisting of questions on demographics. The survey instruments included a combination of individual questions, validated questionnaires, and COVID-19-specific questionnaires, which were used to assess respondent attitudes, behaviors, and beliefs related to COVID-19 and its mitigation, as well as the social and behavioral health impacts of the COVID-19 pandemic.

§§ https://www.qualtrics.com/.

¶¶ Survey weighting was implemented according to the 2010 U.S. Census with respondents who reported gender, age, and race/ethnicity. Respondents who reported a gender of "Other," or who did not report race/ethnicity were assigned a weight of one.

*** Symptoms of anxiety disorder and depressive disorder were assessed via the four-item Patient Health Questionnaire (PHQ-4). Those who scored ≥3 out of 6 on the Generalized Anxiety Disorder (GAD-2) and Patient Health Questionnaire (PHQ-2) subscales were considered symptomatic for these respective disorders. This instrument was included in the April, May, and June surveys.

††† Symptoms of a TSRD attributed to the COVID-19 pandemic were assessed via the six-item Impact of Event Scale (IES-6) to screen for overlapping symptoms of PTSD, ASD, and ADs. For this survey, the COVID-19 pandemic was specified as the traumatic exposure to record peri- and posttraumatic symptoms associated with the range of stressors introduced by the COVID-19 pandemic. Those who scored ≥1.75 out of 4 were considered symptomatic. This instrument was included in the May and June surveys only.

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whether they had started or increased substance use to cope with stress or emotions related to COVID-19 or seriously considered suicide in the 30 days preceding the survey.[§§§]

Analyses were stratified by gender, age, race/ethnicity, employment status, essential worker status, unpaid adult caregiver status, rural-urban residence classification,[¶¶¶] whether the respondent knew someone who had positive test results for SARS-CoV-2, the virus that causes COVID-19, or who had died from COVID-19, and whether the respondent was receiving treatment for diagnosed anxiety, depression, or posttraumatic stress disorder (PTSD) at the time of the survey. Comparisons within subgroups were evaluated using Poisson regressions with robust standard errors to calculate prevalence ratios, 95% confidence intervals (CIs), and p-values to evaluate statistical significance ($\alpha = 0.005$ to account for multiple comparisons). Among the 1,497 respondents who completed all three surveys, longitudinal analyses of the odds of incidence[****] of symptoms of adverse mental or behavioral health conditions by essential worker and unpaid adult caregiver status were conducted on unweighted responses using logistic regressions to calculate unadjusted and adjusted[††††] odds ratios (ORs), 95% CI, and p-values ($\alpha = 0.05$). The statsmodels package in Python (version 3.7.8; Python Software Foundation) was used to conduct all analyses.

Overall, 40.9% of 5,470 respondents who completed surveys during June reported an adverse mental or behavioral health condition, including those who reported symptoms of anxiety disorder or depressive disorder (30.9%), those with TSRD symptoms related to COVID-19 (26.3%), those who reported having started or increased substance use to cope with stress or emotions related to COVID-19 (13.3%), and those who reported having seriously considered suicide in the preceding 30 days (10.7%) (Table 1). At least one adverse mental or behavioral health symptom was reported by more than one half of respondents who were aged 18–24 years (74.9%) and 25–44 years (51.9%), of Hispanic ethnicity (52.1%), and who held less than a high school diploma (66.2%), as well as those who were essential workers (54.0%), unpaid caregivers for adults (66.6%), and who reported treatment for diagnosed anxiety (72.7%), depression (68.8%), or PTSD (88.0%) at the time of the survey.

Prevalences of symptoms of adverse mental or behavioral health conditions varied significantly among subgroups (Table 2). Suicidal ideation was more prevalent among males than among females. Symptoms of anxiety disorder or depressive disorder, COVID-19–related TSRD, initiation of or increase in substance use to cope with COVID-19–associated stress, and serious suicidal ideation in the previous 30 days were most commonly reported by persons aged 18–24 years; prevalence decreased progressively with age. Hispanic respondents reported higher prevalences of symptoms of anxiety disorder or depressive disorder, COVID-19–related TSRD, increased substance use, and suicidal ideation than did non-Hispanic whites (whites) or non-Hispanic Asian (Asian) respondents. Black respondents reported increased substance use and past 30-day serious consideration of suicide in the previous 30 days more commonly than did white and Asian respondents. Respondents who reported treatment for diagnosed anxiety, depression, or PTSD at the time of the survey reported higher prevalences of symptoms of adverse mental and behavioral health conditions compared with those who did not. Symptoms of a COVID-19–related TSRD, increased substance use, and suicidal ideation were more prevalent among employed than unemployed respondents, and among essential workers than nonessential workers. Adverse conditions also were more prevalent among unpaid caregivers for adults than among those who were not, with particularly large differences in increased substance use (32.9% versus 6.3%) and suicidal ideation (30.7% versus 3.6%) in this group.

Longitudinal analysis of responses of 1,497 persons who completed all three surveys revealed that unpaid caregivers for adults had a significantly higher odds of incidence of adverse mental health conditions compared with others (Table 3). Among those who did not report having started or increased substance use to cope with stress or emotions related to COVID-19 in May, unpaid caregivers for adults had 3.33 times the odds of reporting this behavior in June (adjusted OR 95% CI = 1.75–6.31; p<0.001). Similarly, among those who did not report having seriously considered suicide in the previous 30 days in May, unpaid caregivers for adults had 3.03 times the odds of reporting suicidal ideation in June (adjusted OR 95% CI = 1.20–7.63; p = 0.019).

[§§§] For this survey, substance use was defined as use of "alcohol, legal or illegal drugs, or prescriptions drugs that are taken in a way not recommended by your doctor." Questions regarding substance use and suicidal ideation were included in the May and June surveys only. Participants were informed that responses were deidentified and that direct support could not be provided to those who reported substance use behavior or suicidal ideation. Regarding substance use, respondents were provided the following: "This survey is anonymous so we cannot provide direct support. If you would like crisis support please contact the Substance Abuse and Mental Health Services Administration National Helpline, 1-800-662-HELP (4357), (also known as the Treatment Referral Routing Service) or TTY: 1-800-487-4889. This is a confidential, free, 24-hour-a-day, 365-day-a-year, information service, in English and Spanish, for persons and family members facing mental and/or substance use disorders." Regarding suicidal ideation, respondents were provided the following: "This survey is anonymous so we cannot provide direct support. If you would like crisis support please contact the National Suicide Prevention Lifeline, 1-800-273-TALK (8255, or chat line) for help for themselves or others."

[¶¶¶] Rural-urban classification was determined by using self-reported ZIP codes according to the Federal Office of Rural Health Policy definition of rurality. https://www.hrsa.gov/rural-health/about-us/definition/datafiles.html.

[****] Odds of incidence was defined as the odds of the presence of an adverse mental or behavioral health outcome reported during a later survey after previously having reported the absence of that outcome (e.g., having reported symptoms of anxiety disorder during June 24–30, 2020, after not having reported symptoms of anxiety disorder during April 2–8, 2020).

[††††] Adjusted for gender, employment status, and essential worker status or unpaid adult caregiver status.

TABLE 1. Respondent characteristics and prevalence of adverse mental health outcomes, increased substance use to cope with stress or emotions related to COVID-19 pandemic, and suicidal ideation — United States, June 24–30, 2020

Characteristic	All respondents who completed surveys during June 24–30, 2020 weighted* no. (%)	Weighted %*						
		Conditions				Started or increased substance use to cope with pandemic-related stress or emotions¶	Seriously considered suicide in past 30 days	≥1 adverse mental or behavioral health symptom
		Anxiety disorder†	Depressive disorder†	Anxiety or depressive disorder†	COVID-19–related TSRD§			
All respondents	**5,470 (100)**	**25.5**	**24.3**	**30.9**	**26.3**	**13.3**	**10.7**	**40.9**
Gender								
Female	2,784 (50.9)	26.3	23.9	31.5	24.7	12.2	8.9	41.4
Male	2,676 (48.9)	24.7	24.8	30.4	27.9	14.4	12.6	40.5
Other	10 (0.2)	20.0	30.0	30.0	30.0	10.0	0.0	30.0
Age group (yrs)								
18–24	731 (13.4)	49.1	52.3	62.9	46.0	24.7	25.5	74.9
25–44	1,911 (34.9)	35.3	32.5	40.4	36.0	19.5	16.0	51.9
45–64	1,895 (34.6)	16.1	14.4	20.3	17.2	7.7	3.8	29.5
≥65	933 (17.1)	6.2	5.8	8.1	9.2	3.0	2.0	15.1
Race/Ethnicity								
White, non-Hispanic	3,453 (63.1)	24.0	22.9	29.2	23.3	10.6	7.9	37.8
Black, non-Hispanic	663 (12.1)	23.4	24.6	30.2	30.4	18.4	15.1	44.2
Asian, non-Hispanic	256 (4.7)	14.1	14.2	18.0	22.1	6.7	6.6	31.9
Other race or multiple races, non-Hispanic**	164 (3.0)	27.8	29.3	33.2	28.3	11.0	9.8	43.8
Hispanic, any race(s)	885 (16.2)	35.5	31.3	40.8	35.1	21.9	18.6	52.1
Unknown	50 (0.9)	38.0	34.0	44.0	34.0	18.0	26.0	48.0
2019 Household income (USD)								
<25,000	741 (13.6)	30.6	30.8	36.6	29.9	12.5	9.9	45.4
25,000–49,999	1,123 (20.5)	26.0	25.6	33.2	27.2	13.5	10.1	43.9
50,999–99,999	1,775 (32.5)	27.1	24.8	31.6	26.4	12.6	11.4	40.3
100,999–199,999	1,301 (23.8)	23.1	20.8	27.7	24.2	15.5	11.7	37.8
≥200,000	282 (5.2)	17.4	17.0	20.6	23.1	14.8	11.6	35.1
Unknown	247 (4.5)	19.6	23.1	27.2	24.9	6.2	3.9	41.5
Education								
Less than high school diploma	78 (1.4)	44.5	51.4	57.5	44.5	22.1	30.0	66.2
High school diploma	943 (17.2)	31.5	32.8	38.4	32.1	15.3	13.1	48.0
Some college	1,455 (26.6)	25.2	23.4	31.7	22.8	10.9	8.6	39.9
Bachelor's degree	1,888 (34.5)	24.7	22.5	28.7	26.4	14.2	10.7	40.6
Professional degree	1,074 (19.6)	20.9	19.5	25.4	24.5	12.6	10.0	35.2
Unknown	33 (0.6)	25.2	23.2	28.2	23.2	10.5	5.5	28.2
Employment status††								
Employed	3,431 (62.7)	30.1	29.1	36.4	32.1	17.9	15.0	47.8
Essential	1,785 (32.6)	35.5	33.6	42.4	38.5	24.7	21.7	54.0
Nonessential	1,646 (30.1)	24.1	24.1	29.9	25.2	10.5	7.8	41.0
Unemployed	761 (13.9)	32.0	29.4	37.8	25.0	7.7	4.7	45.9
Retired	1,278 (23.4)	9.6	8.7	12.1	11.3	4.2	2.5	19.6
Unpaid adult caregiver status§§								
Yes	1,435 (26.2)	47.6	45.2	56.1	48.4	32.9	30.7	66.6
No	4,035 (73.8)	17.7	16.9	22.0	18.4	6.3	3.6	31.8
Region¶¶								
Northeast	1,193 (21.8)	23.9	23.9	29.9	22.8	12.8	10.2	37.1
Midwest	1,015 (18.6)	22.7	21.1	27.5	24.4	9.0	7.5	36.1
South	1,921 (35.1)	27.9	26.5	33.4	29.1	15.4	12.5	44.4
West	1,340 (24.5)	25.8	24.2	30.9	26.7	14.0	10.9	43
Rural-urban classification***								
Rural	599 (10.9)	26.0	22.5	29.3	25.4	11.5	10.2	38.3
Urban	4,871 (89.1)	25.5	24.6	31.1	26.4	13.5	10.7	41.2

See table footnotes on the next page.

TABLE 1. (*Continued*) Respondent characteristics and prevalence of adverse mental health outcomes, increased substance use to cope with stress or emotions related to COVID-19 pandemic, and suicidal ideation — United States, June 24–30, 2020

Characteristic	All respondents who completed surveys during June 24–30, 2020 weighted* no. (%)	Weighted %*						
		Conditions				Started or increased substance use to cope with pandemic-related stress or emotions¶	Seriously considered suicide in past 30 days	≥1 adverse mental or behavioral health symptom
		Anxiety disorder†	Depressive disorder†	Anxiety or depressive disorder†	COVID-19–related TSRD§			
Know someone who had positive test results for SARS-CoV-2								
Yes	1,109 (20.3)	23.8	21.9	29.6	21.5	12.9	7.5	39.2
No	4,361 (79.7)	26.0	25.0	31.3	27.5	13.4	11.5	41.3
Knew someone who died from COVID-19								
Yes	428 (7.8)	25.8	20.6	30.6	28.1	11.3	7.6	40.1
No	5,042 (92.2)	25.5	24.7	31.0.	26.1	13.4	10.9	41
Receiving treatment for previously diagnosed condition								
Anxiety								
Yes	536 (9.8)	59.6	52.0	66.0	51.9	26.6	23.6	72.7
No	4,934 (90.2)	21.8	21.3	27.1	23.5	11.8	9.3	37.5
Depression								
Yes	540 (9.9)	52.5	50.6	60.8	45.5	25.2	22.1	68.8
No	4,930 (90.1)	22.6	21.5	27.7	24.2	12.0	9.4	37.9
Posttraumatic stress disorder								
Yes	251 (4.6)	72.3	69.1	78.7	69.4	43.8	44.8	88
No	5,219 (95.4)	23.3	22.2	28.6	24.2	11.8	9.0	38.7

Abbreviations: COVID-19 = coronavirus disease 2019; TSRD = trauma- or stress-related disorder.

* Survey weighting was employed to improve the cross-sectional June cohort representativeness of the U.S. population by gender, age, and race/ethnicity according to the 2010 U.S. Census with respondents in which gender, age, and race/ethnicity were reported. Respondents who reported a gender of "Other" or who did not report race/ethnicity were assigned a weight of one.

† Symptoms of anxiety disorder and depressive disorder were assessed via the four-item Patient Health Questionnaire (PHQ-4). Those who scored ≥3 out of 6 on the Generalized Anxiety Disorder (GAD-2) and Patient Health Questionnaire (PHQ-2) subscales were considered symptomatic for each disorder, respectively.

§ Disorders classified as TSRDs in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM–5) include posttraumatic stress disorder (PTSD), acute stress disorder (ASD), and adjustment disorders (ADs), among others. Symptoms of a TSRD precipitated by the COVID-19 pandemic were assessed via the six-item Impact of Event Scale (IES-6) to screen for overlapping symptoms of PTSD, ASD, and ADs. For this survey, the COVID-19 pandemic was specified as the traumatic exposure to record peri- and posttraumatic symptoms associated with the range of stressors introduced by the COVID-19 pandemic. Those who scored ≥1.75 out of 4 were considered symptomatic.

¶ 104 respondents selected "Prefer not to answer."

** The Other race or multiple races, non-Hispanic category includes respondents who identified as not being Hispanic and as more than one race or as American Indian or Alaska Native, Native Hawaiian or Pacific Islander, or "Other."

†† Essential worker status was self-reported. The comparison was between employed respondents (n = 3,431) who identified as essential vs. nonessential. For this analysis, students who were not separately employed as essential workers were considered nonessential workers.

§§ Unpaid adult caregiver status was self-reported. The definition of an unpaid caregiver for adults was a person who had provided unpaid care to a relative or friend aged ≥18 years to help them take care of themselves at any time in the last three months. Examples provided included helping with personal needs, household chores, health care tasks, managing a person's finances, taking them to a doctor's appointment, arranging for outside services, and visiting regularly to see how they are doing.

¶¶ Region classification was determined by using the U.S. Census Bureau's Census Regions and Divisions of the United States. https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf.

*** Rural-urban classification was determined by using self-reported ZIP codes according to the Federal Office of Rural Health Policy definition of rurality. https://www.hrsa.gov/rural-health/about-us/definition/datafiles.html.

Discussion

Elevated levels of adverse mental health conditions, substance use, and suicidal ideation were reported by adults in the United States in June 2020. The prevalence of symptoms of anxiety disorder was approximately three times those reported in the second quarter of 2019 (25.5% versus 8.1%), and prevalence of depressive disorder was approximately four times that reported in the second quarter of 2019 (24.3% versus 6.5%) (*2*). However, given the methodological differences and potential unknown biases in survey designs, this analysis might not be directly comparable with data reported on anxiety and depression disorders in 2019 (*2*). Approximately one quarter of respondents reported symptoms of a TSRD related to the pandemic, and approximately one in 10 reported that they started or increased substance use because of COVID-19. Suicidal ideation was also elevated; approximately twice as many respondents reported serious consideration of suicide in the previous 30 days than did adults in the United States in 2018, referring to the previous 12 months (10.7% versus 4.3%) (*6*).

Mental health conditions are disproportionately affecting specific populations, especially young adults, Hispanic persons, black persons, essential workers, unpaid caregivers for adults, and those receiving treatment for preexisting psychiatric conditions. Unpaid caregivers for adults, many of whom are currently providing critical aid to persons at increased risk

TABLE 2. Comparison of symptoms of adverse mental health outcomes among all respondents who completed surveys (N = 5,470), by respondent characteristic* — United States, June 24–30, 2020

Characteristic	Prevalence ratio[¶] (95% CI[¶])			
	Symptoms of anxiety disorder or depressive disorder[†]	Symptoms of a TSRD related to COVID-19[§]	Started or increased substance use to cope with stress or emotions related to COVID-19	Serious consideration of suicide in past 30 days
Gender				
Female vs. male	1.04 (0.96–1.12)	0.88 (0.81–0.97)	0.85 (0.75–0.98)	0.70 (0.60–0.82)**
Age group (yrs)				
18–24 vs. 25–44	1.56 (1.44–1.68)**	1.28 (1.16–1.41)**	1.31 (1.12–1.53)**	1.59 (1.35–1.87)**
18–24 vs. 45–64	3.10 (2.79–3.44)**	2.67 (2.35–3.03)**	3.35 (2.75–4.10)**	6.66 (5.15–8.61)**
18–24 vs. ≥65	7.73 (6.19–9.66)**	5.01 (4.04–6.22)**	8.77 (5.95–12.93)**	12.51 (7.88–19.86)**
25–44 vs. 45–64	1.99 (1.79–2.21)**	2.09 (1.86–2.35)**	2.56 (2.14–3.07)**	4.18 (3.26–5.36)**
25–44 vs. ≥65	4.96 (3.97–6.20)**	3.93 (3.18–4.85)**	6.70 (4.59–9.78)**	7.86 (4.98–12.41)**
45–64 vs. ≥65	2.49 (1.98–3.15)**	1.88 (1.50–2.35)**	2.62 (1.76–3.9)**	1.88 (1.14–3.10)
Race/Ethnicity[††]				
Hispanic vs. non-Hispanic black	1.35 (1.18–1.56)**	1.15 (1.00–1.33)	1.19 (0.97–1.46)	1.23 (0.98–1.55)
Hispanic vs. non-Hispanic Asian	2.27 (1.73–2.98)**	1.59 (1.24–2.04)**	3.29 (2.05–5.28)**	2.82 (1.74–4.57)**
Hispanic vs. non-Hispanic other race or multiple races	1.23 (0.98–1.55)	1.24 (0.96–1.61)	1.99 (1.27–3.13)**	1.89 (1.16–3.06)
Hispanic vs. non-Hispanic white	1.40 (1.27–1.54)**	1.50 (1.35–1.68)**	2.09 (1.79–2.45)**	2.35 (1.96–2.80)**
Non-Hispanic black vs. non-Hispanic Asian	1.68 (1.26–2.23)**	1.38 (1.07–1.78)	2.75 (1.70–4.47)**	2.29 (1.39–3.76)**
Non-Hispanic black vs. non-Hispanic other race or multiple races	0.91 (0.71–1.16)	1.08 (0.82–1.41)	1.67 (1.05–2.65)	1.53 (0.93–2.52)
Non-Hispanic black vs. non-Hispanic white	1.03 (0.91–1.17)	1.30 (1.14–1.48)**	1.75 (1.45–2.11)**	1.90 (1.54–2.36)**
Non-Hispanic Asian vs. non-Hispanic other race or multiple races	0.54 (0.39–0.76)**	0.78 (0.56–1.09)	0.61 (0.32–1.14)	0.67 (0.35–1.29)
Non-Hispanic Asian vs. non-Hispanic white	0.62 (0.47–0.80)**	0.95 (0.74–1.20)	0.64 (0.40–1.02)	0.83 (0.52–1.34)
Non-Hispanic other race or multiple races vs. non-Hispanic white	1.14 (0.91–1.42)	1.21 (0.94–1.56)	1.05 (0.67–1.64)	1.24 (0.77–2)

See table footnotes on the next page.

for severe illness from COVID-19, had a higher incidence of adverse mental and behavioral health conditions compared with others. Although unpaid caregivers of children were not evaluated in this study, approximately 39% of unpaid caregivers for adults shared a household with children (compared with 27% of other respondents). Caregiver workload, especially in multigenerational caregivers, should be considered for future assessment of mental health, given the findings of this report and hardships potentially faced by caregivers.

The findings in this report are subject to at least four limitations. First, a diagnostic evaluation for anxiety disorder or depressive disorder was not conducted; however, clinically validated screening instruments were used to assess symptoms. Second, the trauma- and stressor-related symptoms assessed were common to multiple TSRDs, precluding distinction among them; however, the findings highlight the importance of including COVID-19–specific trauma measures to gain insights into peri- and posttraumatic impacts of the COVID-19 pandemic (*7*). Third, substance use behavior was self-reported; therefore, responses might be subject to recall, response, and social desirability biases. Finally, given that the web-based survey might not be fully representative of the United States population, findings might have limited generalizability. However, standardized quality and data inclusion screening procedures, including algorithmic analysis of click-through behavior, removal of duplicate responses and scrubbing methods for web-based panel quality were applied. Further the prevalence of symptoms of anxiety disorder and depressive disorder were largely consistent with findings from the Household Pulse Survey during June (*1*).

Markedly elevated prevalences of reported adverse mental and behavioral health conditions associated with the COVID-19 pandemic highlight the broad impact of the pandemic and the need to prevent and treat these conditions. Identification of populations at increased risk for psychological distress and unhealthy coping can inform policies to address health inequity, including increasing access to resources for clinical diagnoses and treatment options. Expanded use of telehealth, an effective means of delivering treatment for mental health conditions, including depression, substance use disorder, and suicidal ideation (*8*), might reduce COVID-19-related mental health consequences. Future studies should identify drivers of adverse mental and behavioral health during the COVID-19 pandemic and whether factors such as social isolation, absence of school structure, unemployment and other financial worries, and various forms of violence (e.g., physical,

TABLE 2. (*Continued*) Comparison of symptoms of adverse mental health outcomes among all respondents who completed surveys (N = 5,470), by respondent characteristic* — United States, June 24–30, 2020

Characteristic	Prevalence ratio¶ (95% CI¶)			
	Symptoms of anxiety disorder or depressive disorder†	Symptoms of a TSRD related to COVID-19§	Started or increased substance use to cope with stress or emotions related to COVID-19	Serious consideration of suicide in past 30 days
Employment status				
Employed vs. unemployed	0.96 (0.87–1.07)	1.28 (1.12–1.46)**	2.30 (1.78–2.98)**	3.21 (2.31–4.47)**
Employed vs. retired	3.01 (2.58–3.51)**	2.84 (2.42–3.34)**	4.30 (3.28–5.63)**	5.97 (4.20–8.47)**
Unemployed vs. retired	3.12 (2.63–3.71)**	2.21 (1.82–2.69)**	1.87 (1.30–2.67)**	1.86 (1.16–2.96)
Essential vs. nonessential worker§§	1.42 (1.30–1.56)**	1.52 (1.38–1.69)**	2.36 (2.00–2.77)**	2.76 (2.29–3.33)**
Unpaid caregiver for adults vs. not¶¶	2.55 (2.37–2.75)**	2.63 (2.42–2.86)**	5.28 (4.59–6.07)**	8.64 (7.23–10.33)**
Rural vs. urban residence***	0.94 (0.82–1.07)	0.96 (0.83–1.11)	0.84 (0.67–1.06)	0.95 (0.74–1.22)
Knows someone with positive SARS-CoV-2 test result vs. not	0.95 (0.86–1.05)	0.78 (0.69–0.88)**	0.96 (0.81–1.14)	0.65 (0.52–0.81)**
Knew someone who died from COVID-19 vs. not	0.99 (0.85–1.15)	1.08 (0.92–1.26)	0.84 (0.64–1.11)	0.69 (0.49–0.97)
Receiving treatment for anxiety vs. not	2.43 (2.26–2.63)**	2.21 (2.01–2.43)**	2.27 (1.94–2.66)**	2.54 (2.13–3.03)**
Receiving treatment for depression vs. not	2.20 (2.03–2.39)**	1.88 (1.70–2.09)**	2.13 (1.81–2.51)**	2.35 (1.96–2.82)**
Receiving treatment for PTSD vs. not	2.75 (2.55–2.97)**	2.87 (2.61–3.16)**	3.78 (3.23–4.42)**	4.95 (4.21–5.83)**

Abbreviations: CI = confidence interval; COVID-19 = coronavirus disease 2019; PTSD = posttraumatic stress disorder; TSRD = trauma- or stress-related disorder.

* Number of respondents for characteristics: gender (female = 2,784, male = 2,676), age group in years (18–24 = 731; 25–44 = 1,911; 45–64 = 1,895; ≥65 = 933), race/ethnicity (non-Hispanic white = 3453, non-Hispanic black = 663, non-Hispanic Asian = 256, non-Hispanic other race or multiple races = 164, Hispanic = 885).

† Symptoms of anxiety disorder and depressive disorder were assessed via the four-item Patient Health Questionnaire (PHQ-4). Those who scored ≥3 out of 6 on the Generalized Anxiety Disorder (GAD-2) and Patient Health Questionnaire (PHQ-2) subscales were considered to have symptoms of these disorders.

§ Disorders classified as TSRDs in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM–5) include PTSD, acute stress disorder (ASD), and adjustment disorders (ADs), among others. Symptoms of a TSRD precipitated by the COVID-19 pandemic were assessed via the six-item Impact of Event Scale (IES-6) to screen for overlapping symptoms of PTSD, ASD, and ADs. For this survey, the COVID-19 pandemic was specified as the traumatic exposure to record peri- and posttraumatic symptoms associated with the range of stressors introduced by the COVID-19 pandemic. Persons who scored ≥1.75 out of 4 were considered to be symptomatic.

¶ Comparisons within subgroups were evaluated on weighted responses via Poisson regressions used to calculate a prevalence ratio, 95% CI, and p-value (not shown). Statistical significance was evaluated at a threshold of a = 0.005 to account for multiple comparisons. In the calculation of prevalence ratios for started or increased substance use, respondents who selected "Prefer not to answer" (n = 104) were excluded.

** P-value is statistically significant (p<0.005).

†† Respondents identified as a single race unless otherwise specified. The non-Hispanic, other race or multiple races category includes respondents who identified as not Hispanic and as more than one race or as American Indian or Alaska Native, Native Hawaiian or Pacific Islander, or 'Other'.

§§ Essential worker status was self-reported. The comparison was between employed respondents (n = 3,431) who identified as essential vs. nonessential. For this analysis, students who were not separately employed as essential workers were considered nonessential workers.

¶¶ Unpaid adult caregiver status was self-reported. The definition of an unpaid caregiver for adults was having provided unpaid care to a relative or friend aged ≥18 years to help them take care of themselves at any time in the last three months. Examples provided included helping with personal needs, household chores, health care tasks, managing a person's finances, taking them to a doctor's appointment, arranging for outside services, and visiting regularly to see how they are doing.

*** Rural-urban classification was determined by using self-reported ZIP codes according to the Federal Office of Rural Health Policy definition of rurality. https://www.hrsa.gov/rural-health/about-us/definition/datafiles.html.

emotional, mental, or sexual abuse) serve as additional stressors. Community-level intervention and prevention efforts should include strengthening economic supports to reduce financial strain, addressing stress from experienced racial discrimination, promoting social connectedness, and supporting persons at risk for suicide (*9*). Communication strategies should focus on promotion of health services§§§§,¶¶¶¶,***** and culturally and linguistically tailored prevention messaging regarding practices to improve emotional well-being. Development and implementation of COVID-19–specific screening instruments for early identification of COVID-19–related TSRD symptoms would allow for early clinical interventions that might prevent progression from acute to chronic TSRDs. To reduce potential harms of increased substance use related to COVID-19, resources, including social support, comprehensive treatment options, and harm reduction services, are essential and should remain accessible. Periodic assessment of mental health, substance use, and suicidal ideation should evaluate the prevalence of psychological distress over time. Addressing mental health disparities and preparing support systems to mitigate mental health consequences as the pandemic evolves will continue to be needed urgently.

§§§§ Disaster Distress Helpline (https://www.samhsa.gov/disaster-preparedness): 1-800-985-5990 (press 2 for Spanish), or text TalkWithUs for English or Hablanos for Spanish to 66746. Spanish speakers from Puerto Rico can text Hablanos to 1-787-339-2663.

¶¶¶¶ Substance Abuse and Mental Health Services Administration National Helpline (also known as the Treatment Referral Routing Service) for persons and families facing mental disorders, substance use disorders, or both: https://www.samhsa.gov/find-help/national-helpline, 1-800-662-HELP, or TTY 1-800-487-4889.

***** National Suicide Prevention Lifeline (https://suicidepreventionlifeline.org/): 1-800-273-TALK for English, 1-888-628-9454 for Spanish, or Lifeline Crisis Chat (https://suicidepreventionlifeline.org/chat/).

TABLE 3. Odds of incidence* of symptoms of adverse mental health, substance use to cope with stress or emotions related to COVID–19 pandemic, and suicidal ideation in the third survey wave, by essential worker status and unpaid adult caregiver status among respondents who completed monthly surveys from April through June (N = 1,497) — United States, April 2–8, May 5–12, and June 24–30, 2020

	Essential worker† vs. all other employment statuses (nonessential worker, unemployed, retired)				Unpaid caregiver for adults§ vs. not unpaid caregiver			
	Unadjusted		Adjusted¶		Unadjusted		Adjusted**	
Symptom or behavior	OR (95% CI)††	p-value††	OR (95% CI)††	p-value††	OR (95% CI)††	p-value††	OR (95% CI)††	p-value††
Symptoms of anxiety disorder§§	1.92 (1.29–2.87)	0.001	1.63 (0.99–2.69)	0.056	1.97 (1.25–3.11)	0.004	1.81 (1.14–2.87)	0.012
Symptoms of depressive disorder§§	1.49 (1.00–2.22)	0.052	1.13 (0.70–1.82)	0.606	2.29 (1.50–3.50)	<0.001	2.22 (1.45–3.41)	<0.001
Symptoms of anxiety disorder or depressive disorder§§	1.67 (1.14–2.46)	0.008	1.26 (0.79–2.00)	0.326	1.84 (1.19–2.85)	0.006	1.73 (1.11–2.70)	0.015
Symptoms of a TSRD related to COVID–19¶¶	1.55 (0.86–2.81)	0.146	1.27 (0.63–2.56)	0.512	1.88 (0.99–3.56)	0.054	1.79 (0.94–3.42)	0.076
Started or increased substance use to cope with stress or emotions related to COVID–19	2.36 (1.26–4.42)	0.007	2.04 (0.92–4.48)	0.078	3.51 (1.86–6.61)	<0.001	3.33 (1.75–6.31)	<0.001
Serious consideration of suicide in previous 30 days	0.93 (0.31–2.78)	0.895	0.53 (0.16–1.70)	0.285	3.00 (1.20–7.52)	0.019	3.03 (1.20–7.63)	0.019

Abbreviations: CI = confidence interval, COVID–19 = coronavirus disease 2019, OR = odds ratio, TSRD = trauma– and stressor–related disorder.

* For outcomes assessed via the four-item Patient Health Questionnaire (PHQ–4), odds of incidence were marked by the presence of symptoms during May 5–12 or June 24–30, 2020, after the absence of symptoms during April 2–8, 2020. Respondent pools for prospective analysis of odds of incidence (did not screen positive for symptoms during April 2–8): anxiety disorder (n = 1,236), depressive disorder (n = 1,301) and anxiety disorder or depressive disorder (n = 1,190). For symptoms of a TSRD precipitated by COVID–19, started or increased substance use to cope with stress or emotions related to COVID–19, and serious suicidal ideation in the previous 30 days, odds of incidence were marked by the presence of an outcome during June 24–30, 2020, after the absence of that outcome during May 5–12, 2020. Respondent pools for prospective analysis of odds of incidence (did not report symptoms or behavior during May 5–12): symptoms of a TSRD (n = 1,206), started or increased substance use (n = 1,408), and suicidal ideation (n = 1,456).

† Essential worker status was self–reported. For Table 3, essential worker status was determined by identification as an essential worker during the June 24–30 survey. Essential workers were compared with all other respondents, not just employed respondents (i.e., essential workers vs. all other employment statuses [nonessential worker, unemployed, and retired], not essential vs. nonessential workers).

§ Unpaid adult caregiver status was self–reported. The definition of an unpaid caregiver for adults was having provided unpaid care to a relative or friend 18 years or older to help them take care of themselves at any time in the last three months. Examples provided included helping with personal needs, household chores, health care tasks, managing a person's finances, taking them to a doctor's appointment, arranging for outside services, and visiting regularly to see how they are doing.

¶ Adjusted for gender, employment status, and unpaid adult caregiver status.

** Adjusted for gender, employment status, and essential worker status.

†† Respondents who completed surveys from all three waves (April, May, June) were eligible to be included in an unweighted longitudinal analysis. Comparisons within subgroups were evaluated via logit–linked Binomial regressions used to calculate unadjusted and adjusted odds ratios, 95% confidence intervals, and p–values. Statistical significance was evaluated at a threshold of $\alpha = 0.05$. In the calculation of odds ratios for started or increased substance use, respondents who selected "Prefer not to answer" (n = 11) were excluded.

§§ Symptoms of anxiety disorder and depressive disorder were assessed via the PHQ–4. Those who scored ≥3 out of 6 on the two–item Generalized Anxiety Disorder (GAD–2) and two–item Patient Health Questionnaire (PHQ–2) subscales were considered symptomatic for each disorder, respectively.

¶¶ Disorders classified as TSRDs in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM–5) include posttraumatic stress disorder (PTSD), acute stress disorder (ASD), and adjustment disorders (ADs), among others. Symptoms of a TSRD precipitated by the COVID–19 pandemic were assessed via the six–item Impact of Event Scale (IES–6) to screen for overlapping symptoms of PTSD, ASD, and ADs. For this survey, the COVID–19 pandemic was specified as the traumatic exposure to record peri– and posttraumatic symptoms associated with the range of potential stressors introduced by the COVID–19 pandemic. Those who scored ≥1.75 out of 4 were considered symptomatic.

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Corresponding author: Rashon Lane for the CDC COVID-19 Response Team, Rlane@cdc.gov.

[1]Turner Institute for Brain and Mental Health, Monash University, Melbourne, Australia; [2]Austin Health, Melbourne, Australia; [3]CDC COVID-19 Response Team; [4]Brigham and Women's Hospital, Boston, Massachusetts; [5]Harvard Medical School, Boston, Massachusetts; [6]University of Melbourne, Melbourne, Australia.

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Summary

What is already known about this topic?

Communities have faced mental health challenges related to COVID-19–associated morbidity, mortality, and mitigation activities.

What is added by this report?

During June 24–30, 2020, U.S. adults reported considerably elevated adverse mental health conditions associated with COVID-19. Younger adults, racial/ethnic minorities, essential workers, and unpaid adult caregivers reported having experienced disproportionately worse mental health outcomes, increased substance use, and elevated suicidal ideation.

What are the implications for public health practice?

The public health response to the COVID-19 pandemic should increase intervention and prevention efforts to address associated mental health conditions. Community-level efforts, including health communication strategies, should prioritize young adults, racial/ethnic minorities, essential workers, and unpaid adult caregivers.

administration of the survey in June. No other potential conflicts of interest were disclosed.

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Characteristics of Marijuana Use During Pregnancy — Eight States, Pregnancy Risk Assessment Monitoring System, 2017

Jean Y. Ko, PhD[1]; Kelsey C. Coy, MPH[1,2]; Sarah C. Haight, MPH[1]; Tamara M. Haegerich, PhD[3]; Letitia Williams, MPH[1]; Shanna Cox, MSPH[1]; Rashid Njai, PhD[4]; Althea M. Grant, PhD[4]

Marijuana is the most commonly used illicit substance under federal law in the United States (*1*); however, many states have legalized medical and adult nonmedical use. Evidence regarding the safety and health effects of cannabis use during pregnancy is largely inconclusive (*2*). Potential adverse health effects to exposed infants (e.g., lower birthweight) have been documented (*2*). To provide population-based estimates of use surrounding pregnancy, identify reasons for and mode of use, and understand characteristics of women who continue versus cease marijuana use during pregnancy, CDC analyzed data from eight states participating in the 2017 Pregnancy Risk Assessment Monitoring System (PRAMS) marijuana supplement. Overall, 9.8% of women self-reported marijuana use before pregnancy, 4.2% during pregnancy, and 5.5% after pregnancy. The most common reasons for use during pregnancy were to relieve stress or anxiety, nausea or vomiting, and pain. Smoking was the most common mode of use. In multivariable models that included age, race/ethnicity, marital status, education, insurance status, parity, trimester of entry into prenatal care, and cigarette and e-cigarette use during pregnancy, women who continued versus ceased marijuana use during pregnancy were more likely to be non-Hispanic white or other race/ethnicity than non-Hispanic black, be unmarried, have ≤12 years of education, and use cigarettes during pregnancy. The American College of Obstetricians and Gynecologists (ACOG) and the American Academy of Pediatrics (AAP) recommend refraining from marijuana use during pregnancy and lactation (*3,4*). Given the increasing number of states legalizing medical and adult nonmedical marijuana use, surveillance of perinatal marijuana use can inform clinical guidance, provider and patient education, and public health programs to support evidence-based approaches to addressing substance use.

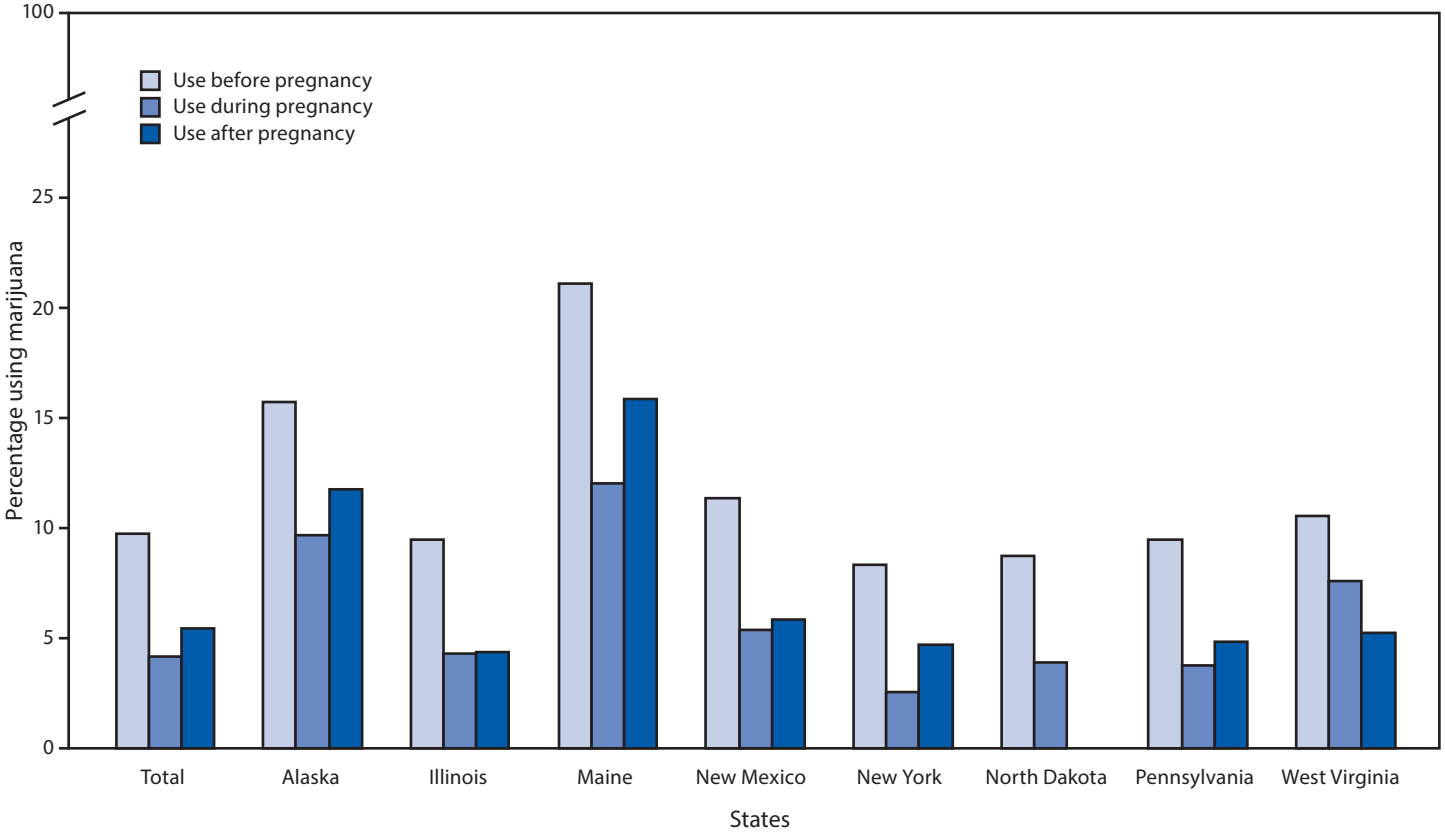
PRAMS is a state-specific, population-based surveillance system designed to monitor self-reported behaviors and experiences before, during, and after pregnancy among women who have had a recent live birth. In each participating state, a monthly stratified systematic sample of women with recent live births is selected from birth certificate records and surveyed by mail or telephone 2–6 months after delivery.* Supplementary questions about marijuana use were asked in eight states included in this analysis: Alaska, Illinois, Maine, New Mexico, New York, North Dakota, Pennsylvania, and West Virginia; each state had a response rate ≥55%. Data were weighted to adjust for noncoverage and nonresponse and represent the total population of women with a live birth in each state in 2017.

Women were asked "At any time during the 3 months before you got pregnant or during your most recent pregnancy, did you use marijuana or hash in any form?" Use before pregnancy was identified as a frequency greater than "never" to the follow-up question "During the 3 months before you got pregnant, about how often did you use marijuana products in an average month?" Use during pregnancy was identified the same way, from the question "During your most recent pregnancy, about how often did you use marijuana products in an average month?" Women who indicated marijuana use in both periods were defined as having continued use, whereas those who used before pregnancy and ceased during pregnancy were defined as having ceased use. Women who indicated "yes" to the question "Since your new baby was born, have you used marijuana or hash in any form?" were defined as using marijuana after pregnancy. Women who self-reported use during pregnancy indicated the reason or reasons (to relieve nausea or vomiting; stress or anxiety; symptoms of a chronic condition; pain; to have fun or relax; and other) and mode or modes (smoking; eating; drinking; vaporizing; dabbing; or other) of using marijuana during pregnancy. More than one option could be chosen. Qualitative thematic coding categorized "other" responses; written responses of mental health conditions were recoded as relieving stress or anxiety and written responses of poor appetite or weight loss were recoded as relieving nausea or vomiting. Remaining responses were retained as other. Weighted prevalence estimates and 95% confidence intervals (CIs) were calculated overall and by state using SUDAAN (version 11.0; RTI International). Among women who used marijuana in the 3 months before pregnancy, chi-squared tests were used to compare characteristics of women who continued versus ceased marijuana use during pregnancy, including age, race/ethnicity, marital status, education, insurance status, parity, trimester of entry into prenatal care, and cigarette and e-cigarette use during pregnancy. Adjusted prevalence ratios (aPRs) were calculated to describe associations between continued versus ceased use in pregnancy and maternal characteristics. P-values <0.05 were considered significant.

Among 7,688 women, 6,236 (81.1%) had any information on marijuana use before, during, or after pregnancy. Prevalences of self-reported marijuana use before, during,

* https://www.cdc.gov/prams/methodology.htm.

FIGURE 1. Prevalence* of marijuana use before, during, and after pregnancy (N = 6,236)† — eight states, Pregnancy Risk Assessment Monitoring System (PRAMS), 2017§,¶



* Age-standardized prevalence estimates were also calculated but did not differ meaningfully from unadjusted results.
† A total of 6,236 unique women had data on use before (n = 5,802), during (n = 5,805), and after pregnancy (n = 5,720).
§ Postpartum use estimates are not available for North Dakota.
¶ Marijuana legalization status as of 2017: medical and adult nonmedical use for Alaska and Maine; medical use for Illinois, New Mexico, New York, North Dakota, Pennsylvania, and West Virginia. In North Dakota and West Virginia, medical use of marijuana was legalized in 2017, but enactment might not have occurred by the time of PRAMS data collection.

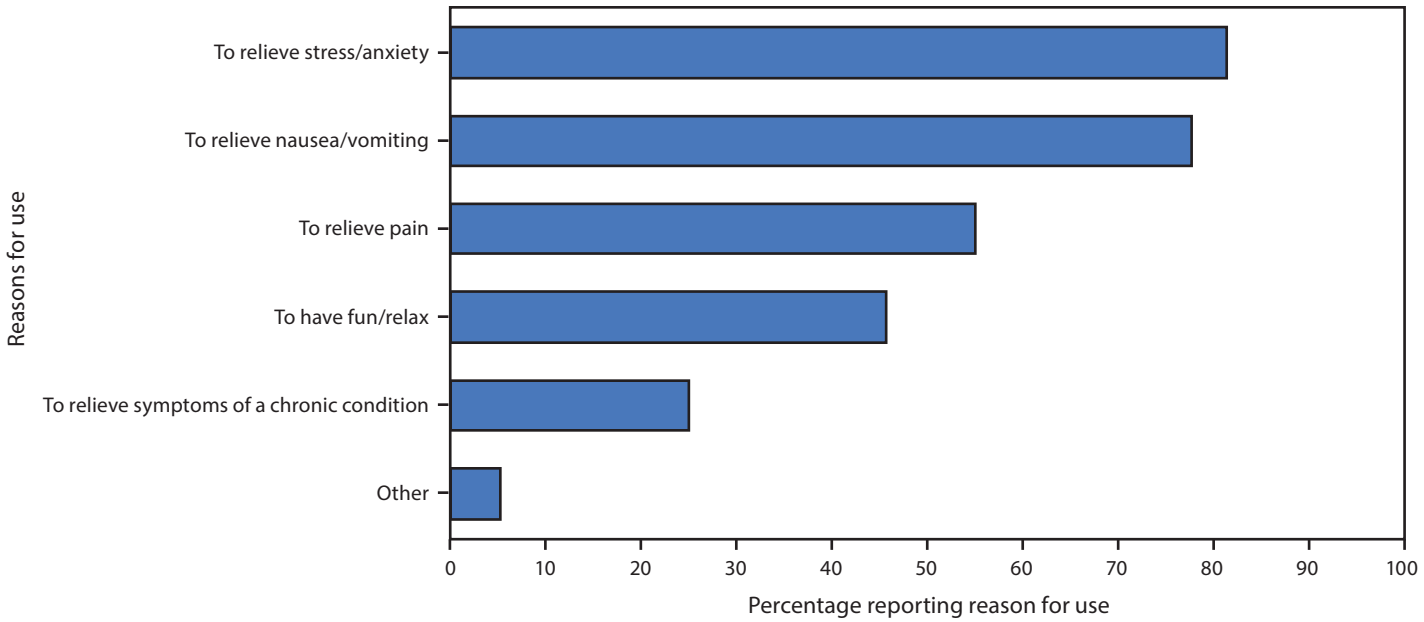
and after pregnancy were 9.8%, 4.2%, and 5.5%, respectively (Figure 1). Estimates also varied by state, ranging from 8.4% in New York to 21.2% in Maine before pregnancy, 2.6% in New York to 12.1% in Maine during pregnancy, and 4.4% in Illinois to 15.9% in Maine after pregnancy. Among 413 women who reported use during pregnancy and their reason for use, the most commonly reported reasons included to relieve stress or anxiety (81.5%), nausea or vomiting (77.8%), and pain (55.1%) (Figure 2). Additional reported reasons included to have fun or relax (45.7%), relieve symptoms of a chronic condition (24.9%), and other (5.1%). The most common mode of marijuana use during pregnancy was smoking (91.0%); less frequently reported were eating (12.1%), vaporizing (7.1%), dabbing (4.5%), drinking (0.5%), and other (0.5%) modes. Among 765 women for whom data were available on marijuana use before and during pregnancy, 41.2% continued use, and 58.8% ceased use during pregnancy (Table). In multivariable analysis, women who continued versus ceased use during pregnancy were more likely to be non-Hispanic white (aPR = 1.8; 95% CI = 1.1–3.2) or other race/ethnicity (aPR = 2.5; 95% CI = 1.4–4.5) compared with non-Hispanic black, to be unmarried (aPR = 1.7; 95% CI = 1.1–2.6), have <12 years of education (aPR = 1.9; 95% CI = 1.3–2.8) or 12 years of education (aPR = 1.6; 95% CI = 1.1–2.2), compared with >12 years of education, and to have used cigarettes during pregnancy (aPR = 1.6; 95% CI = 1.2–2.3).

Discussion

Among women in eight states who had a recent live birth, 9.8% reported using marijuana before pregnancy, 4.2% during pregnancy, and 5.5% after pregnancy. The observed prevalence during pregnancy is similar to 2018 estimates from a national population-based survey, which found that 4.7% of pregnant

† Table 6.18B, Substance Abuse and Mental Health Services Administration's Results from the 2017 National Survey On Drug Use and Health. https://www.samhsa.gov/data/sites/default/files/cbhsq-reports/NSDUHDetailedTabs2017/NSDUHDetailedTabs2017.pdf.

FIGURE 2. Reasons for marijuana use during pregnancy*,†,§ (N = 413) — eight states,¶ Pregnancy Risk Assessment Monitoring System, 2017



* Among 418 women who used marijuana during pregnancy, five did not provide a response to reasons for use. More than one reason for use could be chosen.
† To relieve stress/anxiety also includes written-in responses of to relieve "depression," "anxiety," "posttraumatic stress disorder," "bipolar disorder," and "conversion disorder."
§ To relieve nausea/vomiting also includes written-in responses of "to increase appetite," "to be able to eat," and "to gain weight."
¶ Alaska, Illinois, Maine, New Mexico, New York, North Dakota, Pennsylvania, and West Virginia.

women used marijuana in the preceding 30 days.† The most common mode of marijuana use among those in the PRAMS sample was smoking, which is similar to findings from women attending prenatal care at two California medical centers (*5*). The most common reasons for use during pregnancy were to relieve stress or anxiety, nausea or vomiting, and pain. In a qualitative study, women who used marijuana during pregnancy reported that it helped them with nausea and appetite changes or improved their mood (*6*). Marijuana was also described by those women as natural and safe compared with other substances, including prescribed medications (*6*). In a national sample, approximately 70% of pregnant women perceived slight or no risk of harm from using marijuana once or twice a week (*7*). Among pregnant women who continued to use marijuana during pregnancy, 26% perceived it as harmful, whereas 75% of women who ceased use during pregnancy perceived it as harmful (*8*). In this analysis, after controlling for other factors, women who continued versus ceased use during pregnancy were more likely to be non-Hispanic white or other race/ethnicity than non-Hispanic black, be unmarried, have ≤12 years of education, and use cigarettes during pregnancy. Co-use of tobacco has been documented among pregnant women using marijuana (*7*) and is more likely to occur among pregnant women who continue to use marijuana than among those who cease use during pregnancy (*8*). Further, among pregnant women who reported drinking alcohol in the preceding 30 days, tobacco and marijuana were also commonly used (*9*). ACOG, AAP, and the United States Preventive Service Task Force recommend universal verbal screening during pregnancy to identify substance use (including marijuana) and provide opportunity for treatment when indicated (*3*,*4*,*10*).

ACOG and AAP recommend discontinuation of marijuana use during pregnancy and lactation because of insufficient pregnancy- and lactation-specific safety data (*3*,*4*). These guidelines also recommend that marijuana used for medicinal purposes be discontinued during pregnancy in favor of alternative therapies with better pregnancy-specific safety data (*3*,*4*). Marijuana is not currently regulated in the same manner as pharmaceuticals. Thus, even in states with comprehensive medical laws, plant-derived cannabis products might not have accurate dosing or content labels. Given the limited evidence surrounding the treatment effectiveness of marijuana, including a full understanding of potential harms during pregnancy, physicians and patients should discuss evidence-based pharmacologic and nonpharmacologic treatments during pregnancy.

TABLE. Maternal characteristics by marijuana use and cessation during pregnancy among women who used marijuana before pregnancy – eight states,* Pregnancy Risk Assessment Monitoring System (PRAMS), 2017

Maternal characteristic	Prepregnancy use weighted % (95% CI) (n = 765)†	Marijuana use status during pregnancy weighted % (95% CI)		aPR§ (95% CI)
		Continuous use (n = 410)†	Cease use (n = 355)†	
Total	—	**41.2 (35.1–47.6)**	**58.8 (52.4–64.9)**	—
Age group, yrs				
<20	7.9 (4.8–12.6)	45.4 (23.5–69.2)	54.6 (30.8–76.5)	1.0 (0.5–2.1)
20–24	26.3 (21.1–32.2)	52.6 (40.7–64.3)	47.4 (35.7–59.3)	1.2 (0.7–2.1)
25–34	54.3 (47.8–60.6)	37.5 (29.7–45.9)	62.5 (54.1–70.3)	1.2 (0.7–1.9)
≥35	11.6 (7.9–16.6)	30.2 (14.3–53.0)	69.8 (47.0–85.7)	Referent
Race/Ethnicity				
White, non-Hispanic	64.5 (57.8–70.7)	41.9 (34.5–49.5)	58.2 (50.5–65.5)	1.8 (1.1–3.2)¶
Black, non-Hispanic	15.4 (11.0–21.2)	28.3 (16.3–44.4)	71.7 (55.6–83.8)	Referent
Hispanic	13.6 (9.4–19.4)	41.4 (24.1–61.1)	58.6 (38.9–75.9)	1.7 (1.0–3.0)
Other**	6.5 (4.1–10.2)	70.0 (47.6–85.7)	30.0 (14.3–52.4)	2.5 (1.4–4.5)¶
Marital status				
Married	33.5 (27.8–39.6)	22.2 (15.4–31.1)††	77.8 (68.9–84.7)††	Referent
Not married	66.6 (60.4–72.2)	50.7 (42.5–58.9)††	49.3 (41.1–57.5)††	1.7 (1.1–2.6)¶
Education, yrs				
<12	13.6 (9.6–19.1)	75.1 (59.3–86.2)††	24.9 (13.8–40.7)††	1.9 (1.3–2.8)¶
12	30.1 (24.7–36.1)	58.0 (46.9–68.4)††	42.0 (31.6–53.1)††	1.6 (1.1–2.2)¶
>12	56.3 (49.8–62.5)	23.8 (17.8–31.2)††	76.2 (68.9–82.3)††	Referent
Insurance status during prenatal care§§				
Medicaid	51.2 (44.7–57.6)	53.8 (44.7–62.6)††	46.2 (37.4–55.3)††	1.0 (0.8–1.4)
Private¶¶	44.1 (37.8–50.6)	24.1 (17.1–32.9)††	75.9 (67.1–82.9)††	Referent
Other***	4.4 (2.0–9.2)	60.1 (25.8–86.7)††	39.9 (13.3–74.2)††	1.0 (0.4–2.7)
None	0.3 (0.2–0.7)	—†††	—†††	1.2 (0.7–2.2)
Parity				
First birth	47.6 (41.2–54.1)	34.9 (27.1–43.7)	65.1 (56.3–72.9)	Referent
Second or later birth	52.4 (45.9–58.8)	47.0 (38.2–56.0)	53.0 (44.0–61.8)	1.1 (0.8–1.4)
Entry into prenatal care				
First trimester	80.2 (74.4–85.0)	38.9 (31.9–46.5)	61.1 (53.5–68.1)	Referent
Second trimester	15.7 (11.4–21.2)	48.5 (32.5–64.9)	51.5 (35.1–67.6)	1.0 (0.7–1.5)
Third trimester/None	4.2 (2.3–7.5)	68.4 (36.6–89.1)	31.6 (10.9–63.4)	1.4 (0.9–2.3)
Cigarette use during pregnancy§§§				
Yes	29.6 (24.1–35.8)	73.7 (62.5–82.5)††	26.3 (17.5–37.5)††	1.6 (1.2–2.3)¶
No	70.4 (64.2–75.9)	27.6 (21.6–34.4)††	72.4 (65.6–78.4)††	Referent
Electronic nicotine cigarette use during pregnancy				
Yes	3.4 (1.8–6.2)	78.0 (45.8–93.7)	22.1 (6.3–54.2)	1.2 (0.6–2.1)
No	96.6 (93.8–98.2)	40.1 (33.9–46.6)	59.9 (53.4–66.1)	Referent

Abbreviations: aPR = adjusted prevalence ratio; CI = confidence interval.

* Alaska, Illinois, Maine, New Mexico, New York, North Dakota, Pennsylvania, and West Virginia.

† Unweighted.

§ Among prepregnancy marijuana users, the association between continued use during pregnancy and maternal characteristics controlling for all other characteristics (unweighted n = 675).

¶ Adjusted prevalence ratio statistically significant (p<0.05).

** Other race/ethnicity includes persons who were not Hispanic and whose race was Alaska native, American Indian, Asian, Chinese, Filipino, Hawaiian, Japanese, other nonwhite, or mixed race.

†† Chi–square tests indicated that characteristic was significantly different (p<0.05) across marijuana use during pregnancy.

§§ Observations with no prenatal care or missing information on insurance during prenatal care were imputed with value for insurance during delivery.

¶¶ Includes Civilian Health and Medical Program of the Uniformed Services (CHAMPUS) and TRICARE.

*** Includes Children's Health Insurance Program and other state government programs.

††† Suppressed because cell sizes <5.

§§§ Ascertained from PRAMS and birth certificate.

The findings in this report are subject to at least four limitations. First, although data are state-specific population-based estimates of women who had live births in the eight states included in this report, these findings are not generalizable to populations in other states. Second, marijuana use was self-reported and might be biased because of social desirability and reporting requirements for substance use during pregnancy,[§] as well as state legalization status of marijuana.[¶] At the time of data collection in 2017, medical and adult nonmedical marijuana use was legal in Alaska and Maine, and medical use was legal in Illinois, New Mexico, New York, North Dakota, Pennsylvania, and West Virginia.[**] Third, written-in responses for other reasons of use were recoded to predetermined response options but might not be reflective of respondents' intent. Finally, dependence on marijuana as a reason for use was not captured in this data source; in a national survey, 18.1% of pregnant women who used marijuana in the past-year met criteria for abuse or dependence (*7*).

Given the increasing number of states legalizing medical and nonmedical use of marijuana, surveillance of marijuana use in the perinatal period can inform clinical guidance, provider and patient education, and public health programs. Further monitoring of frequency, mode, and reasons for marijuana use during pregnancy could help characterize its use and inform research on adverse outcomes and prevention. Robust data are needed to inform effective policy and public health initiatives in the context of state legalization status. Provider education on evidence-based approaches for substance use screening during pregnancy and subsequent patient-provider discussions regarding common reasons for marijuana use during pregnancy might improve clinical care. Continued public education on the available science regarding the benefits and harms of cannabis use overall and during pregnancy is important.

[§] https://www.guttmacher.org/state-policy/explore/substance-use-during-pregnancy.
[¶] https://www.ncsl.org/research/health/state-medical-marijuana-laws.aspx.
[**] In North Dakota and West Virginia, medical use of marijuana was legalized in 2017 but enactment might not have occurred by the time of PRAMS data collection.

Acknowledgments

States that participated in the Pregnancy Risk Assessment Monitoring System marijuana supplement (Alaska, Illinois, Maine, New Mexico, New York, North Dakota, Pennsylvania, and West Virginia).

Corresponding author: Jean Y. Ko, JeanKo@cdc.gov, 770-488-5200.

[1]Division of Reproductive Health, National Center for Chronic Disease Prevention and Health Promotion, CDC; [2]Oak Ridge Institute for Science and Education, Oak Ridge, Tennessee; [3]Division of Overdose Prevention, National Center for Injury Prevention and Control, CDC; [4]Office of the Director, Deputy Director for Non Infectious Diseases, CDC.

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Summary

What is already known about this topic?

Marijuana is an illicit substance under federal law; however, many states have legalized medical and nonmedical adult use. The American College of Obstetricians and Gynecologists and the American Academy of Pediatrics recommend refraining from marijuana use during pregnancy and lactation because evidence on safety and health effects are inconclusive or insufficient.

What is added by this report?

Overall, 9.8% of women reported marijuana use before pregnancy, 4.2% during pregnancy, and 5.5% after pregnancy. The most frequently reported reasons for marijuana use during pregnancy were to relieve stress or anxiety, nausea or vomiting, and pain.

What are the implications for public health practice?

Continuous surveillance of marijuana use in the perinatal period can inform clinical guidance, provider and patient education, and public health programs to support evidence-based approaches to addressing substance use.

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Top Food Category Contributors to Sodium and Potassium Intake — United States, 2015–2016

Rebecca C. Woodruff, PhD[1,2]; Lixia Zhao, PhD[2]; Jaspreet K.C. Ahuja, MS[3]; Cathleen Gillespie, MS[2]; Joseph Goldman, MA[3]; Diane M. Harris, PhD[4]; Sandra L. Jackson, PhD[2]; Alanna Moshfegh, MS[3]; Donna Rhodes, MS[3]; Rhonda S. Sebastian, MA[3]; Ana Terry, MS[5]; Mary E. Cogswell, DrPH[2]

Most U.S. adults consume too much sodium and not enough potassium (*1*,*2*). For apparently healthy U.S. adults aged ≥19 years, guidelines recommend reducing sodium intake that exceeds 2,300 mg/day and consuming at least 3,400 mg/day of potassium for males and at least 2,600 mg/day for females* (*1*). Reducing population-level sodium intake can reduce blood pressure and prevent cardiovascular diseases, the leading causes of death in the United States (*1*,*3*). Adequate potassium intake might offset the hypertensive effects of excessive sodium intake (*1*). Data from the 2015–2016 What We Eat in America (WWEIA) dietary interview component of the National Health and Nutrition Examination Survey (NHANES)† were analyzed to identify top food categories contributing to sodium and potassium intake for U.S. residents aged ≥1 year. During 2015–2016, 40% of sodium consumed came from the top 10 food categories, which included prepared foods with sodium added (e.g., deli meat sandwiches and pizza). Approximately 43% of potassium consumed was from 10 food categories, which included foods naturally low in sodium (e.g., unflavored milk, fruit, vegetables) and prepared foods. These results can inform efforts to encourage consumption of foods naturally low in sodium, which might have the dual benefit of reducing sodium intake and increasing potassium intake, contributing to cardiovascular disease prevention.

This analysis used data from the 2015–2016 NHANES, a nationally representative survey and physical examination of the U.S. civilian, noninstitutionalized population. NHANES uses a multistage probability sampling design with oversampling of some age, race, and ethnicity (Hispanic or non-Hispanic). Among 9,544 participants (58.7% unweighted response rate), 7,976 (83.6%) were included in this analysis. Respondents were excluded if they were aged <1 year (4.0%), had an incomplete or unreliable initial 24-hour dietary recall or reported no energy intake (i.e., 0 kcal/day; 16.5%), consumed any human milk on the day of the recall (1.8%), were pregnant or had unknown pregnancy status (1.6%), or were lactating (0.5%).

The first of two, nonconsecutive, 24-hour dietary recalls was used for this analysis. The NHANES participant or a proxy completed the recall in person with trained interviewers using the U.S. Department of Agriculture's automated multiple-pass method,§ which is designed to enhance complete and accurate food recall. Components of each reported food or beverage were assigned to mutually exclusive food codes with corresponding nutrient profiles, which provide the energy (in kilocalories) and nutrient content per 100 g.¶ Respondent total daily energy and sodium and potassium intake were calculated by summing the amount of each food consumed (in grams), multiplied by its assigned food code values. Sodium and potassium density were defined as milligrams of each nutrient per 1,000 kcal. For this analysis, food codes were grouped into 87 mutually exclusive categories adapted from the WWEIA Food Categories** (Supplementary Table, https://stacks.cdc.gov/view/cdc/91457) and included sandwiches and burgers as consumed (e.g., cheese sandwich rather than bread and cheese separately). Sodium included salt added in food preparation but did not include salt added at the table.

Data were analyzed with SAS-callable SUDAAN (version 9.3; RTI International) using day one dietary sample weights and accounting for the complex sampling design. The population proportions (*4*) of intake for each food category were estimated and ranked overall, and by age group (*1*), sex, race, ethnicity (Hispanic or non-Hispanic), and, for adults aged ≥19 years, by hypertension status (using the 2017 American College of Cardiology/American Heart Association [ACC/AHA] guideline)†† and weight status.§§

* The 2015–2020 Dietary Guidelines for Americans recommends that persons in the United States limit their sodium intake. The 2019 Dietary Reference Intake values for sodium and potassium intake vary by age, with lower values for children than for adults.

† https://www.cdc.gov/nchs/nhanes/index.htm.

§ https://www.ars.usda.gov/northeast-area/beltsville-md-bhnrc/beltsville-human-nutrition-research-center/food-surveys-research-group/docs/ampm-usda-automated-multiple-pass-method/.

¶ https://www.ars.usda.gov/fsrg/fndds.

** https://www.ars.usda.gov/northeast-area/beltsville-md-bhnrc/beltsville-human-nutrition-research-center/food-surveys-research-group/docs/dmr-food-categories/.

†† Hypertension status was determined using the average of up to three blood pressure measurements collected during an examination and reported use of antihypertensive medication. The 2017 American College of Cardiology/American Heart Association Hypertension guideline uses the following classifications: 1) normal blood pressure: <120/80 mmHg, 2) elevated blood pressure: systolic 120–129 mmHg and diastolic <80mmHg, and 3) stage I or II hypertension: self-reported antihypertensive medication use or systolic ≥130 mmHg, diastolic ≥80 mmHg. https://www.ahajournals.org/doi/10.1161/HYP.0000000000000065.

§§ Weight status was categorized according to body mass index (BMI) (kg/m^2), which was determined by measured heighted and weight: underweight or normal weight (BMI <25.0), overweight (BMI = 25.0–29.9), or obesity (BMI ≥30.0).

Among the U.S. population aged ≥1 year, mean sodium intake was 3,397 mg/day (Table 1). For that population, 40% of sodium was consumed from the top 10 food categories: deli meat sandwiches (6.3%), pizza (5.4%), burritos and tacos (5.3%), soups (4.1%), savory snacks (e.g., chips, crackers, popcorn) (3.8%), poultry (excluding nuggets and tenders) (3.7%), pasta mixed dishes (excluding macaroni and cheese, 3.0%), vegetables (excluding white potatoes) (2.9%), burgers (2.8%), and eggs and omelets (2.7%). The top five food categories contributing to sodium intake for almost all population subgroups (age [Table 1]; sex, race and Hispanic ethnicity [Table 2]; and blood pressure status and weight status [Table 3]) were among the top 10 categories for the U.S. population overall. Exceptions included unflavored milk (7.5%) among children aged 1–3 years; breads, rolls, and buns (4.0%) among adults aged ≥71 years; rice (9.0%) and breads, rolls, and buns (3.6%) among non-Hispanic Asians; quesadillas, tamales, fajitas, and enchiladas (4.3%) among Hispanics; and

TABLE 1. Top 10 food category contributors (%)* to sodium and potassium intake, by age group — United States, 2015–2016

	Proportion (%) in diet, by age group (yrs)								
Food category and dietary contribution†	**All age groups (≥1 year) (N = 7,976)**	**1–3 (n = 561)**	**4–8 (n = 828)**	**9–13 (n = 829)**	**14–18 (n = 756)**	**19–30 (n = 963)**	**31–50 (n = 1,617)**	**51–70 (n = 1,669)**	**≥71 (n = 753)**
Sodium§									
1. Deli meat sandwiches	6.3	2.7	5.9	5.6	7.0	5.9	6.7	6.5	6.4
2. Pizza	5.4	5.1	6.9	7.7	10.7	6.8	4.5	3.8	—¶
3. Burritos and tacos	5.3	2.3	3.8	4.7	4.9	5.9	7.1	4.0	—¶
4. Soups	4.1	4.2	3.8	3.3	2.5	3.0	4.0	5.3	5.2
5. Savory snacks (e.g., chips, crackers, popcorn)	3.8	7.2	6.8	5.9	4.2	3.7	3.0	3.4	2.9
6. Poultry (excl. nuggets and tenders)	3.7	3.4	2.5	2.6	3.2	5.2	4.1	3.1	2.4
7. Pasta mixed dishes (excluding macaroni and cheese)	3.0	4.0	3.1	3.5	2.9	3.5	2.8	2.3	3.6
8. Vegetables (excluding white potatoes)	2.9	3.0	1.9	1.6	1.6	2.3	3.0	4.0	4.0
9. Burgers	2.8	—¶	2.7	2.5	4.2	2.7	3.0	2.7	1.4
10. Eggs and omelets	2.7	3.7	2.2	2.0	1.7	3.3	2.6	2.5	3.2
Total contribution of top 10 food categories	**40.0**	**35.6**	**39.6**	**39.4**	**42.9**	**42.3**	**40.8**	**37.6**	**29.1**
Mean daily sodium intake (mg) (SE)	3,397 (34)	1,929 (58)	2,655 (43)	3,260 (62)	3,423 (90)	3,861 (98)	3,722 (68)	3,431 (46)	2,861 (88)
Mean daily sodium density (mg/1,000 kcal) (SE)	1,692 (12)	1,465 (25)	1,549 (14)	1,663 (24)	1,689 (25)	1742 (32)	1,726 (22)	1,723 (20)	1,653 (32)
Potassium**									
1. Milk, unflavored	6.4	24.8	13.1	10.0	8.9	4.2	4.6	5.0	7.1
2. Fruit	6.4	10.3	8.0	6.5	5.9	5.6	5.3	6.6	8.5
3. Vegetables (excluding white potatoes)	6.1	3.3	3.6	3.5	2.9	5.5	6.6	7.6	7.5
4. Coffee	5.1	0.0	0.1	—¶	0.9	3.7	5.6	8.1	7.1
5. Savory snacks (e.g., chips, crackers, popcorn)	3.5	3.8	5.1	5.4	4.6	3.3	3.4	3.0	2.3
6. 100% fruit juice	3.3	7.7	5.3	4.0	4.0	3.9	2.7	2.2	3.5
7. Mashed, baked, or boiled white potatoes	3.2	1.9	1.8	3.2	2.8	3.0	3.0	3.5	4.3
8. Deli meat sandwiches	3.1	1.1	3.0	3.1	4.0	3.4	3.6	2.8	2.8
9. Poultry (excluding nuggets and tenders)	2.9	2.2	2.0	2.0	2.6	4.4	3.4	2.4	1.7
10. Burritos and tacos	2.9	1.0	2.1	2.8	2.9	3.5	3.8	2.2	—¶
Total contribution of top 10 food categories	**42.9**	**56.1**	**44.1**	**40.5**	**39.5**	**40.5**	**42.0**	**43.4**	**44.8**
Mean daily potassium intake (mg) (SE)	2,497 (35)	1,797 (35)	1,968 (52)	2,168 (52)	2,235 (60)	2,581 (62)	2,675 (72)	2,708 (41)	2,401 (77)
Mean daily potassium density (mg/1,000 kcal) (SE)	1,276 (12)	1,395 (19)	1,175 (21)	1,113 (15)	1,127 (18)	1,190 (20)	1,266 (16)	1,387 (18)	1,401 (31)
Mean daily energy intake (kcal) (SE)	2,041 (18)	1,321 (29)	1,714 (27)	1,995 (38)	2,062 (54)	2,262 (47)	2,211 (35)	2,039 (24)	1,760 (44)

Abbreviations: kcal = kilocalories; SE = standard error.

* The population proportion (%) is defined as the sum of the amount of sodium or potassium consumed from each specific food category for all participants in the designated group, divided by the sum of the nutrient consumed from all food categories for all participants in the designated group, multiplied by 100. All estimates use one 24-hour dietary recall, reflect the complex sampling design, and use the day one dietary sample weights to account for nonresponse, weekend/weekday recalls, and oversampling.

† This analysis used 87 food categories, which were adapted from What We Eat in America (https://www.cdc.gov/nchs/nhanes/wweia.htm). Food categories are ranked in descending order by population proportion among the total population aged ≥1 year.

§ The following food categories were not ranked among the top 10 sodium food sources overall but contributed ≥3% to sodium intake within the specified age subgroups: 1–3 years: unflavored milk (7.5%), cheese (3.7%), bacon, frankfurters, sausages (3.3%), chicken patties, nuggets, and tenders (3.0%); 4–8 years: bacon, frankfurters, sausages (3.3%), hot dog and sausage sandwiches (3.3%), unflavored milk (3.1%); cookies, brownies, cakes (3.1%); ready to eat cereals (3.0%); 14–18 years: chicken patties, nuggets, and tenders (3.2%); 51–70 years: meat mixed dishes (3.4%), breads, rolls, buns (3.0%); ≥71 years: breads, rolls, buns (4.0%), cookies, brownies, cakes (4.0%).

¶ Estimates are statistically unreliable, relative SE ≥30%.

** The following food categories were not ranked among the top 10 potassium food sources overall but contributed ≥3% of potassium intake within the specified age subgroups: 4–8 years: flavored milk (7.0%), pizza (3.4%); 9–13 years: flavored milk (4.2%), pizza (4.0%), pasta mixed dishes (excluding macaroni and cheese (3.0%); 14–18 years: pizza (5.7%), fried white potatoes (3.5%), burgers (3.0%); 19–30 years: fried white potatoes (3.6%), pizza (3.2%); 31–50 years: fried white potatoes (3.2%), alcoholic beverages (3.1%).

TABLE 2. Top 10 food category contributors (%)* to sodium and potassium, by race/ethnicity — United States, 2015–2016

Food category and dietary contribution†	Proportion (%) in diet, by sex		Proportion (%) in diet, by race/ethnicity			
	Male (n = 3,984)	Female (n = 3,992)	White, non-Hispanic (n = 2,578)	Black, non-Hispanic (n = 1,727)	Asian, non-Hispanic (n = 743)	Hispanic (n = 2,537)
Sodium§						
1. Deli meat sandwiches	7.1	5.2	7.6	4.6	2.4	4.2
2. Pizza	6.0	4.6	5.5	5.5	3.2	6.0
3. Burritos and tacos	5.7	4.6	4.6	2.1	1.8	11.6
4. Soups	3.7	4.6	3.1	3.1	12.8	4.5
5. Savory snacks (e.g., chips, crackers, popcorn)	3.6	4.1	4.0	4.3	2.6	3.2
6. Poultry (excluding nuggets and tenders)	3.9	3.3	2.7	7.9	4.0	4.1
7. Pasta mixed dishes (excluding macaroni and cheese)	3.2	2.7	3.3	3.6	2.1	1.8
8. Vegetables (excluding white potatoes)	2.5	3.5	2.9	3.3	5.4	1.8
9. Burgers	3.2	2.1	2.9	3.3	0.6	2.7
10. Eggs and omelets	2.5	2.9	2.6	2.2	2.5	3.6
Total contribution of top 10 food categories	**41.4**	**37.6**	**39.2**	**39.9**	**37.4**	**43.5**
Daily sodium intake (mg) (SE)	3,871 (56)	2,927 (32)	3,404 (49)	3,258 (59)	3,710 (100)	3,332 (47)
Daily sodium density (mg/1,000 kcal) (SE)	1,701 (19)	1,683 (16)	1,685 (16)	1,645 (18)	2,020 (75)	1,640 (17)
Potassium¶						
1. Milk, unflavored	6.7	6.2	6.5	4.9	5.9	
2. Fruit	5.8	7.1	6.1	5.7	9.9	6.7
3. Vegetables (excluding white potatoes)	5.0	7.5	6.1	5.9	9.5	5.0
4. Coffee	5.2	5.0	6.4	2.0	2.5	3.2
5. Savory snacks (e.g., chips, crackers, popcorn)	3.5	3.4	3.5	5.0	2.6	2.8
6. 100% fruit juice	3.4	3.1	2.7	5.1	3.0	4.7
7. Mashed, baked or boiled white potatoes	2.9	3.5	3.7	2.9	1.0	2.1
8. Deli meat sandwiches	3.6	2.5	3.7	2.5	1.3	2.3
9. Burritos and tacos	3.2	2.5	2.5	1.3	1.2	6.0
10. Poultry (excluding nuggets and tenders)	3.1	2.6	2.3	5.4	3.2	3.5
Total contribution of top 10 food categories	**42.4**	**43.4**	**43.5**	**40.7**	**40.1**	**43.4**
Mean daily potassium intake (mg) (SE)	2,771 (39)	2,225 (39)	2,563 (42)	2,191 (44)	2,423 (41)	2,590 (58)
Mean daily potassium density (mg/1,000 kcal) (SE)	1,237 (12)	1,315 (18)	1,297 (15)	1,149 (16)	1,405 (17)	1,252 (13)
Mean daily energy intake (kcal) (SE)	2,318 (27)	1,765 (12)	2,059 (21)	1,995 (33)	1,902 (40)	2,033 (24)

Abbreviations: kcal = kilocalories; SE = standard error.

* The population proportion (%) is defined as the sum of the amount of sodium or potassium consumed from each specific food category for all participants in the designated group, divided by the sum of the nutrient consumed from all food categories for all participants in the designated group, multiplied by 100. All estimates use one 24-hour dietary recall, reflect the complex sampling design, and use the day one dietary sample weights to account for nonresponse, weekend/weekday recalls, and oversampling.

† This analysis used 87 food categories, which were adapted from What We Eat in America (https://www.cdc.gov/nchs/nhanes/wweia.htm). Food categories are ranked in descending order by population proportion among the total population aged ≥1 year.

§ The following food categories were not ranked among the top 10 sodium food sources overall but contributed ≥3% to overall sodium intake. Non-Hispanic Asians: rice (9.0%); breads, rolls, buns (3.6%); soy-based condiments (3.2%); fried rice and lo/chow mein (3.1%). Hispanics: quesadillas, tamales, fajitas and enchiladas (4.3%).

¶ The following food categories were not ranked among the top 10 potassium food sources overall but contributed ≥3% to overall potassium intake among sex and race/ethnic subgroups. Non-Hispanic blacks: fried white potatoes (4.3%); soft drinks, fruit drinks, and sport/energy drinks (3.1%). Non-Hispanic Asians: soups (6.5%). Hispanics: beans, peas, legumes (4.0%); soups (3.0%).

other meat sandwiches (3.6%) among adults aged ≥19 years with elevated blood pressure.

Mean potassium intake was 2,497 mg/day overall (Table 1). Overall, 43% of potassium was consumed from the top 10 food categories: unflavored milk (6.4%); fruit (6.4%); vegetables (excluding white potatoes) (6.1%); coffee (5.1%); savory snacks (e.g., chips, crackers, popcorn) (3.5%); 100% fruit juice (3.3%); mashed, baked, or boiled white potatoes (3.2%); deli meat sandwiches (3.1%); poultry (excluding nuggets and tenders) (2.9%); and burritos and tacos (2.9%). These food categories contributed varying amounts to total potassium intake by age subgroup, ranging from 39.5% among youths aged 14–18 years to 56.1% among children aged 1–3 years. For almost all population subgroups, the top five food categories contributing to potassium intake were among the top 10 categories for the overall population (Tables 1, 2, and 3). Exceptions included flavored milk among children aged 4–8 years (7.0%) and 9–13 years (4.2%), pizza among youth aged 14–18 years (5.7%), and soups among non-Hispanic Asians (6.5%).

Discussion

This analysis found that 40% of sodium intake and 43% of potassium intake came from the top 10 food categories for

TABLE 3. Top 10 food category contributors (%)* to sodium and potassium intake, by blood pressure status and weight status among adults aged ≥19 years – United States, 2015–2016

Food category and dietary contribution†	Proportion (%) in diet, total (N = 5,002)	Proportion (%) in diet, by blood pressure status§			Proportion (%) in diet, by weight status¶		
		Normal blood pressure (n = 1,713)	Elevated blood pressure (n = 667)	Stage I or II hypertension (n = 2,546)	Normal weight and underweight (n = 1,344)	Overweight (n = 1,596)	Obesity (n = 2,015)
Sodium**							
1. Deli meat sandwiches	**6.5**	6.8	6.0	6.4	5.3	7.0	6.8
2. Burritos and tacos	**5.5**	5.5	5.4	5.6	4.0	5.8	6.4
3. Pizza	**4.6**	5.3	3.7	4.3	5.4	3.6	5.1
4. Soups	**4.3**	4.6	3.5	4.3	5.5	3.9	3.8
5. Poultry (excluding nuggets and tenders)	**3.9**	4.1	5.1	3.3	4.2	4.0	3.5
6. Savory snacks (e.g., chips, crackers, popcorn)	**3.3**	3.6	3.2	3.2	3.2	3.5	3.3
7. Vegetables (excluding white potatoes)	**3.2**	3.1	3.3	3.3	3.5	3.4	2.9
8. Pasta mixed dishes (excluding macaroni and cheese)	**2.9**	2.5	2.7	3.3	3.3	2.8	2.7
9. Eggs and omelets	**2.8**	2.9	3.0	2.6	2.8	3.3	2.4
10. Burgers	**2.7**	2.8	2.3	2.7	2.6	2.9	2.6
Total contribution of top 10 food categories	**39.7**	**41.1**	**38.2**	**39.0**	**39.6**	**40.2**	**39.5**
Mean daily sodium intake (mg) (SE)	**3,545 (42)**	3,573 (61)	3,699 (61)	3,472 (66)	3,528 (58)	3,477 (72)	3,614 (86)
Mean daily sodium density (mg/1,000 kcal) (SE)	**1,718 (14)**	1,726 (22)	1,710 (38)	1,715 (19)	1729 (28)	1,671 (20)	1,750 (27)
Potassium††							
1. Vegetables (excluding white potatoes)	**6.8**	7.1	7.0	6.6	7.7	6.9	6.1
2. Coffee	**6.3**	5.6	7.0	6.7	5.8	6.6	6.4
3. Fruit	**6.2**	6.6	5.6	6.0	7.4	6.2	5.3
4. Milk, unflavored	**4.9**	4.4	5.4	5.2	5.7	4.9	4.5
5. Mashed, baked or boiled white potatoes	**3.3**	2.9	3.1	3.8	3.1	2.8	3.9
6. Deli meat sandwiches	**3.2**	3.4	3.1	3.1	2.6	3.5	3.4
7. Savory snacks (e.g., chips, crackers, popcorn)	**3.1**	3.3	2.8	3.1	2.8	3.5	3.1
8. Poultry (excluding nuggets and tenders)	**3.1**	3.4	4.0	2.6	3.0	3.3	2.9
9. Burritos and tacos	**3.0**	3.0	2.9	3.0	2.2	2.9	3.6
10. 100% fruit juice	**2.9**	3.0	2.9	2.8	3.5	2.7	2.6
Total contribution of top 10 food categories	**42.9**	**42.7**	**43.8**	**42.8**	**43.6**	**43.4**	**41.8**
Mean daily potassium intake (mg) (SE)	**2,636 (39)**	2,643 (57)	2,719 (67)	2,603 (43)	2,694 (57)	2,656 (66)	2,566 (45)
Mean daily potassium density (mg/1,000 kcal) (SE)	**1,308 (14)**	1,308 (22)	1,280 (20)	1,317 (17)	1,342 (24)	1,315 (20)	1,274 (16)
Mean daily energy intake (kcal) (SE)	**2,108 (21)**	2,114 (23)	2,197 (45)	2,075 (33)	2,099 (32)	2,109 (41)	2,113 (27)

Abbreviations: BMI = body mass index; BP = blood pressure; kcal = kilocalories; SE = standard error.

* The population proportion (%) is defined as the sum of the amount of sodium or potassium consumed from each specific food category for all participants in the designated group, divided by the sum of the nutrient consumed from all food categories for all participants in the designated group, multiplied by 100. All estimates use one 24–hour dietary recall, reflect the complex sampling design, and use the day one dietary sample weights to account for nonresponse, weekend/weekday recalls, and oversampling.

† This analysis used 87 food categories, which were adapted from What We Eat in America (https://www.cdc.gov/nchs/nhanes/wweia.htm). Food categories are ranked in descending order by population proportion among the total population aged ≥1 year.

§ Blood pressure was defined as normal (<120/80 mmHg), elevated (systolic BP = 120–129 and diastolic BP <80 mmHg), or stage I or II hypertension (self–reported antihypertensive medication use or systolic BP ≥130, diastolic BP ≥80 mmHg) according to the 2017 American College of Cardiology/American Heart Association Hypertension Guideline.

¶ BMI (kg/m^2) was used to classify adults: normal weight (BMI = 18.5–24.9), overweight (BMI = 25.0–29.9), or obesity (BMI ≥30).

** The following food categories were not ranked as top 10 sodium food sources among respondents aged ≥19 years but contributed ≥3% to sodium intake among blood pressure and weight status subgroups. Elevated BP: other meat sandwiches (3.6%), poultry sandwiches (3.0%). Stage I or II hypertension: meat mixed dishes (3.1%).

†† The following food categories were not ranked as top 10 potassium food sources among respondents aged ≥19 years but contributed ≥3% to potassium intake among blood pressure and weight status subgroups. Obese: fried white potatoes (3.5%).

each nutrient. The analysis provides the most current information about the top food categories contributing to sodium and potassium intake in the United States. Consistent with prior analyses (*5*,*6*), the top contributors to sodium intake primarily included prepared foods with sodium added (e.g., deli meat sandwiches, poultry, or vegetables with added sodium). As indicated in earlier research (*7*), potassium intake primarily comes from foods that are naturally low in sodium (e.g., unflavored milk, fruit, and vegetables) and prepared foods. Notably, five food categories (deli meat sandwiches, burritos and tacos, savory snacks, poultry, and vegetables) ranked as top 10 contributors for sodium and potassium intake overall, highlighting the interconnected nature of the food categories contributing to intake of both nutrients.

Multiple federal agencies have ongoing initiatives promoting the National Academies of Medicine (formerly Institute of Medicine) recommendations for sodium reduction and the expansion of healthier food options (*8*). For example,

the Food and Drug Administration developed draft guidance on voluntary targets for sodium added to the U.S. food supply.[¶¶] In addition, the Food Service Guidelines for Federal Facilities[***] expand access to healthy food options and can be adapted for use in hospitals, government facilities, afterschool and recreational programs, faith-based organizations, and other institutions. CDC programs that fund the implementation of food service guidelines include the Sodium Reduction in Communities,[†††] State Physical Activity and Nutrition,[§§§] and High Obesity programs.[¶¶¶]

The findings in this report are subject to at least three limitations. First, dietary data were self-reported and are susceptible to recall and social desirability biases. The automated multiple-pass method might underestimate sodium and potassium intake (*9*). Estimates do not include sodium from salt added at the table, which might contribute 5%–6% to total intake (*10*), or potassium from supplements. Second, the 2017 ACC/AHA guidelines redefining hypertension had not been released at the time of data collection. Some persons classified as having hypertension in this analysis might have been unaware of their change in status. However, this approach permitted assessment of food categories contributing to intake in relation to the current definition of hypertension, which can inform public health strategies to reduce cardiovascular disease risk. Finally, differences in the top food categories reported in this analysis as compared with prior analyses (*5*–*7*) might be attributable to variation in how foods were categorized, rather than to changes in consumer behavior. This analysis counted sandwich toppings or other additions (e.g., condiments) as part of the sandwich categories, but other foods consumed in combination (e.g., salads) were treated as separate food categories (e.g., lettuce, salad dressing), which might have resulted in sandwiches being more likely to be ranked among the top food categories as compared with other foods consumed in combination.

Monitoring the food categories contributing to population sodium and potassium intake can inform cardiovascular disease prevention initiatives. Consuming foods naturally low in sodium (e.g., fruits and vegetables without added sodium) in place of foods that are high in sodium (e.g., prepared foods with added sodium) might have the dual benefit of decreasing sodium intake and increasing potassium intake (*1*). In addition, differences in top food categories contributing to sodium and potassium intake by race and Hispanic ethnicity indicate the need for dietary strategies that encompass the variability in foods consumed to reach populations at elevated risk for cardiovascular disease. Understanding the top food categories contributing to sodium and potassium intake informs individual and public health strategies to lower blood pressure and reduce cardiovascular disease risk.

Summary

What is already known about this topic?

Most U.S. residents consume too much sodium and too little potassium, increasing the risk for cardiovascular disease.

What is added by this report?

During 2015–2016, approximately 40% of sodium intake came from the top 10 food categories, which included prepared foods with added sodium (e.g., deli meat sandwiches, pizza, burritos and tacos, soups, savory snacks). Approximately 43% of potassium intake came from the top 10 categories, which included foods low in added sodium (e.g., unflavored milk, fruit, vegetables) and prepared foods.

What are the implications for public health practice?

Increasing intake of foods that are naturally low in added sodium (e.g., fruits and vegetables without added salt) might have the dual benefit of decreasing sodium intake and increasing potassium intake.

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Corresponding author: Rebecca C. Woodruff, okp9@cdc.gov, 404-498-5986.

[1]Epidemic Intelligence Service, CDC; [2]Division for Heart Disease and Stroke Prevention, National Center for Chronic Disease Prevention and Health Promotion, CDC; [3]Beltsville Human Nutrition Research Center, Agricultural Research Service, U.S. Department of Agriculture; [4]Division of Nutrition, Physical Activity and Obesity, National Center for Chronic Disease Prevention and Health Promotion, CDC; [5]Division of Health and Nutrition Examination Surveys, National Center for Health Statistics, CDC.

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Serious Adverse Health Events, Including Death, Associated with Ingesting Alcohol-Based Hand Sanitizers Containing Methanol — Arizona and New Mexico, May–June 2020

Luke Yip, MD[1]; Danae Bixler, MD[1]; Daniel E. Brooks, MD[2]; Kevin R. Clarke, MD[1]; S. Deblina Datta, MD[1]; Steven Dudley Jr., PharmD[3]; Kenneth K. Komatsu[4]; Jennifer N. Lind, PharmD[1]; Annaliese Mayette, PhD[5]; Michael Melgar, MD[1]; Talia Pindyck, MD[1]; Kristine M. Schmit, MD[1]; Steven A. Seifert, MD[6]; Farshad Mazda Shirazi, MD, PhD[3]; Susan C. Smolinske, PharmD[7]; Brandon J. Warrick, MD[6]; Arthur Chang, MD[1]

On August 5, 2020, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

Alcohol-based hand sanitizer is a liquid, gel, or foam that contains ethanol or isopropanol used to disinfect hands. Hand hygiene is an important component of the U.S. response to the emergence of SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19). If soap and water are not readily available, CDC recommends the use of alcohol-based hand sanitizer products that contain at least 60% ethyl alcohol (ethanol) or 70% isopropyl alcohol (isopropanol) in community settings (*1*); in health care settings, CDC recommendations specify that alcohol-based hand sanitizer products should contain 60%–95% alcohol (≥60% ethanol or ≥70% isopropanol) (*2*). According to the Food and Drug Administration (FDA), which regulates alcohol-based hand sanitizers as an over-the-counter drug, methanol (methyl alcohol) is not an acceptable ingredient. Cases of ethanol toxicity following ingestion of alcohol-based hand sanitizer products have been reported in persons with alcohol use disorder (*3*,*4*). On June 30, 2020, CDC received notification from public health partners in Arizona and New Mexico of cases of methanol poisoning associated with ingestion of alcohol-based hand sanitizers. The case reports followed an FDA consumer alert issued on June 19, 2020, warning about specific hand sanitizers that contain methanol. Whereas early clinical effects of methanol and ethanol poisoning are similar (e.g., headache, blurred vision, nausea, vomiting, abdominal pain, loss of coordination, and decreased level of consciousness), persons with methanol poisoning might develop severe anion-gap metabolic acidosis, seizures, and blindness. If left untreated methanol poisoning can be fatal (*5*). Survivors of methanol poisoning might have permanent visual impairment, including complete vision loss; data suggest that vision loss results from the direct toxic effect of formate, a toxic anion metabolite of methanol, on the optic nerve (*6*). CDC and state partners established a case definition of alcohol-based hand sanitizer–associated methanol poisoning and reviewed 62 poison center call records from May 1 through June 30, 2020, to characterize reported cases. Medical records were reviewed to abstract details missing from poison center call records. During this period, 15 adult patients met the case definition, including persons who were American Indian/Alaska Native (AI/AN). All had ingested an alcohol-based hand sanitizer and were subsequently admitted to a hospital. Four patients died and three were discharged with vision impairment. Persons should never ingest alcohol-based hand sanitizer, avoid use of specific imported products found to contain methanol, and continue to monitor FDA guidance (*7*). Clinicians should maintain a high index of suspicion for methanol poisoning when evaluating adult or pediatric patients with reported swallowing of an alcohol-based hand sanitizer product or with symptoms, signs, and laboratory findings (e.g., elevated anion-gap metabolic acidosis) compatible with methanol poisoning. Treatment of methanol poisoning includes supportive care, correction of acidosis, administration of an alcohol dehydrogenase inhibitor (e.g., fomepizole), and frequently, hemodialysis.

A case of alcohol-based hand sanitizer–associated methanol poisoning was defined as detectable blood methanol concentration and a history of alcohol-based hand sanitizer exposure (e.g., ingestion, dermal, ocular, inhalation, or injection) in any person who sought medical attention in Arizona or New Mexico during May 1–June 30, 2020. To identify and characterize cases, CDC collaborated with Arizona Department of Health Services, Arizona Poison and Drug Information Center System, New Mexico Department of Health, and New Mexico Poison and Drug Information Center to identify and review poison center call records. Clinical and demographic data were abstracted from records that met the case definition. Patients were characterized according to age, sex, signs and symptoms at evaluation, blood test results, including methanol levels, presence of anion-gap acidosis, treatments received, and outcomes. Medical records were reviewed for clinical and demographic details missing from the poison center call records. An illustrative case vignette is presented. Activity was determined to meet the requirements of public health surveillance as defined in 45 CFR 46.102(l)(2).

During May 1–June 30, 15 cases of alcohol-based hand sanitizer–associated methanol poisoning were identified, including persons who were AI/AN (Table). All patients had reportedly ingested hand sanitizer, and all were

admitted to a hospital. The mean patient age was 43 years (range = 21–65 years); 13 were male. All patients had a history of swallowing alcohol-based hand sanitizer products. The earliest available blood methanol concentrations ranged from 21 mg/dL to >500 mg/dL. All patients had evidence of a metabolic acidosis: anion gap levels ranged from 17 to 49 milliequivalents per liter (mEq/L) (normal = 3–10), serum bicarbonate concentrations ranged from <5 to 13 mEq/L (normal = 22–28), and blood pH ranged from 6.70 to 7.25 (normal = 7.35–7.45). Six patients developed seizures during their hospitalization. All patients were treated with fomepizole (a competitive inhibitor of alcohol dehydrogenase, the enzyme that catalyzes the initial step in the metabolism of methanol to its toxic metabolites), and nine received hemodialysis or continuous renal replacement therapy. As of July 8, four patients remain hospitalized. Among seven patients discharged from the hospital, four had no sequelae, and three were discharged with new visual impairment. Among the four patients who died, three had seizures at the time of admission; initial signs and symptoms were not reported for the fourth patient.

Illustrative Case

A man aged 44 years was evaluated at a health care facility for recent onset of visual impairment. The patient reported drinking an unknown quantity of alcohol-based hand sanitizer during the few days before seeking medical care. Initial laboratory investigations were notable for a blood methanol concentration of 97 mg/dL and metabolic acidosis, with an anion gap of 32 mEq/L, serum bicarbonate concentration of <6 mEq/L, and arterial blood pH of 7.09. His clinical course was complicated by seizures. The patient was treated with fomepizole and underwent hemodialysis. He recovered after a 6-day hospitalization for acute methanol poisoning and was discharged with near-total vision loss.

Discussion

In addition to social distancing and consistent use of face masks, hand hygiene is an integral component of the response to the emergence of SARS-CoV-2 in the United States.* Practicing hand hygiene, for example, by washing hands with soap and water for at least 20 seconds,† is a simple and effective way to decrease the spread of pathogens and infections. If soap and water are not readily available, CDC recommends the use of alcohol-based hand sanitizer products that contain at least 60% alcohol (ethanol or isopropanol) in community settings (*1*); alcohol-based hand sanitizers used in health care settings should contain 60%–95% alcohol (≥60% ethanol or ≥70% isopropanol) (*2*). This investigation highlights the serious adverse health events, including death, that can occur after ingesting alcohol-based hand sanitizer products containing methanol. Safety messaging to avoid ingestion of any alcohol-based hand sanitizer product should continue.§ Similar cases of methanol toxicity might be occurring in other states and localities.

Swallowing alcohol-based hand sanitizer products containing methanol can cause life-threatening methanol poisoning. Young children might unintentionally swallow these products, whereas adolescents or adults with history of alcohol use disorder might intentionally swallow these products as an alcohol (ethanol) substitute (*3*,*4*).

Although methanol can be absorbed through the skin (*8*), transcutaneous methanol poisoning is rare and has been reported under unusual circumstances (*9*). The extent and rate of transcutaneous methanol absorption depends on variables such as its form (e.g., vapors, liquid, or solution), contact time, dose, concentration, and size of the exposure area (*8*,*10*).¶

The findings in this report are subject to at least two limitations. First, the clinical diagnosis of methanol poisoning can be challenging because eliciting an exposure history can be challenging for patients with altered mental status, and some hospitals might be unable to test for a blood methanol level. Cases of methanol poisoning might not have been recognized or reported to poison centers or state health departments. Second, the extent of potential exposure to alcohol-based hand sanitizer products containing methanol is uncertain; additional cases might be identified. As of July 15, 2020, FDA had tested and identified 67 alcohol-based hand sanitizer products that contain methanol (*7*). These products are being recalled by the manufacturer or distributor in the United States. An FDA investigation is ongoing.

Severe methanol poisoning resulting in permanent disability or death can occur after swallowing alcohol-based hand sanitizer containing methanol. The public should check their products against the FDA Updates on Hand Sanitizers Consumers Should Not Use website (*7*). If the product is on this list, its use should be discontinued immediately, and the product should be disposed of in hazardous waste containers; these products should not be flushed down a toilet or poured down a drain.** All alcohol-based hand sanitizers should only be used to disinfect hands and should never be swallowed. Children using hand sanitizers should be supervised, and these products should be kept out of reach of children when

* https://www.cdc.gov/handwashing/when-how-handwashing.html.
† https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/prevention.html.
§ https://www.cdc.gov/handwashing/show-me-the-science-hand-sanitizer.html.
¶ https://www.sciencedirect.com/science/article/pii/S0022202X1546837X.
** https://www.fda.gov/drugs/drug-safety-and-availability/fda-advises-consumers-not-use-hand-sanitizer-products-manufactured-eskbiochem.

TABLE. Characteristics of patients admitted to health care facilities with methanol poisoning associated with ingestion of alcohol-based hand sanitizer products containing methanol — Arizona and New Mexico, May–June 2020

Age (yrs)	Sex	Chief complaint(s)*	Serum methanol concentration (mg/dL)	Anion gap† (mEq/L)	Serum bicarbonate§ concentration (mEq/L)	Blood pH¶	Treatment	Outcome
21	M	Gastrointestinal	44	30	6	7.15	4MP	D/C, no sequelae
30	M	Visual disturbance	35	43	11	N/A	4MP	D/C, no sequelae
35	M	Unresponsive, seizures	198	49	<5	6.87	4MP	Died
36	M	Decreased responsiveness	>500	42	7	7.23	4MP, HD	Remains hospitalized**
38	M	Gastrointestinal	131	35	<5	6.81	4MP, HD, CRRT	D/C, no sequelae
38	F	N/A	21††	N/A	N/A	N/A	4MP	Died
39	M	Seizures, unconscious	278	23	11	N/A	4MP, HD	Died
40	M	Dog bite	319	35	<5	7.00	4MP, CRRT	Remains hospitalized**
44	M	Visual disturbance, seizures	97	32	<6	7.09	4MP, HD	D/C with visual impairment
47	M	Headache, visual disturbance	43	34	8	7.25	4MP, HD	D/C with visual impairment
50	M	Visual disturbance	410	22	9	6.70	4MP, CRRT	Remains hospitalized**
51	F	Dyspnea	42	23	6.2	7.14	4MP	D/C with visual impairment
54	M	Media alert§§	56	17	13	N/A	4MP	D/C, no sequelae
63	M	Altered mental status	548	30	11	7.12	4MP, HD	Remains hospitalized**
65	M	Unresponsive, seizures, cardiac arrest	308	31	<5	N/A	4MP, HD, CRRT	Died

Abbreviations: CRRT = continuous renal replacement therapy; D/C = discharged from hospital; F = female; HD = hemodialysis; M = male; mEq = milliequivalents; 4MP = fomepizole; N/A = not available.

* Chief complaint(s) directly came from medical records. Laboratory data were earliest recorded results.

† Normal = 3–10 mEq/L; elevated levels can indicate metabolic acidosis.

§ Normal = 22–28 mEq/L.

¶ Normal = 7.35–7.45.

** As of July 8, 2020.

†† 2 days after admission.

§§ Patient saw media report on alcohol-based hand sanitizers containing methanol and wanted to be evaluated by a medical professional.

not in use. Swallowing alcohol-based hand sanitizer products, including those that do not contain methanol, might also lead to serious illness and outcomes, including death (*3*,*4*). Consumers who have been exposed to alcohol-based hand sanitizers containing methanol should stop using them immediately and seek immediate medical attention if they experience any concerning symptoms. Clinicians should have a high index of suspicion for methanol poisoning when evaluating patients with either a history of swallowing an alcohol-based hand sanitizer or compatible signs and symptoms and, if needed, obtain medical management advice from their regional poison center (1-800-222-1222).

Summary

What is already known about this topic?

Alcohol-based hand sanitizers should only contain ethanol or isopropanol, but some products imported into the United States have been found to contain methanol.

What is added by this report?

From May 1 through June 30, 2020, 15 cases of methanol poisoning were reported in Arizona and New Mexico, associated with swallowing alcohol-based hand sanitizers. Four patients died, and three were discharged with visual impairment.

What are the implications for public health practice?

Alcohol-based hand sanitizer products should never be ingested. In patients with compatible signs and symptoms or after having swallowed hand sanitizer, prompt evaluation for methanol poisoning is required. Health departments in all states should coordinate with poison centers to identify cases of methanol poisoning.

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Maureen Roland, Banner Poison and Drug Information Center; Eric Thomas, Arizona Department of Health Services; Navajo Epidemiology Center.

Corresponding author: Luke Yip, lyip@cdc.gov.

[1]CDC COVID-19 Response Team; [2]Banner Poison and Drug Information Center, Phoenix, Arizona; [3]Arizona Poison and Drug Information Center, Tucson, Arizona; [4]Division of Public Health Preparedness, Arizona Department of Health Services; [5]Epidemiology and Response Division, New Mexico Department of Health; [6]University of New Mexico School of Medicine, Albuquerque, New Mexico; [7]New Mexico Poison and Drug Information Center, Albuquerque, New Mexico.

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COVID-19–Associated Multisystem Inflammatory Syndrome in Children — United States, March–July 2020

Shana Godfred-Cato, DO[1]; Bobbi Bryant, MPH[1,2]; Jessica Leung, MPH[1]; Matthew E. Oster, MD[1]; Laura Conklin, MD[1]; Joseph Abrams, PhD[1]; Katherine Roguski, MPH[1]; Bailey Wallace, MPH[1,2]; Emily Prezzato, MPH[1]; Emilia H. Koumans, MD[1]; Ellen H. Lee, MD[3]; Anita Geevarughese, MD[3]; Maura K. Lash, MPH[3]; Kathleen H. Reilly, PhD[3]; Wendy P. Pulver, MS[4]; Deepam Thomas, MPH[5]; Kenneth A. Feder, PhD[6]; Katherine K. Hsu, MD[7]; Nottasorn Plipat, MD, PhD[8]; Gillian Richardson, MPH[9]; Heather Reid[10]; Sarah Lim, MBBCh[11]; Ann Schmitz, DVM[12,13]; Timmy Pierce, MPH[1,2]; Susan Hrapcak, MD[1]; Deblina Datta, MD[1]; Sapna Bamrah Morris, MD[1]; Kevin Clarke, MD[1]; Ermias Belay, MD[1]; California MIS-C Response Team

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In April 2020, during the peak of the coronavirus disease 2019 (COVID-19) pandemic in Europe, a cluster of children with hyperinflammatory shock with features similar to Kawasaki disease and toxic shock syndrome was reported in England* (*1*). The patients' signs and symptoms were temporally associated with COVID-19 but presumed to have developed 2–4 weeks after acute COVID-19; all children had serologic evidence of infection with SARS-CoV-2, the virus that causes COVID-19 (*1*). The clinical signs and symptoms present in this first cluster included fever, rash, conjunctivitis, peripheral edema, gastrointestinal symptoms, shock, and elevated markers of inflammation and cardiac damage (*1*). On May 14, 2020, CDC published an online Health Advisory that summarized the manifestations of reported multisystem inflammatory syndrome in children (MIS-C), outlined a case definition,† and asked clinicians to report suspected U.S. cases to local and state health departments. As of July 29, a total of 570 U.S. MIS-C patients who met the case definition had been reported to CDC. A total of 203 (35.6%) of the patients had a clinical course consistent with previously published MIS-C reports, characterized predominantly by shock, cardiac dysfunction, abdominal pain, and markedly elevated inflammatory markers, and almost all had positive SARS-CoV-2 test results. The remaining 367 (64.4%) of MIS-C patients had manifestations that appeared to overlap with acute COVID-19 (*2–4*), had a less severe clinical course, or had features of Kawasaki disease.§ Median duration of hospitalization was 6 days; 364 patients (63.9%) required care in an intensive care unit (ICU), and 10 patients (1.8%) died. As the COVID-19 pandemic continues to expand in many jurisdictions, clinicians should be aware of the signs and symptoms of MIS-C and report suspected cases to their state or local health departments; analysis of reported cases can enhance understanding of MIS-C and improve characterization of the illness for early detection and treatment.

Local and state health departments reported suspected MIS-C patients to CDC using CDC's MIS-C case report form, which included information on patient demographics, clinical findings, and laboratory test results. Patients who met the MIS-C case definition and were reported to CDC as of July 29, 2020, were included in the analysis. Latent class analysis (LCA), a statistical modeling technique that can divide cases into groups by underlying similarities, was used to identify and describe differing manifestations in patients who met the MIS-C case definition. The indicator variables used in the LCA were the presence or absence of SARS-CoV-2–positive test results by reverse transcription–polymerase chain reaction (RT-PCR) or serology, shock, pneumonia, and involvement of organ systems (i.e., cardiovascular, dermatologic, gastrointestinal, hematologic, neurologic, renal, or respiratory). Three-class LCA was conducted using the R software package "poLCA" with 100 iterations to identify the optimal classification scheme (*5*). Clinical and demographic variables were reported for patients by LCA class. Chi-squared or Fisher's exact tests were used to compare proportions of categorical variables; numeric variables, with medians and interquartile ranges, were compared using the Kruskal-Wallis rank sum test.

As of July 29, 2020, a total of 570 MIS-C patients with onset dates from March 2 to July 18, 2020, had been reported from 40 state health departments, the District of Columbia, and New York City (Figure). The median patient age was 8 years (range = 2 weeks–20 years); 55.4% were male, 40.5% were Hispanic or Latino (Hispanic), 33.1% were non-Hispanic black (black), and 13.2% non-Hispanic white (white) (Table 1). Obesity was the most commonly reported underlying medical condition, occurring in 30.5% of Hispanic, 27.5% of black, and 6.6% of white MIS-C patients.

* https://www.rcpch.ac.uk/sites/default/files/2020-05/COVID-19-Paediatric-multisystem-%20inflammatory%20syndrome-20200501.pdf.

† The MIS-C case definition included a patient aged <21 years with fever, laboratory evidence of inflammation, and evidence of clinically severe illness requiring hospitalization, with multisystem organ involvement (cardiovascular, dermatologic, gastrointestinal, hematologic, neurologic, renal, or respiratory) who tested positive for SARS-CoV-2 or had exposure to COVID-19. https://www.cdc.gov/mis-c/hcp/.

§ Kawasaki disease is an acute febrile illness of unknown cause, primarily affecting children, and associated with fever, rash, conjunctivitis, redness in the mouth, cracked lips, and swollen lymph nodes, feet, and hands.

Overall, the illness in 490 (86.0%) patients involved four or more organ systems. Approximately two thirds did not have preexisting underlying medical conditions before MIS-C onset. The most common signs and symptoms reported during illness course were abdominal pain (61.9%), vomiting (61.8%), skin rash (55.3%), diarrhea (53.2%), hypotension (49.5%), and conjunctival injection (48.4%). Most patients had gastrointestinal (90.9%), cardiovascular (86.5%), or dermatologic or mucocutaneous (70.9%) involvement. Substantial numbers of MIS-C patients had severe complications, including cardiac dysfunction (40.6%), shock (35.4%), myocarditis (22.8%), coronary artery dilatation or aneurysm (18.6%), and acute kidney injury (18.4%). The majority of patients (63.9%) were admitted to an ICU. The median length of ICU stay was 5 days (interquartile range = 3–7 days).

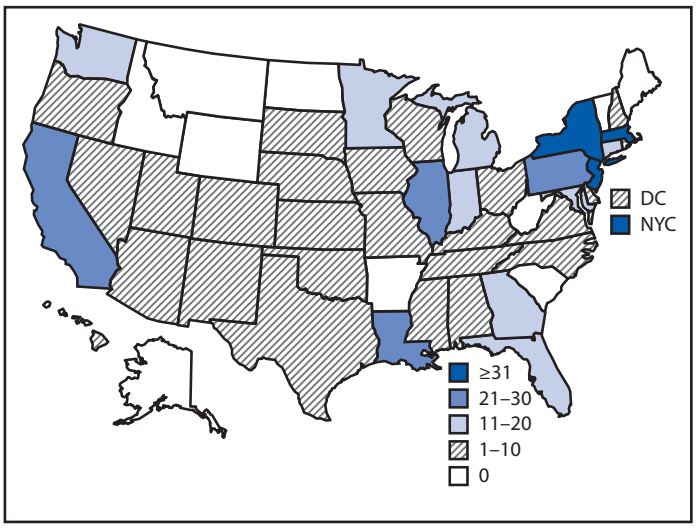
Of the 565 (99.1%) patients who underwent SARS-CoV-2 testing, all had a positive test result by RT-PCR or serology; 46.1% had only serologic evidence of infection and 25.8% had only positive RT-PCR test results. Five patients (0.9%) did not have testing performed but had an epidemiologic link as indicated in the MIS-C case definition.

Among all 570 patients, 527 (92.5%) were treated, including 424 (80.5%) who received intravenous immunoglobulin (IVIG), 331 (62.8%) who received steroids, 309 (58.6%) who received antiplatelet medication, 233 (44.2%) who received anticoagulation medication, and 221 (41.9%) who were treated with vasoactive medication. Ten (1.8%) patients were reported to have died (Table 1).

LCA identified three classes of patients, each of which had significantly different illness manifestations related to some of the key indicator variables. Class 1 represented 203 (35.6%) patients who had the highest number of involved organ systems. Within this group, 99 (48.8%) had involvement of six or more organ systems; those most commonly affected were cardiovascular (100.0%) and gastrointestinal (97.5%). Compared with the other classes, patients in class 1 had significantly higher prevalences of abdominal pain, shock, myocarditis, lymphopenia, markedly elevated C-reactive protein (produced in the liver in response to inflammation), ferritin (an acute-phase reactant), troponin (a protein whose presence in the blood indicates possible cardiac damage), brain natriuretic peptide (BNP), or proBNP (indicative of heart failure) ($p<0.01$) (Tables 1 and 2). Almost all class 1 patients (98.0%) had positive SARS-CoV-2 serology test results with or without positive SARS-CoV-2 RT-PCR test results. These cases closely resembled MIS-C without overlap with acute COVID-19 or Kawasaki disease.

Class 2 included 169 (29.6%) patients; among those in this group, 129 (76.3%) had respiratory system involvement. These patients were significantly more likely to have cough, shortness of breath, pneumonia, and acute respiratory distress syndrome (ARDS), indicating that their illnesses might have been primarily acute COVID-19 or a combination of acute COVID-19 and MIS-C. The rate of SARS-CoV-2 RT-PCR positivity (without seropositivity) in this group (84.0%) was significantly higher than that for class 1 (0.5%) or class 3 (2.0%) patients ($p<0.01$). The case fatality rate among class 2 patients was the highest (5.3%) among all three classes ($p<0.01$).

FIGURE. Geographic distribution of 570 reported cases of multisystem inflammatory syndrome in children — United States, March–July 2020



Abbreviations: DC = District of Columbia; NYC = New York City.

Class 3 included 198 (34.7%) patients; the median age of children in this group (6 years) was younger than that of the class 1 patients (9 years) or class 2 patients (10 years) ($p<0.01$) (Table 1). Class 3 patients also had the highest prevalence of rash (62.6%), and mucocutaneous lesions (44.9%). Although not statistically significant ($p = 0.49$), the prevalence of coronary artery aneurysm and dilatations (18.2%) was higher than that in class 2 patients (15.8%), but lower than that in class 1 patients (21.1%). Class 3 patients more commonly met criteria for complete Kawasaki disease (6.6%) compared with class 1 (4.9%) and class 2 (3.0%) patients ($p = 0.30$), and had the lowest prevalence of underlying medical conditions, organ system involvement, complications (e.g., shock, myocarditis), and markers of inflammation and cardiac damage. Among class 3 patients, 63.1% had positive SARS-CoV-2 serology only and 33.8% had both serologic confirmation and positive RT-PCR results.

Discussion

Initial reports of MIS-C patients described varied clinical signs and symptoms at initial evaluation, but most cases included features of shock, cardiac dysfunction, gastrointestinal

TABLE 1. Characteristics of patients (N = 570) reported with multisystem inflammatory syndrome in children (MIS–C) — United States, March–July 2020

Characteristic	No. (%)				p value
		Latent class analysis group*			
	Total (N = 570)	Class 1 (n = 203)	Class 2 (n = 169)	Class 3 (n = 198)	
Sex					
Female	**254 (44.6%)**	87 (42.9%)	81 (47.9%)	86 (43.4%)	0.57
Male	**316 (55.4%)**	116 (57.1%)	88 (52.1%)	112 (56.6%)	
Age (yrs), median (IQR)	**8 (4–12)**	9 (6–13)	10 (5–15)	6 (3–10)	<0.01
Race/Ethnicity					
Hispanic	**187 (40.5%)**	62 (36.9%)	62 (46.6%)	63 (39.1%)	0.03
Black, non–Hispanic	**153 (33.1%)**	66 (39.3%)	39 (29.3%)	48 (29.8%)	
White, non–Hispanic	**61 (13.2%)**	22 (13.1%)	15 (11.3%)	24 (14.9%)	
Other	**26 (5.6%)**	8 (4.8%)	6 (4.5%)	12 (7.5%)	
Multiple	**18 (3.9%)**	9 (5.4%)	5 (3.8%)	4 (2.5%)	
Asian	**13 (2.8%)**	1 (0.6%)	3 (2.3%)	9 (5.6%)	
American Indian/Alaskan Native	**3 (0.6%)**	0 (0.0%)	3 (2.3%)	0 (0.0%)	
Native Hawaiian/Pacific Islander	**1 (0.2%)**	0 (0.0%)	0 (0.0%)	1 (0.6%)	
Unknown	**108 (—)**	35 (—)	36 (—)	37 (—)	
Outcome					
Died	**10 (1.8%)**	1 (0.5%)	9 (5.3%)	0 (0.0%)	<0.01
Days in hospital, median (IQR)	**6 (4–9)**	8 (6–11)	6 (4–10)	5 (4–8)	<0.01
1	**16 (3.2%)**	3 (1.8%)	3 (2.0%)	10 (5.4%)	<0.01
2–7	**304 (60.2%)**	86 (50.3%)	87 (58.8%)	131 (70.4%)	
8–14	**149 (29.5%)**	66 (38.6%)	41 (27.7%)	42 (22.6%)	
≥15	**36 (7.1%)**	16 (9.4%)	17 (11.5%)	3 (1.6%)	
Missing	**65 (—)**	32 (—)	21 (—)	12 (—)	
ICU admission	**364 (63.9%)**	171 (84.2%)	105 (62.1%)	88 (44.4%)	<0.01
Days in ICU, median (IQR)	**5 (3–7)**	5 (4–7)	6 (3–9)	3 (2–5)	<0.01
Underlying medical conditions					<0.01
Obesity	**146 (25.6%)**	60 (29.6%)	49 (29.0%)	37 (18.7%)	0.02
Chronic lung disease	**48 (8.4%)**	18 (8.9%)	17 (10.1%)	13 (6.6%)	0.46
Clinical characteristic					
No. of organ systems involved					
2–3	**80 (14.0%)**	6 (3.0%)	24 (14.2%)	50 (25.3%)	<0.01
4–5	**351 (61.6%)**	98 (48.3%)	113 (66.9%)	140 (70.7%)	
≥6	**139 (24.4%)**	99 (48.8%)	31 (18.3%)	9 (4.5%)	
Days with fever, median (IQR)	**5 (3–6)**	5 (3–6)	5 (3–6)	5 (3–6)	0.81
Kawasaki disease†	**28 (4.9)**	10 (4.9)	5 (3.0)	13 (6.6)	0.30
Organ system involvement					
Gastrointestinal	**518 (90.9%)**	198 (97.5%)	146 (86.4%)	174 (87.9%)	<0.01
Abdominal pain	**353 (61.9%)**	163 (80.3%)	83 (49.1%)	107 (54.0%)	<0.01
Vomiting	**352 (61.8%)**	145 (71.4%)	95 (56.2%)	112 (56.6%)	<0.01
Diarrhea	**303 (53.2%)**	124 (61.1%)	79 (46.7%)	100 (50.5%)	0.01
Cardiovascular	**493 (86.5%)**	203 (100.0%)	143 (84.6%)	147 (74.2%)	<0.01
Shock	**202 (35.4%)**	154 (75.9%)	48 (28.4%)	0 (0.0%)	<0.01
Elevated troponin	**176 (30.9%)**	93 (45.8%)	43 (25.4%)	40 (20.2%)	<0.01
Elevated BNP or NT–proBNP	**246 (43.2%)**	105 (51.7%)	77 (45.6%)	64 (32.3%)	<0.01
Congestive heart failure	**40 (7.0%)**	21 (10.3%)	14 (8.3%)	5 (2.5%)	0.02
Cardiac dysfunction§	**207 (40.6%)**	105 (55.3%)	64 (46.0%)	38 (21.0%)	<0.01
Myocarditis	**130 (22.8%)**	62 (30.5%)	36 (21.3%)	32 (16.2%)	0.01
Coronary artery dilatation or aneurysm§	**95 (18.6%)**	40 (21.1%)	22 (15.8%)	33 (18.2%)	0.49
Hypotension	**282 (49.5%)**	162 (79.8%)	75 (44.4%)	45 (22.7%)	<0.01
Pericardial effusion§	**122 (23.9%)**	55 (28.9%)	32 (23.0%)	35 (19.3%)	0.01
Mitral regurgitation§	**130 (25.5%)**	68 (35.8%)	30 (21.6%)	32 (17.7%)	<0.01
Dermatologic and mucocutaneous	**404 (70.9%)**	156 (76.8%)	87 (51.5%)	161 (81.3%)	<0.01
Rash	**315 (55.3%)**	121 (59.6%)	70 (41.4%)	124 (62.6%)	<0.01
Mucocutaneous lesions	**201 (35.3%)**	70 (34.5%)	42 (24.9%)	89 (44.9%)	<0.01
Conjunctival injection	**276 (48.4%)**	118 (58.1%)	54 (32.0%)	104 (52.5%)	<0.01
Hematologic	**421 (73.9%)**	161 (79.3%)	130 (76.9%)	130 (65.7%)	<0.01
Elevated D–dimer	**344 (60.4%)**	136 (67.0%)	104 (61.5%)	104 (52.5%)	0.01
Thrombocytopenia¶	**176 (30.9%)**	84 (41.4%)	45 (26.6%)	47 (23.7%)	<0.01
Lymphopenia¶	**202 (35.4%)**	82 (40.4%)	60 (35.5%)	60 (30.3%)	0.11

See table footnotes on the next page.

TABLE 1. (*Continued*) Characteristics of patients (N = 570) reported with multisystem inflammatory syndrome in children (MIS–C) — United States, March–July 2020

Characteristic	No. (%)				
		Latent class analysis group*			
	Total (N = 570)	Class 1 (n = 203)	Class 2 (n = 169)	Class 3 (n = 198)	p value
Respiratory**	**359 (63.0%)**	155 (76.4%)	129 (76.3%)	75 (37.9%)	<0.01
Cough	**163 (28.6%)**	51 (25.1%)	67 (39.6%)	45 (22.7%)	<0.01
Shortness of breath	**149 (26.1%)**	66 (32.5%)	59 (34.9%)	24 (12.1%)	<0.01
Chest pain or tightness	**66 (11.6%)**	33 (16.3%)	24 (14.2%)	9 (4.5%)	0.01
Pneumonia††	**110 (19.3%)**	47 (23.2%)	62 (36.7%)	1 (0.5%)	<0.01
ARDS	**34 (6.0%)**	14 (6.9%)	17 (10.1%)	3 (1.5%)	<0.01
Pleural effusion§§	**86 (15.8%)**	49 (24.7%)	29 (18.4%)	8 (4.2%)	<0.01
Neurologic	**218 (38.2%)**	107 (52.7%)	70 (41.4%)	41 (20.7%)	<0.01
Headache	**186 (32.6%)**	90 (44.3%)	63 (37.3%)	33 (16.7%)	<0.01
Renal	**105 (18.4%)**	77 (37.9%)	28 (16.6%)	0 (0.0%)	<0.01
Acute kidney injury	**105 (18.4%)**	77 (37.9%)	28 (16.6%)	0 (0.0%)	<0.01
Other					
Periorbital edema	**27 (4.7%)**	13 (6.4%)	5 (3.0%)	9 (4.5%)	0.32
Cervical lymphadenopathy >1.5 cm diameter	**76 (13.3%)**	28 (13.8%)	18 (10.7%)	30 (15.2%)	0.43
SARS COV–2 testing					
Any laboratory test done	**565 (99.1%)**	200 (98.5%)	169 (100.0%)	196 (99.0%)	0.39
Any positive laboratory test¶¶ (% among tested)	**565 (100.0%)**	200 (100.0%)	169 (100.0%)	196 (100.0%)	NA
PCR positive/Serology negative, not done, or missing***	**147 (25.8%)**	1 (0.5%)	142 (84.0%)	4 (2.0%)	<0.01
Serology positive/PCR negative†††	**263 (46.1%)**	138 (68.0%)	0 (0.0%)	125 (63.1%)	<0.01
PCR positive/Serology positive	**155 (27.2%)**	61 (30.0%)	27 (16.0%)	67 (33.8%)	<0.01
Epidemiologic link only, with no testing	**5 (0.9%)**	3 (1.5%)	0 (0.0%)	2 (1.0%)	<0.01
Treatment§§§					
IVIG¶¶¶	**424 (80.5%)**	174 (87.9%)	96 (62.7%)	154 (87.5%)	<0.01
Steroids	**331 (62.8%)**	145 (73.2%)	80 (52.3%)	106 (60.2%)	<0.01
Antiplatelet medication	**309 (58.6%)**	113 (57.1%)	69 (45.1%)	127 (72.2%)	<0.01
Anticoagulation medication	**233 (44.2%)**	92 (46.5%)	76 (49.7%)	65 (36.9%)	0.03
Vasoactive medications	**221 (41.9%)**	129 (65.2%)	64 (41.8%)	28 (15.9%)	<0.01
Respiratory support, any	**201 (38.1%)**	104 (52.5%)	79 (51.6%)	18 (10.2%)	<0.01
Intubation and mechanical ventilation	**69 (13.1%)**	37 (18.7%)	30 (19.6%)	2 (1.1%)	<0.01
Immune modulators	**119 (22.6%)**	52 (26.3%)	34 (22.2%)	33 (18.8%)	0.18
Dialysis	**2 (0.4%)**	0 (0.0%)	2 (1.3%)	0 (0.0%)	0.08

Abbreviations: ARDS = acute respiratory distress syndrome; BNP = brain natriuretic peptide; ICU = intensive care unit; IQR = interquartile range; IVIG = intravenous immune globulin; NT-proBNP = N-terminal pro b-type natriuretic peptide; PCR = polymerase chain reaction.

* Latent class analysis (LCA) is a statistical modeling technique in which observations can be classified into latent classes based on their underlying similarities. Variables that are associated with MIS-C clinical manifestation were selected as indicator variables and included in the LCA model.

† Patient had fever, rash, conjunctival injection, cervical lymphadenopathy >1.5 cm diameter, and mucocutaneous lesions.

§ Percentages calculated among 510 persons with an echocardiogram performed.

¶ Thrombocytopenia was defined as a platelet count of less than 150 x 10^3 per μl or if thrombocytopenia was checked on the case-report form. Lymphopenia was defined as a lymphocyte count of <4,500 cells per μl for infants aged <8 months, or less than 1,500 cells per ml for persons aged ≥8 months.

** Among 359 with respiratory organ system involvement, 324 (90%) also had cardiovascular system involvement.

†† Information about pneumonia was collected on the case report form under signs and symptoms, complications, or chest imaging.

§§ Percentages calculated among 545 persons with either an echocardiogram or chest imaging performed.

¶¶ Eight cases had a positive SARS CoV–2 antigen test result, among whom three were also positive by both PCR and serology, one was positive by PCR alone, and one was positive by serology alone.

*** Among 147 cases with a positive PCR result without a positive serologic test result, 10 had a negative serologic test, and the remaining had unknown serologic testing.

††† Among 263 cases with positive serologic test result without a positive PCR result, 254 had a negative PCR result, and the remaining had unknown PCR testing.

§§§ Percentages calculated among 527 persons who received treatment.

¶¶¶ 73 received a second dose of IVIG.

symptoms, significantly elevated markers of inflammation and cardiac damage, and positive test results for SARS-CoV-2 by serology (*3*,*6*–*8*). Because the case definition is nonspecific and confirmatory laboratory testing does not exist, it might be difficult to distinguish MIS-C from other conditions with overlapping clinical manifestations such as severe acute COVID-19 and Kawasaki disease (*9*). Latent class analysis is particularly well-suited to describe differing manifestations of a novel clinical syndrome. It divides patients into groups that might have been previously unrecognized, based on shared characteristics, allowing for an unbiased determination of disease manifestations. Patients identified in class 1 had little overlap with acute COVID-19 or Kawasaki disease, whereas patients in class 2 had clinical and laboratory manifestations that

TABLE 2. Reported serum laboratory values for multisystem inflammatory syndrome in children (MIS-C) cases (N = 570), by latent class analysis (LCA) group* — United States, March–July 2020

	LCA class 1			LCA class 2			LCA class 3			
Laboratory test	No.	Median	IQR	No.	Median	IQR	No.	Median	IQR	p-value
Fibrinogen, peak (mg/dL)	151	557	(449–713)	87	566	(430–662)	105	546	(426–681)	0.67
D-dimer, peak (mg/L)	158	3.0	(1.6–4.9)	106	2.6	(1.2–5.1)	128	1.7	(0.8–3.2)	<0.01
Troponin, peak (ng/mL)	162	0.09	(0.02–0.48)	109	0.05	(0.01–0.30)	130	0.01	(0.01–0.08)	<0.01
BNP, peak (pg/mL)	53	1,321	(414–2,528)	30	198	(76–927)	25	182	(30–616)	<0.01
proBNP, peak (ng/L)	103	4,700	(1,261–13,646)	68	1,503	(247–6,846)	92	507	(176–2,153)	<0.01
CRP, peak (mg/L)	166	21	(14–29)	122	16	(9–25)	144	14	(6–23)	<0.01
Ferritin, peak (ng/mL)	159	610	(347–1,139)	108	422	(207–825)	132	242	(116–466)	<0.01
IL-6, peak (pg/mL)	54	65	(24–258)	27	41	(21–131)	29	69	(7–118)	0.24
Platelets, nadir (103 cells/μl)	115	131	(102–203)	76	172	(103–245)	68	150	(113–237)	0.15
Lymphocytes, nadir (cells/μl)	72	695	(400–1,093)	49	1,200	(790–2,025)	42	1,420	(723–2,250)	<0.01

Abbreviations: BNP = brain natriuretic peptide; CRP = C-reactive protein; IL-6 = Interleukin-6; IQR = interquartile range.

* Latent class analysis (LCA) is a statistical modeling technique in which observations can be classified into latent classes based on their underlying similarities. Variables that are associated with MIS-C clinical manifestation were selected as indicator variables and included in the LCA model.

overlapped with acute COVID-19. This overlap might result from the development of MIS-C soon after symptomatic acute COVID-19 illness. However, the presence of isolated severe acute COVID-19 illness cannot be ruled out in some of these patients. Patients in class 3 generally seemed to have less severe MIS-C illness and clinical manifestations that overlapped with Kawasaki disease, and distinguishing class 3 patients from those with true Kawasaki disease could be difficult (*4*). As the COVID-19 pandemic spreads, and more children are exposed to SARS-CoV-2 with subsequent seroconversion, patients with Kawasaki disease might be misidentified as MIS-C because of an incidental finding of antibodies to SARS-CoV-2.

Overall, the age distribution of the patients in this analysis is similar to that described elsewhere, but there are differences in the clinical manifestations and laboratory findings, perhaps due to differences in inclusion criteria (*6*,*7*). Increases in COVID-19 incidence might result in increased occurrence of MIS-C which might not be apparent immediately because of the 2–4-week delay in the development of MIS-C after acute SARS-CoV-2 infection (*8*). The proportion of Hispanic, black, and white MIS-C patients with obesity is slightly higher than that reported in the general pediatric population.¶ Hispanic and black patients accounted for the largest proportion (73.6%) of reported MIS-C patients. Acute COVID-19 has been reported to disproportionately affect Hispanics and blacks (*10*). Long-standing inequities in the social determinants of health, such as housing, economic instability, insurance status, and work circumstances of patients and their family members have systematically placed social, racial, and ethnic minority populations at higher risk for COVID-19 and more severe illness, possibly including MIS-C.**

The findings in this report are subject to at least four limitations. First, there is a possibility of case identification and reporting bias, including variability in diagnosis, testing, and management of patients by different jurisdictions. Second, inconsistency in completion of case report forms, with some patients still hospitalized at the time of reporting, might have affected data completeness (e.g., race and ethnicity were not reported for 18.9% of cases). Third, access to SARS-CoV-2 testing at the time of onset might have varied by regions, hospitals, and time. Finally, CDC's case definition was broad, with the intention of being more inclusive, which might have led to the unintentional inclusion of patients whose illnesses overlapped with acute COVID-19 and Kawasaki disease.

As the COVID-19 pandemic continues, with the number of cases increasing in many jurisdictions, health care providers should continue to monitor patients to identify children with a hyperinflammatory syndrome with shock and cardiac involvement. Suspected MIS-C patients should be reported to local and state health departments. Distinguishing patients with MIS-C from those with acute COVID-19 and other hyperinflammatory conditions is critical for early diagnosis and appropriate management. It is also critical for monitoring potential adverse events of a COVID-19 vaccine when one becomes widely available. Studies to define the clinical and laboratory characteristics of MIS-C should continue, including identification of parameters that will help distinguish the illness from other similar conditions.

¶ https://www.cdc.gov/obesity/data/childhood.html.

** https://www.cdc.gov/coronavirus/2019-ncov/community/health-equity/race-ethnicity.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fneed-extra-precautions%2Fracial-ethnic-minorities.html.

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Summary

What is already known about this topic?

Multisystem inflammatory syndrome in children (MIS-C) is a rare but severe condition that has been reported approximately 2–4 weeks after the onset of COVID-19 in children and adolescents.

What is added by this report?

Most cases of MIS-C have features of shock, with cardiac involvement, gastrointestinal symptoms, and significantly elevated markers of inflammation, with positive laboratory test results for SARS-CoV-2. Of the 565 patients who underwent SARS-CoV-2 testing, all had a positive test result by RT-PCR or serology.

What are the implications for public health practice?

Distinguishing MIS-C from other severe infectious or inflammatory conditions poses a challenge to clinicians caring for children and adolescents. As the COVID-19 pandemic continues to expand in many jurisdictions, health care provider awareness of MIS-C will facilitate early recognition, early diagnosis, and prompt treatment.

Corresponding author: Shana Godfred-Cato, nzt6@cdc.gov.

[1]CDC COVID-19 Response Team; [2]Oak Ridge Institute for Science and Education; [3]New York City Department of Health and Mental Hygiene; [4]New York State Department of Health; [5]New Jersey Department of Health; [6]Epidemic Intelligence Service, Prevention and Health Promotion Administration, Maryland Department of Health; [7]Massachusetts Department of Public Health; [8]Pennsylvania Department of Health; [9]Louisiana Department of Health; [10]Illinois Department of Public Health; [11]Minnesota Department of Health; [12]Florida Department of Health; [13]Career Epidemiology Field Officer Program, CDC.

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Hospitalization Rates and Characteristics of Children Aged <18 Years Hospitalized with Laboratory-Confirmed COVID-19 — COVID-NET, 14 States, March 1–July 25, 2020

Lindsay Kim, MD[1,2]; Michael Whitaker, MPH[1,3]; Alissa O'Halloran, MSPH[1]; Anita Kambhampati, MPH[1,4]; Shua J. Chai, MD[1,5]; Arthur Reingold, MD[5,6]; Isaac Armistead, MD[7]; Breanna Kawasaki, MPH[8]; James Meek, MPH[9]; Kimberly Yousey-Hindes, MPH[9]; Evan J. Anderson, MD[10,11]; Kyle P. Openo, DrPH[11]; Andy Weigel, MSW[12]; Patricia Ryan, MSc[13]; Maya L. Monroe, MPH[13]; Kimberly Fox, MPH[14]; Sue Kim, MPH[14]; Ruth Lynfield, MD[15]; Erica Bye, MPH[15]; Sarah Shrum Davis, MPH[16]; Chad Smelser, MD[17]; Grant Barney, MPH[18]; Nancy L. Spina, MPH[18]; Nancy M. Bennett, MD[19]; Christina B. Felsen, MPH[19]; Laurie M. Billing, MPH[20]; Jessica Shiltz, MPH[20]; Melissa Sutton, MD[21]; Nicole West, MPH[21]; H. Keipp Talbot, MD[22]; William Schaffner, MD[22]; Ilene Risk, MPA[23]; Andrea Price[23]; Lynnette Brammer, MPH[1]; Alicia M. Fry, MD[1,2]; Aron J. Hall, DVM[1]; Gayle E. Langley, MD[1]; Shikha Garg, MD[1,2]; COVID-NET Surveillance Team

On August 7, 2020, this report was posted as an MMWR Early Release on the MMWR website (https://www.cdc.gov/mmwr).

Most reported cases of coronavirus disease 2019 (COVID-19) in children aged <18 years appear to be asymptomatic or mild (*1*). Less is known about severe COVID-19 illness requiring hospitalization in children. During March 1–July 25, 2020, 576 pediatric COVID-19 cases were reported to the COVID-19–Associated Hospitalization Surveillance Network (COVID-NET), a population-based surveillance system that collects data on laboratory-confirmed COVID-19–associated hospitalizations in 14 states (*2*,*3*). Based on these data, the cumulative COVID-19-associated hospitalization rate among children aged <18 years during March 1–July 25, 2020, was 8.0 per 100,000 population, with the highest rate among children aged <2 years (24.8). During March 21–July 25, weekly hospitalization rates steadily increased among children (from 0.1 to 0.4 per 100,000, with a weekly high of 0.7 per 100,000). Overall, Hispanic or Latino (Hispanic) and non-Hispanic black (black) children had higher cumulative rates of COVID-19–associated hospitalizations (16.4 and 10.5 per 100,000, respectively) than did non-Hispanic white (white) children (2.1). Among 208 (36.1%) hospitalized children with complete medical chart reviews, 69 (33.2%) were admitted to an intensive care unit (ICU); 12 of 207 (5.8%) required invasive mechanical ventilation, and one patient died during hospitalization. Although the cumulative rate of pediatric COVID-19–associated hospitalization remains low (8.0 per 100,000 population) compared with that among adults (164.5),* weekly rates increased during the surveillance period, and one in three hospitalized children were admitted to the ICU, similar to the proportion among adults. Continued tracking of SARS-CoV-2 infections among children is important to characterize morbidity and mortality. Reinforcement of prevention efforts is essential in congregate settings that serve children, including childcare centers and schools.

COVID-NET conducts population-based surveillance for laboratory-confirmed COVID-19–associated hospitalizations in 99 counties† in 14 states (California, Connecticut, Colorado, Georgia, Iowa, Maryland, Michigan, Minnesota, New Mexico, New York, Ohio, Oregon, Tennessee, and Utah), representing all 10 U.S. Department of Health and Human Services regions (*2*,*3*). Laboratory-confirmed COVID-19–associated hospitalizations among residents in a predefined surveillance catchment area who had a positive SARS-CoV-2 molecular test during hospitalization or up to 14 days before admission are included in surveillance. SARS-CoV-2 tests are ordered at the discretion of the treating health care provider. Trained surveillance officers perform medical chart abstractions for all identified cases. Patients aged <18 years hospitalized with COVID-19 during March 1–July 25, 2020, were included in this analysis. Weekly and cumulative COVID-19–associated hospitalization rates were calculated using the number of catchment area residents hospitalized with COVID-19 as the numerator and the National Center for Health Statistics vintage 2019 bridged-race postcensal population estimates as the denominator.§ Descriptive analyses were conducted using all

* https://www.cdc.gov/coronavirus/2019-ncov/covid-data/covidview/index.html.

† Counties in COVID-NET surveillance: California (Alameda, Contra Costa, and San Francisco counties); Colorado (Adams, Arapahoe, Denver, Douglas, and Jefferson counties); Connecticut (New Haven and Middlesex counties); Georgia (Clayton, Cobb, DeKalb, Douglas, Fulton, Gwinnett, Newton, and Rockdale counties); Iowa (one county represented); Maryland (Allegany, Anne Arundel, Baltimore, Baltimore City, Calvert, Caroline, Carroll, Cecil, Charles, Dorchester, Frederick, Garrett, Harford, Howard, Kent, Montgomery, Prince George's, Queen Anne's, St. Mary's, Somerset, Talbot, Washington, Wicomico, and Worcester counties); Michigan (Clinton, Eaton, Genesee, Ingham, and Washtenaw counties); Minnesota (Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, and Washington counties); New Mexico (Bernalillo, Chaves, Dona Ana, Grant, Luna, San Juan, and Santa Fe counties); New York (Albany, Columbia, Genesee, Greene, Livingston, Monroe, Montgomery, Ontario, Orleans, Rensselaer, Saratoga, Schenectady, Schoharie, Wayne, and Yates counties); Ohio (Delaware, Fairfield, Franklin, Hocking, Licking, Madison, Morrow, Perry, Pickaway, and Union counties); Oregon (Clackamas, Multnomah, and Washington counties); Tennessee (Cheatham, Davidson, Dickson, Robertson, Rutherford, Sumner, Williamson, and Wilson counties); and Utah (Salt Lake County).

§ https://www.cdc.gov/coronavirus/2019-ncov/covid-data/covidview/purpose-methods.html.

Summary

What is already known about this topic?

Most reported SARS-CoV-2 infections in children aged <18 years are asymptomatic or mild. Less is known about severe COVID-19 in children requiring hospitalization.

What is added by this report?

Analysis of pediatric COVID-19 hospitalization data from 14 states found that although the cumulative rate of COVID-19–associated hospitalization among children (8.0 per 100,000 population) is low compared with that in adults (164.5), one in three hospitalized children was admitted to an intensive care unit.

What are the implications for public health practice?

Children are at risk for severe COVID-19. Public health authorities and clinicians should continue to track pediatric SARS-CoV-2 infections. Reinforcement of prevention efforts is essential in congregate settings that serve children, including childcare centers and schools.

available data; however, for clinical interventions, treatments, and outcomes, only those hospitalizations with complete medical chart review and a discharge disposition (i.e., discharged alive or died during hospitalization) were included. Obesity was defined as body mass index (kg/m^2) ≥95th percentile for age and sex based on CDC growth charts among children aged ≥2 years; this was not evaluated for children <2 years. All analyses were conducted using SAS statistical software (version 9.4; SAS Institute). COVID-NET activities were determined by CDC to be public health surveillance.¶ Participating sites obtained approval for COVID-NET surveillance from their respective state and local Institutional Review Boards, as required.

During March 1–July 25, 576 children hospitalized with COVID-19 were reported to COVID-NET. Infants aged <3 months accounted for 18.8% of all children hospitalized with COVID-19 (Table). The median patient age was 8 years (interquartile range [IQR] = 9 months–15 years), and 292 (50.7%) were males. Among 526 (91.3%) children for whom race and ethnicity information were reported, 241 (45.8%) were Hispanic, 156 (29.7%) were black, 74 (14.1%) were white; 24 (4.6%) were non-Hispanic Asian or Pacific Islander; and four (0.8%) were non-Hispanic American Indian/Alaska Native.

The cumulative COVID-19–associated hospitalization rate among children aged <18 years during the surveillance period was 8.0 per 100,000 and was highest among children aged <2 years (24.8); rates were substantially lower in children aged 2–4 years (4.2) and 5–17 years (6.4) (Figure 1). Overall weekly hospitalization rates among children increased steadily during the surveillance period (from 0.1 to 0.4 per 100,000, with a weekly high of 0.7 per 100,000; trend test, p<0.001) (Figure 1). COVID-19–associated hospitalization rates were higher among Hispanic and black children than among white children (Figure 2); the rates among Hispanic and black children were nearly eight times and five times, respectively, the rate in white children.

Among 222 (38.5%) of 576 children with information on underlying medical conditions, 94 (42.3%) had one or more underlying conditions (Table). The most prevalent conditions included obesity (37.8%), chronic lung disease (18.0%), and prematurity (gestational age <37 weeks at birth, collected only for children aged <2 years) (15.4%). Hispanic and black children had higher prevalences of underlying conditions (45.7% and 29.8%, respectively) compared with white children (14.9%). Reported signs and symptoms upon hospital admission differed by age: fever or chills were the most common sign and symptom overall (54%) and were most prevalent among children aged <2 years (74.6%). Gastrointestinal symptoms, including nausea or vomiting, abdominal pain, or diarrhea, were reported by 42% of hospitalized children overall.

A medical chart review was completed for 208 (36.1%) children. Median duration of hospitalization was 2.5 days (IQR = 1–5 days). Among 67 children who had a chest radiograph during hospitalization, 44 (65.7%) radiographs showed an infiltrate or consolidation. Among 14 children with chest computed tomography results available, ground-glass opacities (a nonspecific sign indicating infection or alveolar disease) was reported in 10. COVID-19 investigational treatments were only administered to 12 (5.8%) children, all aged 5–17 years; nine received remdesivir. Intravenous immunoglobulin was received by 14 of 208 (6.7%) children. Sixty-nine children (33.2%) were admitted to the ICU for a median of 2 days (IQR = 1–5 days). Invasive mechanical ventilation was required by 12 (5.8%) of 207 children. Since June 18, a discharge diagnosis of multisystem inflammatory syndrome in children (MIS-C) has been systematically collected**; overall, nine (10.8%) of 83 children with completed chart reviews for whom information about MIS-C was systematically collected received a diagnosis of MIS-C. Among 208 children with a discharge disposition, one child (0.5%) with multiple underlying conditions died during hospitalization.

Discussion

Since March 1, 2020, COVID-NET has identified 576 pediatric COVID-19–associated hospitalizations. Although the cumulative COVID-19–associated hospitalization rate among children is low compared with that among adults,

¶ US Department of Health and Human Services, Title 45 Code of Federal Regulations 46, Protection of Human Subjects.

** MIS-C is a hyperinflammatory condition that can affect multiple organs in a child who has a current or recent infection with SARS-CoV-2.

TABLE. Demographic and clinical characteristics of children aged <18 years hospitalized with COVID-19 — COVID-NET, 14 States,* March 1–July 25, 2020†

Characteristic	No./Total no. (%)			
	All ages	0–2 yrs	2–4 yrs	5–17 yrs
Age group (N = 576)				
0–2 mos	108/576 (18.8)	—	—	—
3–5 mos	20/576 (3.5)	—	—	—
6–11 mos	29/576 (5.0)	—	—	—
12–23 mos	31/576 (5.4)	—	—	—
2–4 yrs	50/576 (8.7)	—	—	—
5–11 yrs	97/576 (16.8)	—	—	—
12–17 yrs	241/576 (41.8)	—	—	—
Age (N = 576) median (IQR)		8 yrs (9 mos–15 yrs)		
Sex (N = 576)				
Male	292/576 (50.7)	106/188 (56.4)	25/50 (50.0)	161/338 (47.6)
Female	284/576 (49.3)	82/188 (43.6)	25/50 (50.0)	177/338 (52.4)
Race/Ethnicity (N = 526)				
NH White	74/526 (14.1)	29/162 (17.9)	5/46 (10.9)	40/318 (12.6)
NH Black	156/526 (29.7)	38/162 (23.5)	17/46 (37.0)	101/318 (31.8)
Hispanic or Latino	241/526 (45.8)	73/162 (45.1)	18/46 (39.1)	150/318 (47.2)
NH American Indian/Alaska Native	4/526 (0.8)	0/162 (—)	0/46 (—)	4/318 (1.3)
NH Asian or Pacific Islander	24/526 (4.6)	13/162 (8.0)	3/46 (6.5)	8/318 (2.5)
Multiple races	3/526 (0.6)	0/162 (—)	1/46 (2.2)	2/318 (0.6)
Unknown	24/526 (4.6)	9/162 (5.6)	2/46 (4.3)	13/318 (4.1)
Any underlying condition (N = 222)	94/222 (42.3)	14/65 (21.5)	9/24 (37.5)	71/133 (53.4)
Obesity§	42/111 (37.8)	N/A	6/18 (33.3)	36/93 (38.7)
Chronic lung disease	40/222 (18.0)	2/65 (3.1)	4/24 (16.7)	34/133 (25.6)
Asthma	30/222 (13.5)	1/65 (1.5)	0/24 (0)	29/133 (21.8)
Prematurity (gestational age <37 weeks)¶	10/65 (15.4)	10/65 (15.4)	N/A	N/A
Neurologic disorder	31/222 (14.0)	6/65 (9.2)	7/24 (29.2)	18/133 (13.5)
Immunocompromised condition	12/222 (5.4)	0/65 (—)	2/24 (8.3)	10/133 (7.5)
Feeding tube dependent	12/222 (5.4)	4/65 (6.2)	3/24 (12.5)	5/133 (3.8)
Chronic metabolic disease	10/222 (4.5)	1/65 (1.5)	0/24 (—)	9/133 (6.8)
Diabetes mellitus	6/222 (2.7)	0/65 (—)	0/24 (—)	6/133 (4.5)
Blood disorders	8/222 (3.6)	0/65 (—)	0/24 (—)	8/133 (6.0)
Sickle cell disease	5/222 (2.3)	0/65 (—)	0/24 (—)	5/133 (3.8)
Cardiovascular disease	7/222 (3.2)	2/65 (3.1)	2/24 (8.3)	3/133 (2.3)
Congenital heart disease	4/222 (1.8)	2/65 (3.1)	1/24 (4.2)	1/133 (0.8)
Any underlying condition by race/ethnicity (N = 94)				
NH White	14/94 (14.9)	4/14 (28.6)	0/9 (—)	10/71 (14.1)
NH Black	28/94 (29.8)	3/14 (21.4)	2/9 (22.2)	23/71 (32.4)
Hispanic or Latino	43/94 (45.7)	7/14 (50)	6/9 (66.7)	30/71 (42.3)
NH American Indian/Alaska Native	2/94 (2.1)	0/14 (—)	0/9 (—)	2/71 (2.8)
NH Asian or Pacific Islander	3/94 (3.2)	0/14 (—)	0/9 (—)	3/71 (4.2)
Multiracial	1/94 (1.1)	0/14 (—)	1/9 (11.1)	0/71 (—)
Unknown	3/94 (3.2)	0/14 (—)	0/9 (—)	3/71 (4.2)
Signs and symptoms (N = 224)				
Fever/chills	121/224 (54.0)	50/67 (74.6)	13/24 (54.2)	58/133 (43.6)
Inability to eat/poor feeding¶	22/67 (32.8)	22/67 (32.8)	N/A	N/A
Nausea/vomiting	69/224 (30.8)	14/67 (20.9)	6/24 (25.0)	49/133 (36.8)
Cough	66/224 (29.5)	17/67 (25.4)	3/24 (12.5)	46/133 (34.6)
Nasal congestion/rhinorrhea	53/224 (23.7)	22/67 (32.8)	5/24 (20.8)	26/133 (19.5)
Shortness of breath/respiratory distress	50/224 (22.3)	9/67 (13.4)	2/24 (8.3)	39/133 (29.3)
Abdominal pain	42/224 (18.8)	2/67 (3.0)	3/24 (12.5)	37/133 (27.8)
Diarrhea	27/224 (12.1)	5/67 (7.5)	3/24 (12.5)	19/133 (14.3)
Hospitalization length of stay (N = 208) median days (IQR)	2.5 (1–5)	2 (1–2)	3 (1–4)	3 (2–6)
Chest radiograph findings (N = 67)				
Infiltrate/consolidation	44/67 (65.7)	8/15 (53.3)	3/9 (33.3)	33/43 (76.7)
Bronchopneumonia/pneumonia	14/67 (20.9)	2/15 (13.3)	0/9 (—)	12/43 (27.9)
Pleural effusion	4/67 (6.0)	0/15 (—)	1/9 (11.1)	3/43 (7.0)
Chest CT findings (N = 14)				
Ground glass opacities	10/14 (71.4)	1/1 (100.0)	1/1 (100.0)	8/12 (66.7)
Infiltrate/consolidation	7/14 (50.0)	0/1 (—)	0/1 (—)	7/12 (58.3)
Bronchopneumonia/pneumonia	4/14 (28.6)	0/1 (—)	0/1 (—)	4/12 (33.3)
Pleural effusion	3/14 (21.4)	0/1 (—)	0/1 (—)	3/12 (25.0)

See table footnotes on the next page.

TABLE. (*Continued*) Demographic and clinical characteristics of children aged <18 years hospitalized with COVID-19 — COVID-NET, 14 States,* March 1–July 25, 2020†

Characteristic	No./Total no. (%)			
	All ages	0–2 yrs	2–4 yrs	5–17 yrs
COVID-19 investigational treatment (N = 208)**				
Received treatment	12/208 (5.8)	0/61 (—)	0/24 (—)	12/123 (9.8)
Remdesivir	9/208 (4.3)	0/61 (—)	0/24 (—)	9/123 (7.3)
Azithromycin††	6/208 (2.9)	0/61 (—)	0/24 (—)	6/123 (4.9)
Hydroxychloroquine	4/208 (1.9)	0/61 (—)	0/24 (—)	4/123 (3.3)
Convalescent plasma	1/208 (0.5)	0/61 (—)	0/24 (—)	1/123 (0.8)
Lopinavir-ritonavir§§	1/208 (0.5)	0/61 (—)	0/24 (—)	1/123 (0.8)
ICU admission (N = 208)	69/208 (33.2)	19/61 (31.1)	9/24 (37.5)	41/123 (33.3)
ICU length of stay median days (IQR)	2 (1–5)	1 (1–3)	2 (2–5)	3.5 (1–7)
Interventions (N = 208)¶¶				
Invasive mechanical ventilation***	12/207 (5.8)	0/61 (—)	4/24 (16.7)	8/122 (6.6)
BIPAP/CPAP***	8/207 (3.9)	2/61 (3.3)	2/24 (8.3)	4/122 (3.3)
High flow nasal cannula***	5/207 (2.4)	1/61 (1.6)	1/24 (4.2)	3/122 (2.5)
Systemic steroids	19/208 (9.1)	1/61 (1.6)	4/24(16.7)	14/123 (11.4)
IVIG	14/208 (6.7)	1/61 (1.6)	5/24 (20.8)	8/123 (6.5)
Vasopressor	10/208 (4.8)	0/61 (—)	0/24 (—)	10/123 (8.1)
New clinical discharge diagnoses (N = 208)				
Pneumonia	23/208 (11.1)	2/61 (3.3)	2/24 (8.3)	19/123 (15.4)
Multisystem inflammatory syndrome in children (MIS-C)†††	9/83 (10.8)	1/15 (6.7)	5/15 (33.3)	3/53 (5.7)
Acute respiratory failure	10/208 (4.8)	0/61 (—)	3/24 (12.5)	7/123 (5.7)
Acute kidney injury	6/208 (2.9)	0/61 (—)	0/24 (—)	6/123 (4.9)
Diabetic ketoacidosis	6/208 (2.9)	0/61 (—)	0/24 (—)	6/123 (4.9)
Acute respiratory distress syndrome	4/208 (1.9)	1/61 (1.6)	0/24 (—)	3/123 (2.4)
Died during hospitalization (N = 208)	1/208 (0.5)	0/61 (—)	0/24 (—)	1/123 (0.8)

Abbreviations: BIPAP = bilevel positive airway pressure; CT = computed tomography; CPAP = continuous positive airway pressure; COVID-19 = coronavirus disease 2019; COVID-NET = COVID-19–Associated Hospitalization Surveillance Network; ICU = intensive care unit; IQR = interquartile range; IVIG = intravenous immune globulin; N/A = not applicable; NH = non-Hispanic.

* California, Connecticut, Colorado, Georgia, Iowa, Maryland, Michigan, Minnesota, New Mexico, New York, Ohio, Oregon, Tennessee, and Utah.

† Analyses were conducted on all available data; however, for hospitalization length of stay, radiology findings, treatments, ICU admission, interventions, new clinical diagnoses, and outcome, only cases with a complete medical chart review and a discharge disposition (i.e. discharged alive or died during hospitalization) were included.

§ Obesity was defined as body mass index (kg/m^2) ≥95th percentile for age and sex based on CDC growth charts among children aged ≥2 years; this was not evaluated for children <2 years.

¶ Data collected only on children aged <2 years.

** Not mutually exclusive treatment categories.

†† Given with at least one other COVID-19 investigational treatment.

§§ Not given for human immunodeficiency virus infection.

¶¶ Two hospitalized children received extracorporeal membrane oxygenation (1 each aged <2 years and 5–17 years). None received renal replacement therapy.

*** Highest level of respiratory support for each case that needed respiratory support.

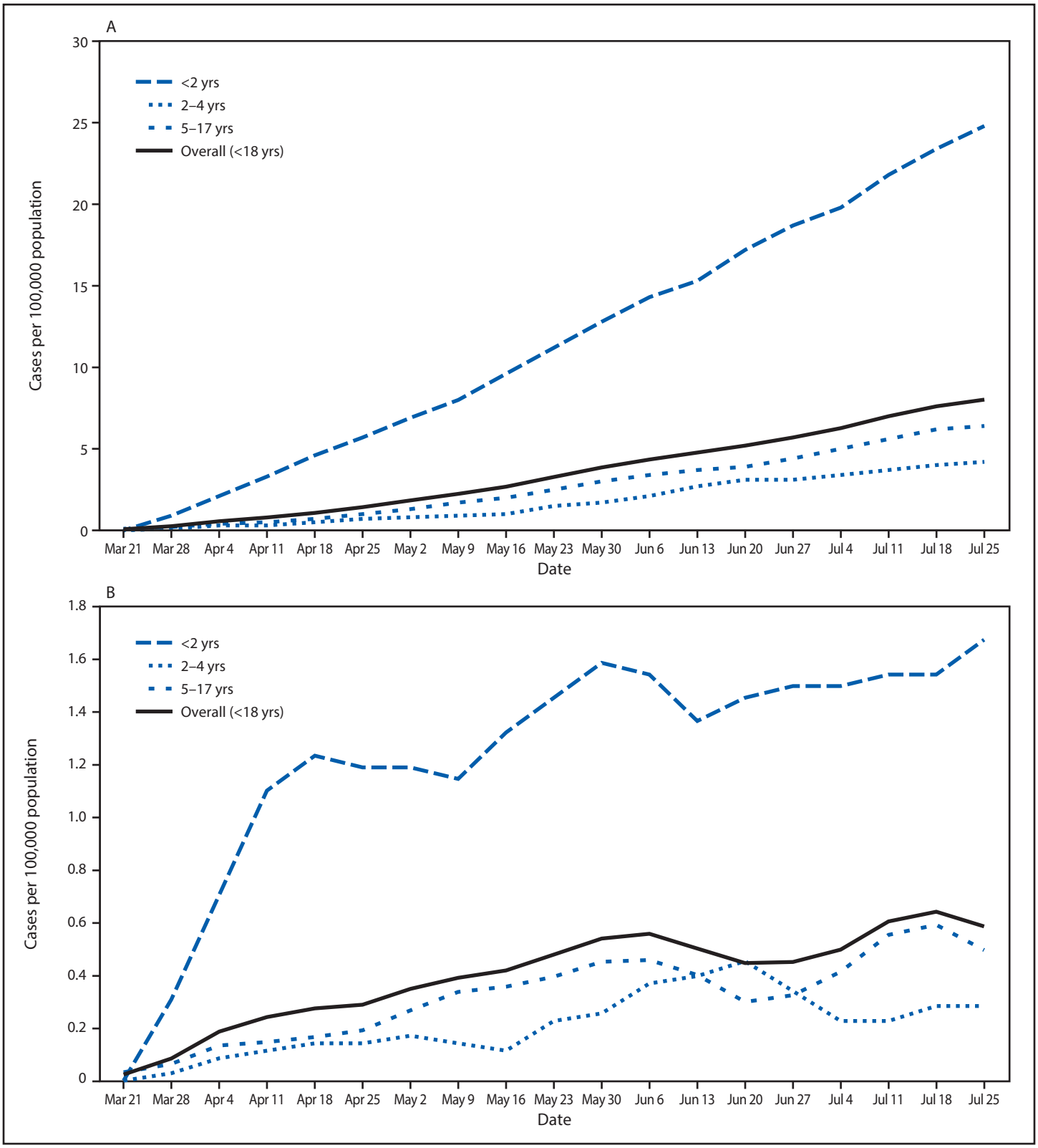
††† Since June 18, a discharge diagnosis of multisystem inflammatory syndrome in children (MIS-C) was systematically collected through COVID-NET.

weekly hospitalization rates in children increased during the surveillance period. Children can develop severe COVID-19 illness; during the surveillance period, one in three children were admitted to the ICU. Hispanic and black children had the highest rates of COVID-19–associated hospitalization.

Continued surveillance will allow for further characterization of the burden and outcomes of COVID-19–associated hospitalizations among children. These data will help to better define the clinical spectrum of disease in children and the contributions of race and ethnicity and underlying medical conditions to hospitalizations and outcomes.

Reasons for disparities in COVID-19-associated hospitalization rates by race and ethnicity are not fully understood. This report found the highest rates of COVID-19-associated hospitalization among Hispanic children. Similarly, a recent study from the Baltimore-District of Columbia region found a higher prevalence of SARS-CoV-2 infection in the Hispanic community compared with that in other racial and ethnic communities (*4*). Although hospitalization rates were lower for Hispanic persons than for black and white persons, hospitalized Hispanic patients were more likely to be younger (aged <44 years) (*4*). It has been hypothesized that Hispanic adults might be at increased risk for SARS-CoV-2 infection because they are overrepresented in frontline (e.g., essential and direct-service) occupations with decreased opportunities for social distancing, which might also affect children living in those households (*4*). During the 2009 influenza A H1N1 pandemic, pediatric mortality rates also were higher among underrepresented ethnic groups in a study from England (*5*).

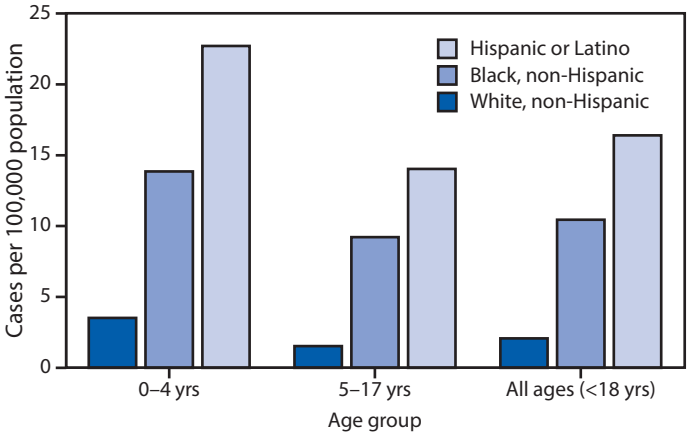
FIGURE 1. Cumulative (A) and weekly (B) COVID-19–associated hospitalization rates*,† among children aged <18 years, by age group — COVID-NET, 14 states§, March 1–July 25, 2020¶



See footnotes on the next page.

Abbreviation: COVID-NET = Coronavirus Disease 2019–Associated Hospitalization Surveillance Network.
* Number of children in each age group hospitalized with COVID-19 per 100,000 population.
† Figure B shows the 3-week moving average of weekly hospitalization rates for children in each age group hospitalized with COVID-19 per 100,000 population. A trend test was conducted using weighted linear regression, where the weight for each MMWR week was the inverse of the variance. Trend test overall (<18 years): p-value <0.001.
§ Counties included in COVID-NET surveillance: California (Alameda, Contra Costa, and San Francisco counties); Colorado (Adams, Arapahoe, Denver, Douglas, and Jefferson counties); Connecticut (New Haven and Middlesex counties); Georgia (Clayton, Cobb, DeKalb, Douglas, Fulton, Gwinnett, Newton, and Rockdale counties); Iowa (one county represented); Maryland (Allegany, Anne Arundel, Baltimore, Baltimore City, Calvert, Caroline, Carroll, Cecil, Charles, Dorchester, Frederick, Garrett, Harford, Howard, Kent, Montgomery, Prince George's, Queen Anne's, St. Mary's, Somerset, Talbot, Washington, Wicomico, and Worcester counties); Michigan (Clinton, Eaton, Genesee, Ingham, and Washtenaw counties); Minnesota (Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, and Washington counties); New Mexico (Bernalillo, Chaves, Dona Ana, Grant, Luna, San Juan, and Santa Fe counties); New York (Albany, Columbia, Genesee, Greene, Livingston, Monroe, Montgomery, Ontario, Orleans, Rensselaer, Saratoga, Schenectady, Schoharie, Wayne, and Yates counties); Ohio (Delaware, Fairfield, Franklin, Hocking, Licking, Madison, Morrow, Perry, Pickaway and Union counties); Oregon (Clackamas, Multnomah, and Washington counties); Tennessee (Cheatham, Davidson, Dickson, Robertson, Rutherford, Sumner, Williamson, and Wilson counties); and Utah (Salt Lake County).
¶ Data are preliminary, and case counts and rates for recent hospital admissions are subject to lag. As data are received each week, previous case counts and rates are updated accordingly.

FIGURE 2. Cumulative COVID-19-associated hospitalization rates* among children aged <18 years, by age group and race/ethnicity — COVID-NET, 14 states†, March 1–July 25, 2020§,¶



Abbreviation: COVID-NET = Coronavirus Disease 2019–Associated Hospitalization Surveillance Network.
* Number of children aged <18 years hospitalized with COVID-19 per 100,000 population.
† Counties included in COVID-NET surveillance: California (Alameda, Contra Costa, and San Francisco counties); Colorado (Adams, Arapahoe, Denver, Douglas, and Jefferson counties); Connecticut (New Haven and Middlesex counties); Georgia (Clayton, Cobb, DeKalb, Douglas, Fulton, Gwinnett, Newton, and Rockdale counties); Iowa (one county represented); Maryland (Allegany, Anne Arundel, Baltimore, Baltimore City, Calvert, Caroline, Carroll, Cecil, Charles, Dorchester, Frederick, Garrett, Harford, Howard, Kent, Montgomery, Prince George's, Queen Anne's, St. Mary's, Somerset, Talbot, Washington, Wicomico, and Worcester counties); Michigan (Clinton, Eaton, Genesee, Ingham, and Washtenaw counties); Minnesota (Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, and Washington counties); New Mexico (Bernalillo, Chaves, Dona Ana, Grant, Luna, San Juan, and Santa Fe counties); New York (Albany, Columbia, Genesee, Greene, Livingston, Monroe, Montgomery, Ontario, Orleans, Rensselaer, Saratoga, Schenectady, Schoharie, Wayne, and Yates counties); Ohio (Delaware, Fairfield, Franklin, Hocking, Licking, Madison, Morrow, Perry, Pickaway and Union counties); Oregon (Clackamas, Multnomah, and Washington counties); Tennessee (Cheatham, Davidson, Dickson, Robertson, Rutherford, Sumner, Williamson, and Wilson counties); and Utah (Salt Lake County).
§ Data are preliminary, and case counts and rates for recent hospital admissions are subject to lag. As data are received each week, prior case counts and rates are updated accordingly. As of July 25, 2020, 50 (8.7%) of 576 pediatric hospitalized cases were missing data on race and ethnicity.
¶ Rates are not shown among non-Hispanic Asian or Pacific Islanders and non-Hispanic American Indian/Alaska Natives because of small case counts, leading to unstable estimates. All non-Hispanic American Indian/Alaska Native hospitalized children were aged 5–17 years.

Forty-two percent of children in this analysis had one or more underlying medical conditions, with higher prevalences among Hispanic and black children. This suggests that the presence of underlying conditions place children at higher risk for COVID-19-associated hospitalizations and that observed disparities might in part be related to the higher prevalence of underlying conditions among hospitalized Hispanic and black children compared with those among white children. This study, along with other studies of hospitalized children with COVID-19, found that obesity was the most prevalent underlying medical condition (*6*,*7*). Childhood obesity affects almost one in five U.S. children and is more prevalent in black and Hispanic children (*8*); therefore, understanding the underlying pathophysiologic association between obesity and SARS-CoV-2 infection is important to identifying possible clinical interventions and preventive strategies to reduce the risk for hospitalization.

This report and others have found that, although one third of children hospitalized with COVID-19 were admitted to the ICU, the case-fatality rate remains low, even among children hospitalized with more severe COVID-19–associated complications, such as MIS-C (*6*,*7*,*9*). By comparison, among U.S. children hospitalized with seasonal influenza virus infection, estimates of ICU admissions have ranged from 16% to 25% among hospitalized children without and with underlying medical conditions, respectively, and reports of in-hospital deaths also are rare (<1%) (*10*). The percentage of ICU admission was similar among children (33.2%) and adults (32.0%) reported to COVID-NET; however, invasive mechanical ventilation was required less frequently in children (5.8%) than in adults (18.6%) (*3*). Continued monitoring of hospitalizations, ICU admissions, and mortality among children is important to understand potential risk factors for severe outcomes.

The findings in this report are subject to at least five limitations. First, laboratory confirmation is dependent on clinician-ordered SARS-CoV-2 molecular testing. Rates

likely are underestimates; cases can be missed because of test availability, test performance, and provider or facility testing practices. Second, hospitalization rates by age group and race/ethnicity are preliminary and might change as additional cases are identified during the surveillance period. Third, analysis of interventions, treatments, and outcomes was based on a convenience sample of children with a final disposition and complete chart reviews. A higher proportion of included children were aged <6 months, and two sites contributed more than half of cases; however, compared with other single-center or state-based studies, COVID-NET is more geographically and racially diverse (*2*). Approximately 60% of pediatric hospitalizations reported to COVID-NET have not had a chart review, and this sample might be biased. In the future, COVID-NET plans to have complete, population-based data on hospitalized children. Finally, COVID-NET did not systematically collect information on MIS-C until June 18. In addition, given that molecular tests can miss approximately half of patients with MIS-C despite serologic or epidemiologic evidence of a past SARS-CoV-2 infection (*9*), COVID-NET surveillance likely underestimates the percentage of MIS-C cases among SARS-CoV-2 infections in children.

Using a multisite, geographically diverse network, this report found that children with SARS-CoV-2 infection can have severe illness requiring hospitalization and intensive care. Improved understanding of the social determinants of health is needed to inform and reduce disparities as evidenced by pediatric COVID-19-associated hospitalization rates. Similar to the general population, children should be encouraged to wash their hands often and continue social distancing, and children aged ≥2 years should wear a mask when around persons outside of their families to reduce the risk for SARS-CoV-2 infection and transmission to others. Ongoing monitoring of hospitalization rates, clinical characteristics, ICU admission, and outcomes in the pediatric population is important to further characterize the morbidity and mortality of COVID-19 in children.

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Corresponding author: Lindsay Kim; LKim@cdc.gov.

[1]CDC COVID-NET Team; [2]US Public Health Service, Rockville, Maryland; [3]Eagle Global Scientific, Atlanta, Georgia; [4]Cherokee Nation Assurance, Arlington, Virginia; [5]California Emerging Infections Program, Oakland, California; [6]School of Public Health, University of California, Berkeley, Berkeley, California; [7]University of Colorado Anschutz Medical Campus, Aurora, Colorado; [8]Colorado Department of Public Health & Environment, Denver, Colorado; [9]Connecticut Emerging Infections Program, Yale School of Public Health, New Haven, Connecticut; [10]Departments of Pediatrics and Medicine, Emory University School of Medicine, Atlanta, Georgia; [11]Emerging Infections Program, Atlanta Veterans Affairs Medical Center, Atlanta, Georgia; [12]Iowa Department of Public Health, Des Moines, Iowa; [13]Maryland Department of Health, Baltimore, Maryland; [14]Michigan Department of Health and Human Services, Lansing, Michigan; [15]Minnesota Department of Health, St. Paul, Minnesota; [16]New Mexico Emerging Infections Program, Albuquerque, New Mexico; [17]New Mexico Department of Health, Santa Fe, New Mexico; [18]New York State Department of Health, Albany, New York; [19]University of Rochester School of Medicine and Dentistry, Rochester, New York; [20]Ohio Department of Health, Columbus, Ohio; [21]Public Health Division, Oregon Health Authority, Portland, Oregon; [22]Vanderbilt University Medical Center, Nashville, Tennessee; [23]Salt Lake County Health Department, Salt Lake City, Utah.

COVID-NET Surveillance Team

Ashley Coates, Pam Daily Kirley, Tanya Libby, Jeremy Roland, California Emerging Infections Program; Nisha Alden, Rachel Herlihy, Sarah McLafferty, Colorado Department of Public Health & Environment; Paula Clogher, Hazal Kayalioglu, Amber Maslar, Adam Misiorski, Linda Niccolai, Danyel Olson, Christina Parisi, Connecticut Emerging Infections Program, Yale School of Public Health; Emily Fawcett, Siyeh Gretzinger, Katelyn Lengacher, Jeremiah Williams, Emerging Infections Program, Georgia Department of Health, Veterans Affairs Medical Center, Foundation for Atlanta Veterans Education and Research; David Blythe, Alicia Brooks, Maryland Department of Health; Rachel Park, Michelle Wilson, Maryland Emerging Infections Program, The Johns Hopkins Bloomberg School of Public Health; Kathryn Como-Sabetti, Richard Danila, Minnesota Department of Health; Cory Cline, New Mexico Department of Health; Kathy Angeles, Nancy Eisenberg, Kristina Flores, Caroline Habrun, Emily Hancock, Sarah Khanlian, Meaghan Novi, Erin Phipps, Yadira Salazar-Sanchez, New Mexico Emerging Infections Program; Elizabeth Dufort, Alison Muse, New York State Department of Health; Sophrena Bushey, Maria Gaitan, RaeAnne Kurtz, University of Rochester School of Medicine and Dentistry; Ama Owusu-Dommey, Lindsey Snyder, Oregon Health Authority; Katherine Michaelis, Kylie Seeley, Oregon Health & Science University; Tiffanie Markus, Vanderbilt University Medical Center; Ryan Chatelain, Andrea George, Mary Hill, Laine McCullough, Melanie Spencer, Ashley Swain, Salt Lake County Health Department; Keegan McCaffrey, Utah Department of Health; Rachel Holstein, Oak Ridge Institute for Science and Education and CDC COVID-NET Team; Seth Meador, Jonathan Wortham, CDC COVID-NET Team.

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Transmission of SARS-CoV-2 Involving Residents Receiving Dialysis in a Nursing Home — Maryland, April 2020

Benjamin F. Bigelow[1,*]; Olive Tang, PhD[1,*]; Gregory R. Toci[1]; Norberth Stracker, MS[1,2]; Fatima Sheikh, MD[1]; Kara M. Jacobs Slifka, MD[3]; Shannon A. Novosad, MD[3]; John A. Jernigan, MD[3]; Sujan C. Reddy, MD[3]; Morgan J. Katz, MD[1]

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SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19), can spread rapidly in nursing homes once it is introduced (*1*,*2*). To prevent outbreaks, more data are needed to identify sources of introduction and means of transmission within nursing homes. Nursing home residents who receive hemodialysis (dialysis) might be at higher risk for SARS-CoV-2 infections because of their frequent exposures outside the nursing home to both community dialysis patients and staff members at dialysis centers (*3*). Investigation of a COVID-19 outbreak in a Maryland nursing home (facility A) identified a higher prevalence of infection among residents undergoing dialysis (47%; 15 of 32) than among those not receiving dialysis (16%; 22 of 138) (p<0.001). Among residents with COVID-19, the 30-day hospitalization rate among those receiving dialysis (53%) was higher than that among residents not receiving dialysis (18%) (p = 0.03); the proportion of dialysis patients who died was 40% compared with those who did not receive dialysis (27%) (p = 0.42). Careful consideration of infection control practices throughout the dialysis process (e.g., transportation, time spent in waiting areas, spacing of machines, and cohorting), clear communication between nursing homes and dialysis centers, and coordination of testing practices between these sites are critical to preventing COVID-19 outbreaks in this medically vulnerable population.

In April 2020, a COVID-19 outbreak occurred at a Maryland nursing home (facility A), a 200-bed skilled nursing facility specializing in postacute and long-term care, with an independently operated dialysis center co-located on site. In Maryland, during the month of April, approximately 25% of all SARS-CoV-2 tests had positive results when considering the rolling 7-day average, and approximately half of nursing homes in the state had active outbreaks.† The Maryland Department of Health conducted SARS-CoV-2 testing for symptomatic nursing home residents with a 3–5-day turnaround time for results. Because of the evolving outbreak and limited testing capacity at the health department, a Johns Hopkins response team provided SARS-CoV-2 testing with a 24-hour turnaround time for all facility A residents who had not previously had a positive test result within the past 48 hours. On April 30, SARS-CoV-2 testing was conducted among all facility A residents, and the prevalences among patients receiving and those not receiving dialysis and by floor of residence in facility A were assessed. All statistical analyses were performed using chi-square tests (p<0.05) with Stata statistical software (version 16; StataCorp, LLC).

Investigation and Findings

On April 16, 2020, the facility census was 170; 75% of residents resided in double-occupancy rooms. Thirty-two (19%) residents were receiving dialysis at the co-located dialysis center. The two schedules for dialysis were Monday, Wednesday, and Friday or Tuesday, Thursday, and Saturday, with three 4-hour shifts per schedule. Shifts overlapped appointment times and residents remained in a dialysis waiting room until their appointment. Facility A residents accounted for 40% of dialysis patients at the center; other patients were from the surrounding community and were scheduled simultaneously with facility A residents.

By April 1, per an order by the Maryland Governor, facility A and the dialysis center required universal surgical masks for all staff members, cancelled group activities and group dining, and prohibited visitors. Staff members were screened for symptoms (e.g., shortness of breath, cough, fever, myalgias, headache, diarrhea, and loss of taste or smell) and their temperature was measured before each shift and being permitted to work. Residents of the nursing home were screened every 8 hours; community dialysis patients were screened before their dialysis appointment.

On April 16, a resident at facility A developed an elevated temperature and malaise and subsequently had a positive result for SARS-CoV-2 RNA by reverse transcription–polymerase chain reaction (RT-PCR) testing of a nasopharyngeal swab specimen. This resident (the index patient) received dialysis on the Tuesday, Thursday, and Saturday schedule during shift 2. The patient received dialysis on April 18, and after receiving a positive test result, was transferred to a designated COVID-19 area in another nursing home (Figure 1).

During the following week (beginning April 20), the Maryland Department of Health tested 47 symptomatic

* These authors contributed equally to this work.
† https://coronavirus.maryland.gov/.

residents of the nursing home and 10 symptomatic staff members (symptoms were defined as any of the following: fever >99°F [37.2°C], cough, malaise, headache, or upper respiratory symptoms); 11 residents and three staff members had positive test results for SARS-CoV-2. Two of the infected residents received dialysis on the Monday, Wednesday, and Friday schedule, one each on shifts 2 and 3. All staff members with positive test results were excluded from work.

On April 21, the dialysis center attempted to cohort all residents into four groups: 1) patients with confirmed COVID-19; 2) symptomatic persons with SARS-CoV-2 test results pending; 3) potentially exposed but asymptomatic persons; and 4) asymptomatic, nonexposed persons. Per cohorting strategy, when possible, these groups received dialysis during different shifts; however, because of scheduling constraints, groups 1 and 2 could receive dialysis on the same shift, as could groups 3 and 4. Universal masking was strongly recommended for patients in the dialysis center; however, the center reported patients often had difficulty wearing masks for the entire session. Dialysis center staff members caring for patients with COVID-19 were required to wear gowns, masks, gloves, and eye protection. Efforts were made to separate dialysis machines by 6 feet (2 meters), but because of space limitations, this was not always possible.

On April 30, among the facility's 164 residents, 152 (93%) had nasopharyngeal specimens tested for SARS-CoV-2 with RT-PCR; three residents refused testing, and nine had previously received positive SARS-CoV-2 test results. Symptom status at the time of universal testing was recorded based on discussion with facility staff members. Among the 152 residents who received testing, 25 (16%) additional SARS-CoV-2 infections were identified, including in 12 (41%) of the 29 remaining residents who were receiving dialysis and in 13 (11%) of the 123 remaining residents who were not receiving dialysis. Among the 25 newly identified cases, 18 (72%) persons were asymptomatic at the time of testing, including seven of 12 and 11 of 13 residents who did and did not receive dialysis, respectively. Two dialysis technicians subsequently became symptomatic, received positive test results (May 1 and May 4) and self-isolated at home. Overall, 40 COVID-19 cases were identified in facility A in 37 residents and three staff members.

As of April 30, 15 of 32 (47%) residents receiving dialysis had positive test results, compared with 22 of 138 (16%) who did not receive dialysis (p<0.001, chi-squared test) (Table). The prevalence of SARS-CoV-2 infection among residents on the second floor of facility A (33 of 81; 41%) was significantly higher than that among residents on the first floor (four of 89; 4.5%) (p = <0.001) (Figure 2).

Among residents with SARS-CoV-2 infection, those receiving dialysis were more often hospitalized within 30 days of receiving a positive test result (eight of 15) compared with those not receiving dialysis (four of 22; 18%) (p = 0.03). Among residents with SARS-CoV-2 infection, six of 15 residents receiving dialysis and six of 22 (27%) residents not receiving dialysis died within 30 days of diagnosis (p = 0.42). Information on cause of death or comorbidities was not available for residents who died.

Public Health Interventions

Facility A closed to new admissions after the first case was identified on April 16 and did not accept new admissions until May 8. Testing for symptomatic residents and staff members was conducted during April 16 –29. Follow-up facility-wide testing for all residents who had not previously had test results positive for SARS-CoV-2, regardless of symptoms, was conducted on April 30; however, because of testing limitations, asymptomatic staff members and community dialysis patients were not tested. To mitigate transmission among residents, following guidance from the local health department, the facility cohorted residents by test results. All residents, regardless of COVID-19 status, were isolated in their rooms while the facility remained in active outbreak status. Staff members were required to wear personal protective equipment for care of all residents with positive test results and those under observation. Residents with SARS-CoV-2 infection receiving dialysis were scheduled separately from residents who had negative test results.

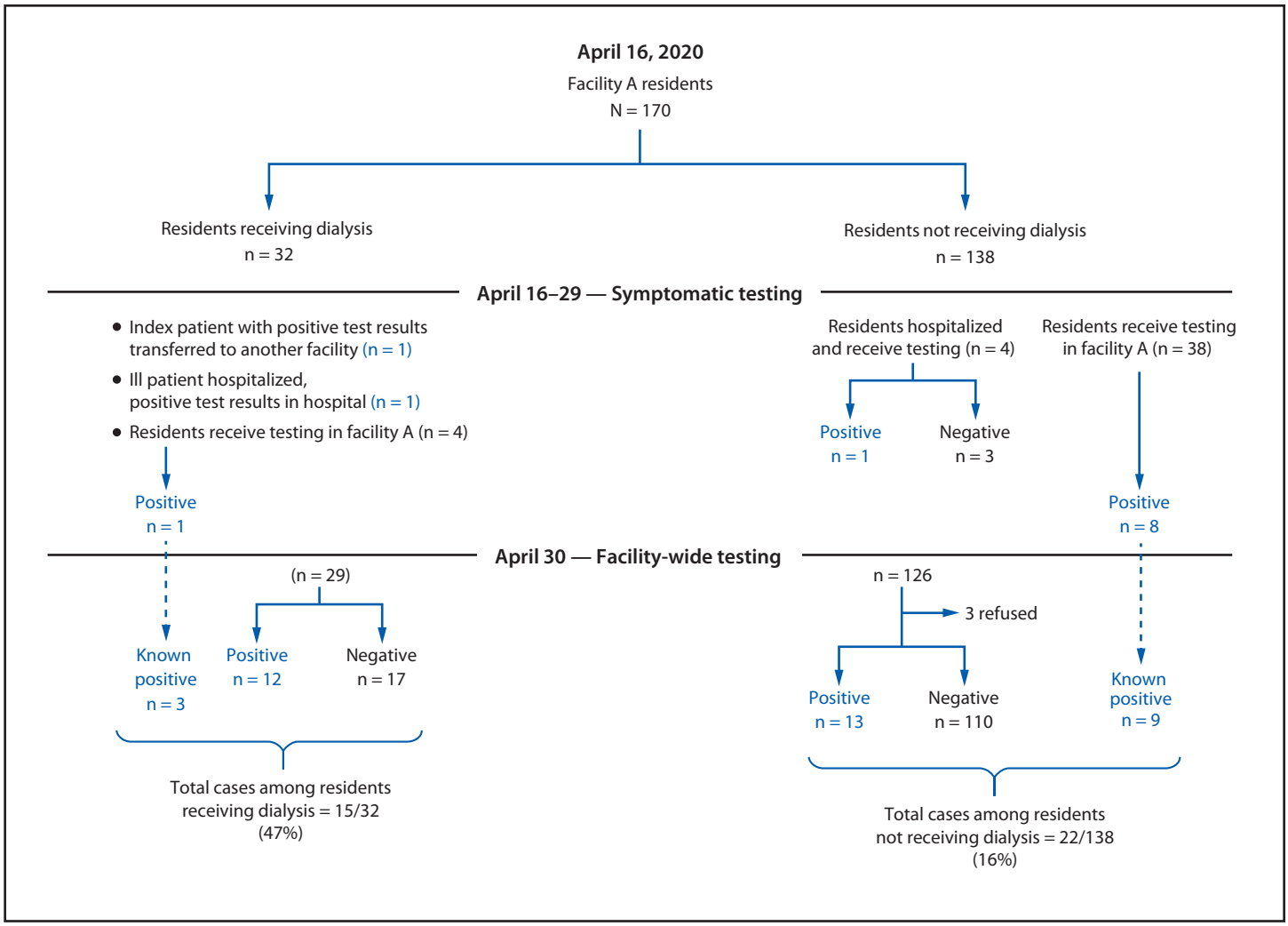
Discussion

During a COVID-19 outbreak investigation at a skilled nursing facility in Maryland, testing identified infections in both residents who were and were not receiving dialysis, but disease prevalence was significantly higher among residents receiving dialysis and among residents on the second floor compared with those not receiving dialysis and those on the first floor.

Residents leaving their rooms for dialysis could be a potential source of SARS-CoV-2 introduction into the nursing home and might pose an underrecognized source of transmission, both in the dialysis center and in the nursing home. Better monitoring and understanding of the risks associated with residents who regularly leave the facility for outpatient health care is needed. Implementing procedures that ensure use of masks, social distancing, and improved ventilation during transportation and in waiting areas is important for preventing SARS-CoV-2 transmission.

Nursing home residents who undergo dialysis are a particularly vulnerable population (*3*,*4*). Compared with other residents, they often have more underlying medical

FIGURE 1. SARS-CoV-2 testing results among residents of a nursing home receiving or not receiving dialysis — Maryland, April 2020



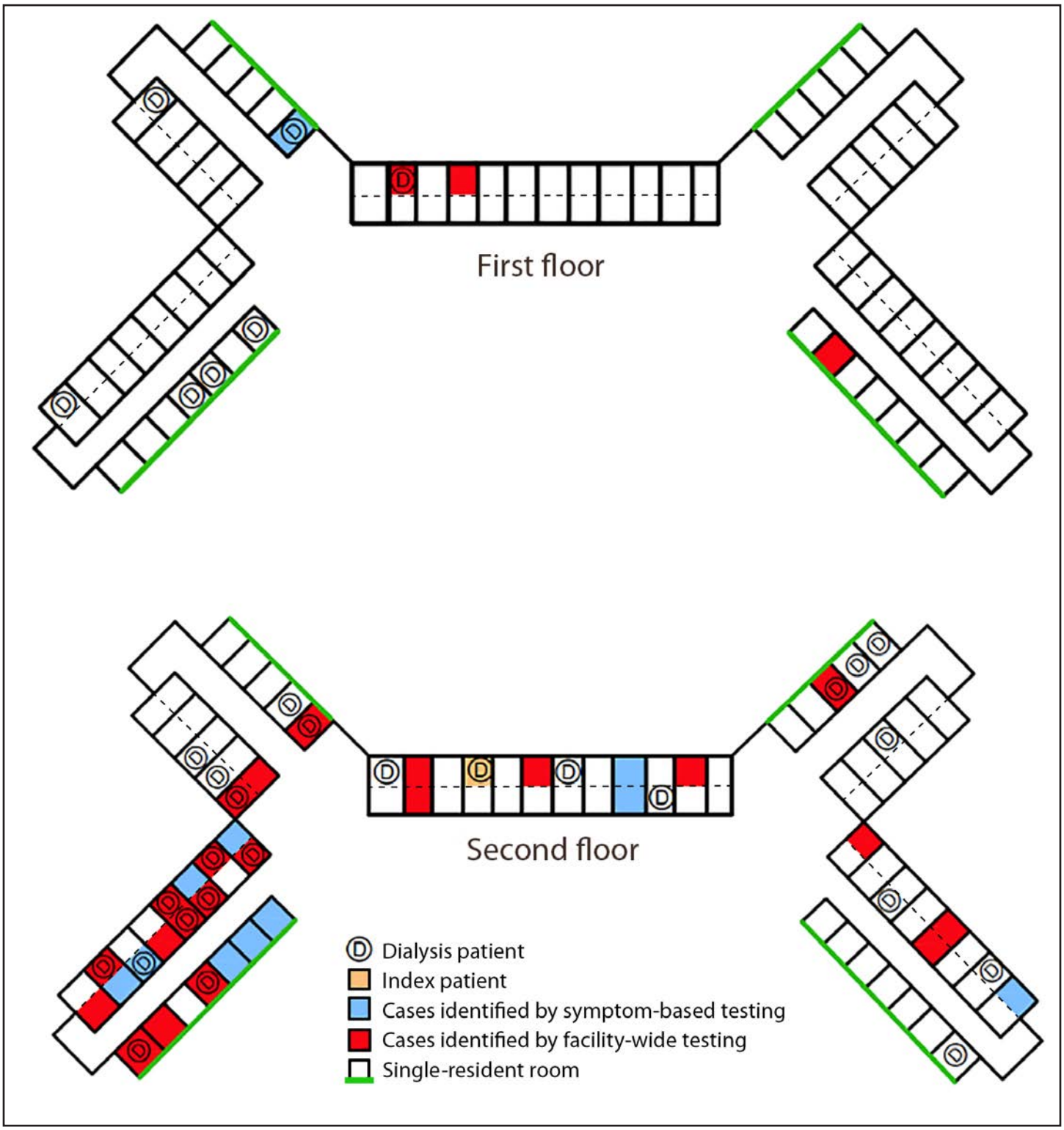
conditions, many of which have been associated with more severe SARS-CoV-2 infections, including diabetes mellitus, hypertension, and heart disease (*5*,*6*). This population might also be more frequently exposed to persons outside the nursing home, including community dialysis patients and dialysis center staff members.

Identifying the definitive source for this outbreak or tracing the chain of subsequent transmission was not possible. For example, many residents receiving dialysis were housed on the second floor of the nursing home, and transmission might have occurred within the nursing home, at the dialysis center, or during transportation between the two locations (e.g., in the closed confines of an elevator). Given that shifts overlapped appointment times at the dialysis center, before their dialysis appointments residents might spend time in a waiting area where additional exposures might occur. Further, whereas the first identified cases occurred among residents who were

TABLE. Number of residents who had positive test results for SARS-CoV-2 RNA among facility A residents (N = 170), overall and by residence floor and dialysis schedule — Maryland, April 16–30, 2020

Characteristic	No. of residents	No. (%) of cases
Dialysis status, all residents		
Not receiving dialysis	138	22 (16)
Receiving dialysis	32	15 (47)
Facility residence (residents receiving dialysis only)		
First floor	7	2 (29)
Second floor	25	13 (52)
Dialysis schedule		
Monday/Wednesday/Friday	19	9 (47)
Shift 1	4	0 (0)
Shift 2	3	1 (33)
Shift 3	12	8 (67)
Tuesday/Thursday/Saturday	13	6 (46)
Shift 1	6	3 (50)
Shift 2	6	2 (33)
Shift 3	1	1 (100)

FIGURE 2. Distribution of COVID-19 cases among facility A residents receiving or not receiving dialysis, by floor* — Maryland, April 2020



Abbreviations: COVID-19 = coronavirus disease 2019; D = room of resident receiving dialysis.

* All dialysis treatments were completed in the dialysis center, which was co-located on site. Symptom-based testing referred to targeted testing of residents who were experiencing at least one of the following symptoms: fever >99°F (37.2°C), cough, malaise, headache, or upper respiratory symptoms. Facility-wide testing refers to the testing of all facility A residents who had not previously had test results positive for SARS-CoV-2, regardless of symptoms.

receiving dialysis, given the COVID-19 incubation period of up to 14 days and delayed testing among other residents and staff members, the definitive source of introduction remains unclear. The prevalence of asymptomatic infections poses additional challenges to identifying the source of introduction and tracing transmission through the facility (*7*,*8*).

The findings in this report are subject to at least three limitations. First, no observations of infection control and prevention practices were conducted in the dialysis center, limiting the ability to identify breaches that might have contributed to transmission. Second, the impact of residents leaving the facility for other medical appointments was not assessed. Finally, because of limited testing capacity, testing for all asymptomatic staff members in the nursing home was not performed, and records of activities for infected staff members were not available.

Effective and continual communication between dialysis centers and nursing homes is important to preventing SARS-CoV-2 transmission. If nursing homes rapidly notify dialysis centers of residents who have positive test results and those with suspected infection, dialysis centers can cohort residents (e.g., inform recommended use of personal protective equipment and provide dialysis for residents with positive test results during last shift of day with terminal cleaning) and limit exposure to others in the dialysis center (*9*). Likewise, if dialysis centers notify the nursing home in a timely manner of any community dialysis patients or dialysis staff members who had positive test results, nursing homes can perform facility-wide testing to detect asymptomatic cases and take recommended precautions (e.g., placing all exposed patients in quarantine) (*9*). Dialysis centers and nursing homes might benefit from closely reviewing the entire dialysis process, from residents leaving the facility to discharging them after dialysis, to identify practices that could contribute to SARS-CoV-2 transmission. Nursing homes might consider placing residents who undergo dialysis in single rooms close to the dialysis center with increased monitoring given their higher risk for infection. Dialysis centers and nursing homes are closely connected with a shared patient population; therefore, early identification of cases coupled with aggressive infection prevention and control actions are needed to protect medically vulnerable populations in both locations.

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Corresponding author: Benjamin F. Bigelow, benbigelow@jhmi.edu.

Summary

What is already known about this topic?

Residents of long-term care facilities have high COVID-19–associated morbidity and mortality. More information is needed about SARS-CoV-2 introduction and transmission in nursing homes.

What is added by this report?

Investigation of a COVID-19 outbreak in a Maryland nursing home identified a significantly higher prevalence among residents receiving dialysis (47%) than among those not receiving dialysis (16%); 72% were asymptomatic at the time of testing.

What are the implications for public health practice?

Nursing home residents undergoing dialysis might be at a higher risk for SARS-CoV-2 infection because of exposures to staff members and community dialysis patients. Attention to infection control practices and surveillance in nursing homes and dialysis centers is critical to preventing nursing home COVID-19 outbreaks.

[1]Department of Medicine, Johns Hopkins University School of Medicine, Baltimore, Maryland; [2]Division of Population Health and Disease Prevention, Baltimore City Health Department, Baltimore, Maryland; [3]CDC COVID-19 Response Team.

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Facility-Wide Testing for SARS-CoV-2 in Nursing Homes — Seven U.S. Jurisdictions, March–June 2020

Kelly M. Hatfield, MSPH[1]; Sujan C. Reddy, MD[1]; Kaitlin Forsberg, MPH[1]; Lauren Korhonen, MSPH[1]; Kelley Garner, MPH[2]; Trent Gulley, MPH[2]; Allison James, DVM, PhD[2]; Naveen Patil, MD[2]; Carla Bezold, ScD[3]; Najibah Rehman, MD[3]; Marla Sievers, MPH[4]; Benjamin Schram, MPH[5]; Tracy K. Miller, PhD[5]; Molly Howell, MPH[5]; Claire Youngblood, MA[6]; Hannah Ruegner, MPH[6]; Rachel Radcliffe, DVM[6]; Allyn Nakashima, MD[7]; Michael Torre, PhD[7]; Kayla Donohue, MPH[8]; Paul Meddaugh, MS[8]; Mallory Staskus, MS[8]; Brandon Attell, MA[1]; Caitlin Biedron, MD[1]; Peter Boersma, MPH[1]; Lauren Epstein, MD[1]; Denise Hughes[1]; Meghan Lyman, MD[1]; Leigh E. Preston, DrPH[1]; Guillermo V. Sanchez, MSHS, MPH[1]; Sukarma Tanwar, MMed[1]; Nicola D. Thompson, PhD[1]; Snigdha Vallabhaneni, MD[1]; Amber Vasquez, MD[1]; John A. Jernigan, MD[1]

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Undetected infection with SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19) contributes to transmission in nursing homes, settings where large outbreaks with high resident mortality have occurred (*1*,*2*). Facility-wide testing of residents and health care personnel (HCP) can identify asymptomatic and presymptomatic infections and facilitate infection prevention and control interventions (*3*–*5*). Seven state or local health departments conducted initial facility-wide testing of residents and staff members in 288 nursing homes during March 24–June 14, 2020. Two of the seven health departments conducted testing in 195 nursing homes as part of facility-wide testing all nursing homes in their state, which were in low-incidence areas (i.e., the median preceding 14-day cumulative incidence in the surrounding county for each jurisdiction was 19 and 38 cases per 100,000 persons); 125 of the 195 nursing homes had not reported any COVID-19 cases before the testing. Ninety-five of 22,977 (0.4%) persons tested in 29 (23%) of these 125 facilities had positive SARS-CoV-2 test results. The other five health departments targeted facility-wide testing to 93 nursing homes, where 13,443 persons were tested, and 1,619 (12%) had positive SARS-CoV-2 test results. In regression analyses among 88 of these nursing homes with a documented case before facility-wide testing occurred, each additional day between identification of the first case and completion of facility-wide testing was associated with identification of 1.3 additional cases. Among 62 facilities that could differentiate results by resident and HCP status, an estimated 1.3 HCP cases were identified for every three resident cases. Performing facility-wide testing immediately after identification of a case commonly identifies additional unrecognized cases and, therefore, might maximize the benefits of infection prevention and control interventions. In contrast, facility-wide testing in low-incidence areas without a case has a lower proportion of test positivity; strategies are needed to further optimize testing in these settings.

CDC compiled data from seven state or local health departments that conducted facility-wide testing in nursing homes. Testing of specimens (i.e., from the nasopharynx or anterior nares) for SARS-CoV-2 was performed using reverse transcription–polymerase chain reaction (RT-PCR) testing; one health department also used point-of-care testing with Abbott ID Now (Abbott Diagnostics, Inc.). Two health departments conducted initial facility-wide testing in all nursing homes in the state (i.e., statewide testing strategy). Five health departments targeted initial facility-wide testing to facilities with a newly reported case in a resident or HCP (i.e., targeted testing strategy). Five nursing homes were included because of high COVID-19 incidence in the surrounding county or a neighboring nursing home outbreak. For each testing event, all orally consenting residents and HCPs (*6*) at a facility were tested. Results are reported at the individual level, thus if a resident or HCP had more than one positive test result, they were only included once.

Because testing strategies varied by health department, data were aggregated according to testing strategy. Results were stratified by resident and HCP status when possible. County-level cumulative COVID-19 incidence for the 14 days preceding testing was calculated for each facility, using information from USAFacts.* For facilities using the targeted testing strategy, a linear generalized estimating equation (GEE) was used to estimate the association between the number of days from identification of the first COVID-19 case in the nursing home until completion of the facility-wide testing and the cumulative number of persons with positive SARS-CoV-2 test results, adjusting for the number of persons tested and the surrounding county incidence. For a subset of 62 facilities using the targeted strategy with data on resident and HCP status, a GEE model was used to describe the relationship between the cumulative number of residents and HCP with positive SARS-CoV-2 test results at completion of the initial testing, adjusting for the number of residents and HCP tested and the county incidence. Models were fitted using GEE with an exchangeable correlation structure that accounted for clustering within jurisdictions (*7*). In the statewide testing strategy group, associations were assessed between the COVID-19 incidence in the surrounding county and the odds of identifying any cases at each facility testing event, adjusted for the number of persons tested in

* https://usafacts.org/visualizations/coronavirus-covid-19-spread-map/.

all facilities that did not have previous cases. Logistic GEE models with an exchangeable correlation structure accounting for clustering by jurisdiction (*7*) were fitted. The role of facility size was not assessed, but in the multivariable models, adjustment was made for the number of persons who received testing as a proxy for facility size. All analyses were conducted using SAS (version 9.4; SAS Institute); statistical significance was assessed using $p<0.05$. This investigation was deemed not human subjects research under Department of Health and Human Services, Title 45 Code of Federal Regulations 46, Protection of Human Subjects.

Overall, seven health departments provided data from 288 nursing homes that conducted initial facility-wide testing during March 24–June 14 (Table 1). Health departments reported turnaround times ranging from 1 to 7 days from testing until receipt of results.

Five health departments using the targeted testing strategy (Arkansas; Detroit, Michigan; New Mexico; Utah; and Vermont) tested 93 nursing homes, and in 79% of those, new COVID-19 cases were detected (median = 6 new cases, interquartile range = 1–21). In these 93 nursing homes, 13,443 persons were tested, and 1,619 (12%) had positive SARS-CoV-2 test results. Among the 93 nursing homes, 88 (95%) had a documented COVID-19 case before testing; the number of days between identification of the first case and the completion of facility-wide testing ranged from 1 to 41 days (median = 7 days). Population average estimates from regression analyses suggested that each additional day

TABLE 1. Characteristics of nursing homes that completed facility-wide testing for SARS-CoV-2, by testing strategy and health department (N = 288) — seven state and local health department jurisdictions, United States, March 24–June 14, 2020

	Targeted testing strategy*					Statewide testing strategy*	
Characteristic	Arkansas	Detroit, Michigan†	New Mexico	Utah	Vermont	North Dakota	South Carolina
No. of nursing homes	29	26	16	16	6	50	145§
No. of counties represented	19	1	8	4	4	33	41
No. (%) of known COVID-19 cases before facility-wide testing	29 (100)	26 (100)	11¶ (69.0)	16 (100)	6 (100)	11 (22.0)	59 (41.0)
No. of patients tested	5,039	2,550	3,139	2,227	488	8,728	28,737
No. (%) of cases after facility-wide testing	184 (3.7)	1,048 (41.1)	166 (5.3)	149 (6.7)	72 (14.8)	93 (1.1)	333 (1.1)
No. of persons tested per facility, median (range)	159 (83–349)	94.5 (44–161)	194 (71–322)	92 (15–436)	74 (22–150)	126 (29–504)	186 (20–792)
No. of cases per facility before facility-wide testing, median (range)	2 (1–15)**	12.5 (2–32)	1 (0–21)	2 (1–10)	1 (1–30)	Unknown	Unknown
No. cases per facility at completion of facility-wide testing, median (range)	2 (1–52)	35 (14–99)	2.5 (0–51)	6.5 (1–33)	2 (1–51)	0 (0–19)	0 (0–45)
Dates of 2020 facility-wide testing completion, range (span, days)	Mar 24–Apr 26 (33)	Apr 16–Apr 25 (9)	Apr 2–May 5 (33)	Mar 31–Jun 14 (75)	Mar 30–Apr 22 (23)	Apr 10–Jun 4 (24)	May 4–Jun 5 (32)
Days from first case to testing per facility, median (range)	5 (1–17)	32 (20–41)	8 (1–17)	4 (1–12)	6 (2–18)	5 (4–32)††	30 (1–66)
Incidence§§ per facility in surrounding county, median (IQR)	28 (13–52)	282 (280–322)	43 (32–117)	91 (57–100)	72 (64–105)	19 (0–38)	38 (21–72)

Abbreviation: COVID-19 = coronavirus disease 2019; IQR: interquartile range.

* Targeted testing strategy represents health departments that performed facility-wide testing of residents and health care personnel in response to a known or suspected case. Statewide testing strategy represents health departments that conducted facility-wide testing statewide.

† Health care personnel data were not available from the Detroit Health Department for this analysis. The Detroit Health Department used the Abbot ID Now (Abbott Diagnostics, Inc.) for some tests reported; all others used reverse transcription–polymerase chain reaction testing.

§ Persons in 194 nursing homes received testing as part of statewide testing efforts; 145 nursing homes included in this analysis had reported complete aggregate data to their respective health department as of July 14, 2020.

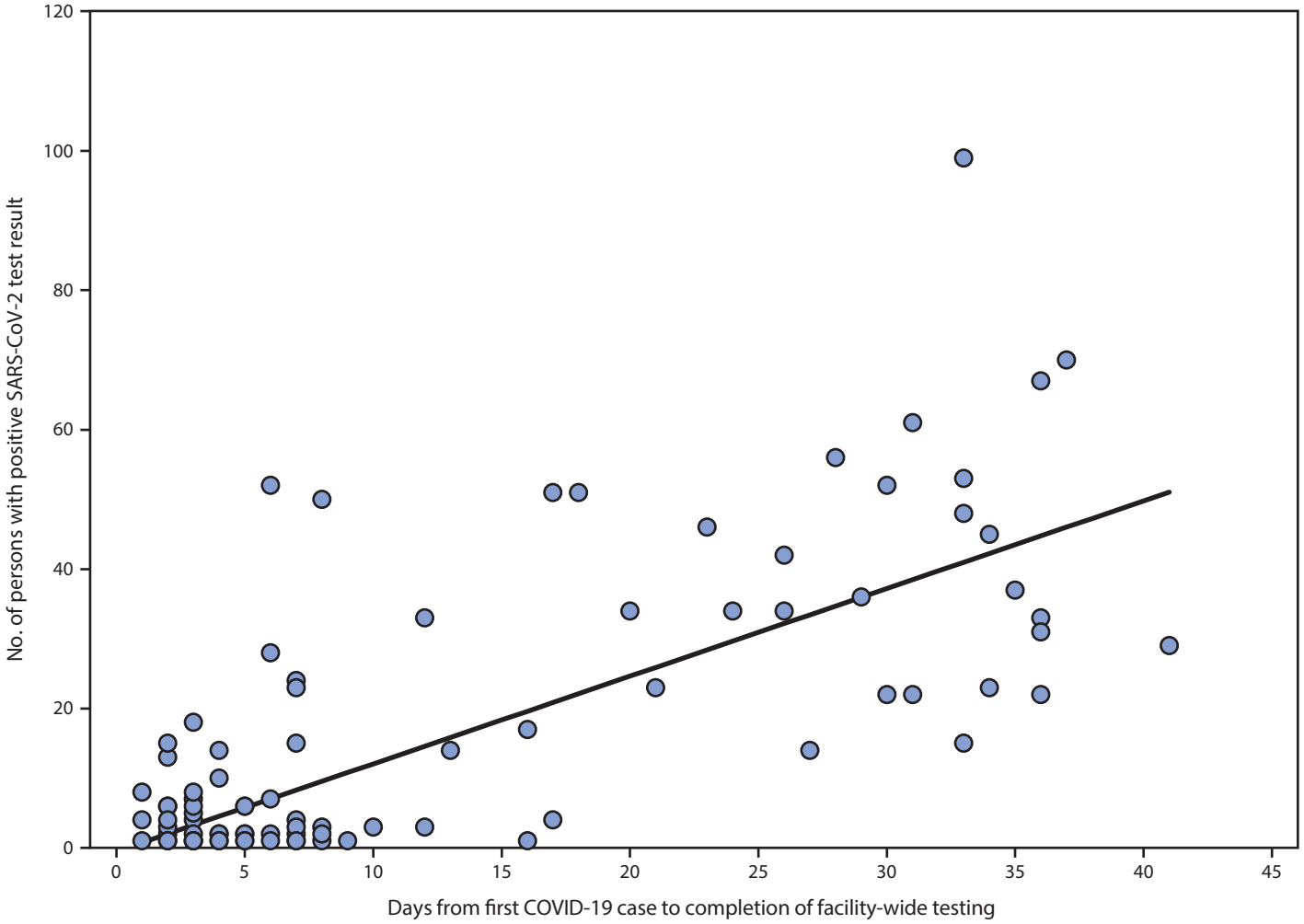
¶ Eleven nursing homes conducted testing in response to a known case; five nursing homes performed testing in response to high county incidence or nearby outbreaks (no previously identified cases of coronavirus disease 2019 [COVID-19] in that nursing home).

** Number of cases before the facility-wide testing was unknown for four facilities.

†† Unknown for eight of 11 nursing homes with known cases of COVID-19 before facility-wide testing.

§§ The cumulative number of new cases in the county per 100,000 population in the 14 days before the facility-wide testing. Data from USAfacts (https://usafacts.org/) was used to calculate county incidence.

FIGURE. Association between total number of persons with positive SARS-CoV-2 test results after facility-wide testing and number of days from first case identification until completion of facility-wide testing* — five state and local health department jurisdictions,† United States, March–June 2020



Abbreviation: COVID-19 = coronavirus disease 2019.

* The parameter estimate, based on generalized estimating equations modeling the relationship of days from first case of COVID-19 in a nursing home to completion of facility-wide testing, was 1.3 (95% CI = 1.0–1.5) and was adjusted for the surrounding county incidence and the total number of persons tested during facility-wide testing. This parameter was separately estimated excluding facilities in Detroit, which used the Abbot ID Now platform and produced similar results (parameter estimate = 1.3; 95% CI = 0.6–2.0). All other sites used reverse transcription–polymerase chain reaction testing.

† The five jurisdictions (Arkansas; Detroit, Michigan; New Mexico; Utah, and Vermont) used a targeted testing strategy.

from case identification to facility-wide testing was associated with identification of 1.3 additional cases (Figure). Among 62 facilities for which resident and HCP results could be differentiated, a linear association was found between the number of residents and HCP who had positive SARS-CoV-2 testing results ($p<0.001$): an estimated 1.3 cases among HCP were identified for every three resident cases. In 45 (73%) of these facilities with at least one resident with test results positive for SARS-CoV-2, an average of 5.2% HCP who were tested had positive test results (range = 0%–26%).

The two health departments using a statewide testing strategy (North Dakota and South Carolina) conducted facility-wide testing in 195 nursing homes in low-incidence areas (i.e., the median preceding 14-day cumulative incidence in the surrounding county for each jurisdiction was 19 and 38 cases per 100,000 persons). Seventy (36%) of the 195 nursing homes had reported one or more residents or HCP with positive SARS-CoV-2 test results before the testing event, whereas 125 (64%) had not reported cases. Among 22,977 persons tested at the 125 nursing homes that had not reported cases, 95 (0.4%) had positive test results; 29 (23%) facilities each identified one to 25 cases, including 23 (18%) with one to three cases, and six (5%) with four or more cases. Multivariable models found no association between the cumulative county incidence and the odds of identifying a case among these 125 nursing homes ($p = 0.67$). Within the 70 nursing homes that reported cases in residents or HCP before the facility-wide testing, 14,488 persons were tested, and 331 (2%) had a positive

result. For 62 facilities with available data, the number of days between identification of the first case and the facility-wide testing ranged from 1 to 66 days (median = 29.5 days). However, the cumulative number of cases was not available. Among the 70 facilities, 41 (59%) identified one to 45 cases, including 21 (30%) that identified one to three cases and 20 (29%) that identified four or more cases.

With both testing strategies, the mean number of cases identified in nursing homes was higher among those with at least one resident case identified before the facility-wide testing (25.7 among those using a targeted testing strategy, 7.3 among those using a statewide testing strategy), compared with those that had previously identified only HCP cases (3.5 and 0.3, respectively) or had no known cases before the testing (0.8 and 0.4, respectively) ($p<0.001$) (Table 2).

Discussion

Facility-wide testing of residents and HCP in nursing homes can provide important insights into the epidemiology of SARS-CoV-2 transmission and permit early identification of cases to guide infection prevention and control interventions. Conducting facility-wide testing as soon as possible after identifying a case of COVID-19 offers advantages over other approaches. First, previously undetected cases can be identified; these data indicate that 79% of testing events performed in response to a known case identified unrecognized cases. Second, testing as soon as possible after identifying an initial case was associated with identification of fewer cases and might improve the feasibility and effectiveness of cohorting (i.e., designating a location and HCP exclusively for care of residents with COVID-19) and other isolation strategies aimed at interrupting transmission (*8*). For these reasons, testing of all residents and HCP in a nursing home with efficient turnaround time is recommended as soon as possible after identifying a new COVID-19 case (*6*,*9*).

An association was found between infections in residents and infections in HCP, and the prevalence of infections among HCP was often higher than expected given results of community serosurveys in low-incidence settings, raising the possibility that infections in HCP might be occurring in the workplace (*10*). Transmission likely occurred between residents and HCP and among HCP, highlighting the importance of testing both residents and HCP to detect virus transmission and the need for more effective interventions to prevent transmission among HCP working in nursing homes.

Testing guidance for nursing homes has suggested baseline testing of all residents and serial testing of HCP as part of the "reopening process" (e.g., the relaxing of restrictions) (*6*,*8*). In low-incidence areas a large number of tests was needed to identify a few cases (0.4% persons with positive test results in places that had never had a COVID-19 case). In facilities without known COVID-19 cases, strategies to improve testing efficiency might focus on populations at highest risk for acquisition (e.g., HCP living in high-incidence areas or residents who might have been recently exposed during hospitalization or dialysis treatments). Other methods to improve efficiency might include point-of-care testing with rapid turnaround time, sample pooling, self-collection of samples (e.g., saliva or anterior nares swabs), or wastewater surveillance.

The findings in this report are subject to at least four limitations. First, symptoms at the time of testing were not systematically collected; thus, determining what proportion of cases might have been identified using symptom screening methods is not possible. Second, it was not possible to describe variations in infection prevention and control, other interventions that might affect COVID-19 spread, or follow-up over time. The full effectiveness of facility-wide testing (and total number of cases identified) might only be known through follow-up testing. Cases might be missed if the patient was no longer shedding virus, still incubating disease, or if less sensitive tests, such as point-of-care tests, are used. In this report, one health department used the less sensitive Abbott ID Now for some testing; however, findings were consistent when excluding that jurisdiction's data.[†] Third, the estimates of the relationship between cases identified and delays in conducting testing might only be relevant for the period examined (i.e., 1–41 days); this relationship might not be valid for longer delays as the number of persons susceptible to infection decreases. Finally, health departments contributing statewide testing data had a relatively low community incidence at time of testing; findings from jurisdictions with a higher community incidence might differ.

These observations from facility-wide testing in nursing homes in seven U.S. health jurisdictions can inform use of test-based prevention strategies in these settings. Facility-wide testing after identification of an index case might maximize the benefits of infection prevention and control interventions by enabling early identification of unrecognized cases, cohorting and isolation of resident cases, and exclusion of infected HCP from the workplace through nonpunitive sick-leave policies. Facility-wide testing in low-incidence areas without a case has a lower proportion of test positivity; strategies are needed to optimize testing in these nursing homes. State and local health departments need to take steps to ensure that nursing homes have the resources necessary to rapidly perform facility-wide testing among residents and HCP after identification of a case.

[†] When excluding nursing homes from Detroit, which used Abbot ID Now for testing, the findings that for each additional day before completion of an initial facility-wide testing, 1.3 additional cases were identified and that the mean number of persons who had positive test results at the completion of facility-wide testing was highest among facilities with one or more resident cases before the testing event were consistent.

TABLE 2. Number of COVID-19 cases identified in nursing homes that conducted facility-wide SARS-CoV-2 testing as part of a statewide strategy targeting all nursing homes (statewide strategy) and those that conducted facility-wide testing only after identification of a known or suspected case (targeted strategy), by resident or health care provider cases identified before facility-wide testing — seven state and local health department jurisdictions, United States, March–June, 2020

Types of cases known before testing	Statewide testing strategy*			Targeted testing strategy†		
	No. of nursing homes§	No. of persons with positive test results¶		No. of nursing homes**	No. of persons with positive test results¶	
		Mean (SD)	Range		Mean (SD)	Range
One or more residents	35	7.3 (11.2)	0–45	59	25.7 (21.9)	1–99
Health care personnel only	22	0.3 (0.6)	0–2	22	3.5 (3.2)	1–13
No cases known	125	0.8 (2.7)	0–25	5	0.4 (0.9)	0–2

Abbreviations: COVID-19 = coronavirus disease 2019; SD = standard deviation.
* Conducted in two health department jurisdictions (North Dakota and South Carolina).
† Conducted in five health department jurisdictions (Arkansas; Detroit, Michigan; New Mexico; Utah; and Vermont).
§ Thirteen nursing homes from the statewide strategy are excluded because the quantification of health care personnel cases and resident cases before the facility-wide testing was not possible.
¶ At completion of facility-wide testing.
** Seven nursing homes from the targeted strategy are excluded because the quantification of health care personnel cases and resident cases before the facility-wide testing was not possible.

[1]CDC COVID-19 Response Team; [2]Arkansas Department of Health; [3]Detroit Health Department, Detroit, Michigan; [4]New Mexico Department of Health; [5]North Dakota Department of Health; [6]South Carolina Department of Health and Environmental Control; [7]Utah Department of Health; [8]Vermont Department of Health.

Corresponding author: Kelly M. Hatfield, khatfield2@cdc.gov.

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Summary

What is already known about this topic?

Facility-wide testing of health care personnel and nursing home residents for SARS-CoV-2 can inform strategies to prevent transmission.

What is added by this report?

In two health department jurisdictions, testing in facilities without a previous COVID-19 case identified a prevalence of 0.4%. Five health department jurisdictions that targeted facility-wide testing after identification of a case found a prevalence of 12%; for each additional day before completion of initial facility-wide testing, an estimated 1.3 additional cases were identified.

What are the implications for public health practice?

Performing facility-wide testing rapidly following identification of a case in a nursing home might facilitate control of transmission among residents and health care personnel. Strategies are needed to optimize facility-wide testing in nursing homes without a reported case.

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Notes from the Field

Seroprevalence Estimates of SARS-CoV-2 Infection in Convenience Sample — Oregon, May 11–June 15, 2020

Melissa Sutton, MD[1]; Paul Cieslak, MD[1]; Meghan Linder, MPH[1]

The first known case of coronavirus disease 2019 (COVID-19) in Oregon was diagnosed on February 28, 2020. Through May 31, a total of 4,243 COVID-19 cases in Oregon were confirmed by nucleic acid testing for SARS-CoV-2, the virus that causes COVID-19, yielding a cumulative COVID-19 incidence of approximately 0.1%.* Because this rate does not account for persons who were infected but did not seek testing (e.g., those with asymptomatic or mildly symptomatic infections), persons who chose not to be tested, or persons unable to access testing, the rate is believed to be lower than the true cumulative COVID-19 incidence in the state. A population-based seroprevalence survey can provide estimates of the cumulative incidence of infection more accurately than does nucleic acid testing by identifying additional persons who have had previous infections with SARS-CoV-2 but were not reported as COVID-19 cases. Seroprevalence estimates from several states and geographic areas within the United States vary from 1.0% to 6.9% (*1*–*4*). No seroprevalence estimates for SARS-CoV-2 infection are yet available for Oregon.

To estimate the seroprevalence of infection with SARS-CoV-2 in Oregon, a cross-sectional, population-based convenience sample for SARS-CoV-2 immunoglobulin G (IgG) antibody testing was collected from mid-May through mid-June, in alignment with the World Health Organization seroepidemiologic investigation protocol.† Eighty-six facilities participating in CDC's Influenza-like Illness Surveillance Network§ and Oregon's Electronic Surveillance System for the Early Notification of Community-based Epidemics¶ were randomized and approached sequentially with a goal of recruiting 18 facilities to provide 50 specimens each. Facilities were asked to submit random subsamples of deidentified sera from patients of all ages visiting any ambulatory, emergency, or inpatient health care setting and to include the specimen collection date and the patient's date of birth. Specimens were stored according to instructions provided by the test manufacturer and transported to the Oregon State Public Health Laboratory for testing with the Abbott Architect Laboratories SARS-CoV-2 IgG immunoassay. Abbott Laboratories (Abbott Park, Illinois) reports a sensitivity of 96.8% at ≥14 days after a positive polymerase chain reaction test result and specificity of 99.1%–100% (*1*). Results from actual use support the reported analytical performance of this test (*2*).

Although 18 facilities were initially recruited, another facility was added through the same sequential approach because one facility was only able to submit 15 specimens. The facilities' locations were approximately representative of the geographic distribution of Oregon's population. During May 11–June 15, 2020, a total of 898 venous specimens (average from each facility = 47; range = 15–50) were collected from the 19 facilities; one specimen was discarded because of a laboratory error. This activity was reviewed by CDC and was conducted consistent with CDC policies and procedures, and institutional review board clearance was not required.** Stata (version 15.1; StataCorp) was used for all analyses.

Antibodies to SARS-CoV-2 were detected in nine of 897 specimens, yielding an unadjusted seroprevalence of 1.0% (95% confidence interval = 0.2%–1.8%). Antibodies were not detected in any specimens from the 29 persons aged ≤17 years. Seroprevalence generally increased with age (chi-squared test for trend, p = 0.049) (Table).

The estimated seroprevalence of SARS-CoV-2 antibodies in a convenience sample of adult Oregonians was approximately 10 times the measured cumulative COVID-19 incidence obtained by nucleic acid testing, consistent with results from seven other U.S. states and geographic areas (*4*). This convenience sample, obtained from patients interacting with health care systems throughout the state, is not necessarily generalizable to the entire state population. Limitations of seroprevalence testing include false positivity in settings of low background prevalence such as Oregon, lack of antibody development by some infected persons, and in others, waning of antibodies to undetectable levels. The data suggest that a substantial number of COVID-19 cases in Oregon have gone undiagnosed and not reported and that a large portion of Oregon's population remains susceptible to COVID-19 infection. Although the sample size was small, a pattern of increasing seroprevalence with age was observed. These findings are similar to those reported in a recent survey in neighboring Idaho (*1*). Follow-up surveillance studies are planned in Oregon to reassess cumulative incidence as the pandemic progresses.

* https://www.pdx.edu/prc/population-reports-estimates.
† https://apps.who.int/iris/bitstream/handle/10665/331656/WHO-2019-nCoV-Seroepidemiology-2020.1-eng.pdf?sequence=1&isAllowed=y.
§ https://www.cdc.gov/flu/weekly/overview.htm#anchor_1539281266932.
¶ https://www.oregon.gov/oha/PH/DiseasesConditions/CommunicableDisease/PreparednessSurveillanceEpidemiology/essence/Pages/index.aspx.

** U.S. Department of Health and Human Services, Title 45 Code of Federal Regulations 46, Protection of Human Subjects.

TABLE. Estimated seroprevalence of SARS-CoV-2 IgG antibodies among a convenience sample of deidentified serum specimens from 19 facilities participating in the Influenza-like Illness Surveillance Network, by age group* — Oregon, May 11–June 15, 2020

		SARS-CoV-2 IgG-positive†	
Age group (yrs)	No. samples tested	No.	% (95% CI)
0–4	5	0	0 (0–52)
5–17	24	0	0 (1–14)
18–49	274	1	0.4 (0–2.0)
50–64	211	1	0.5 (0–2.6)
65–74	178	3	1.7 (0.3–4.8)
75–84	144	3	2.1 (0.4–6.0)
≥85	61	1	1.6 (0–8.8)
Total	**897**	**9**	**1.0 (0.2–1.8)**

Abbreviations: CI = confidence interval; IgG = immunoglobulin G.

* Seroprevalence generally increased with age (chi-square test for trend, p = 0.049).

† Abbott Architect Laboratories SARS-CoV-2 IgG immunoassay. Abbott Laboratories (Abbott Park, IL) reports a sensitivity of 96.8% at ≥14 days after a positive polymerase chain reaction test result and specificity of 99.1%–100%.

Corresponding author: Melissa Sutton, Melissa.Sutton@dhsoha.state.or.us.

[1]Public Health Division, Oregon Health Authority.

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Notes from the Field:

Emergency Visits for Complications of Injecting Transmucosal Buprenorphine Products — United States, 2016–2018

Sukarma Tanwar, MMed[1,2]; Andrew I. Geller, MD[2]; Maribeth C. Lovegrove, MPH[2]; Daniel S. Budnitz, MD[2]

The opioid partial agonist buprenorphine is a critical component of medication-assisted treatment for opioid use disorder and is associated with improved treatment adherence and decreased illicit opioid use (*1*). Combination buprenorphine/naloxone transmucosal products are designed to deter injection owing to the opioid-antagonist actions of naloxone and can reduce the desired effects and precipitate rapid withdrawal when these products are administered intravenously; nonetheless, injection of transmucosal buprenorphine/naloxone has been reported (*2*,*3*). During 2016–2017, 14.6% of approximately 127,000 emergency department (ED) visits for nonmedical use* of prescription opioids involved buprenorphine products, commonly for injection-related complications (*4*). ED visits for nonmedical use of buprenorphine involved less severe overdose morbidity (e.g., unresponsiveness or cardiorespiratory failure) than did those involving other opioids (*4*). Complications of injecting transmucosal buprenorphine products represent a potentially preventable source of morbidity from nonmedical use of buprenorphine. Further description of complications related to buprenorphine injection can help prevent these complications while preserving access to this effective therapy for opioid use disorder.

During 2016–2018, among ED visits tracked by the National Electronic Injury Surveillance System-Cooperative Adverse Drug Event Surveillance project, a nationally representative active public health surveillance system (*5*), 598 cases of nonmedical injection of prescription opioids were identified by record review. CDC used these cases to derive an estimate that an average of 47,437 (95% confidence interval [CI] = 27,004–67,871) ED visits for nonmedical injection of prescription opioids occurred in the United States annually. Of these ED visits involving nonmedical injection of prescription opioids, approximately one third (34.2%; 95% CI = 19.3%–56.1%) involved transmucosal buprenorphine products.

Among estimated ED visits for nonmedical injection of transmucosal buprenorphine, mean patient age was 33 years (range = 20–56 years), and two thirds (66.0%; 95% CI = 60.9%–71.0%) of patients were men. ED visits for nonmedical injection of transmucosal buprenorphine usually involved a transmucosal buprenorphine/naloxone combination product (85.4% [95% CI = 76.3%–94.5%] of estimated visits). An estimated two thirds (66.0%; 95% CI = 43.0%–89.0%) of buprenorphine nonmedical injection visits resulted in the patient being treated and released or leaving against medical advice. Concurrent use of nonpharmaceutical substances (e.g., heroin, cocaine) was documented in approximately one third (31.6%; 95% CI = 21.7%–41.6%) of estimated visits for nonmedical injection of buprenorphine.

Injection-specific complications were documented in an estimated two thirds (67.2%; 95% CI = 53.7%–80.6%) of buprenorphine nonmedical injection ED visits. Among 101 ED surveillance cases of visits for buprenorphine nonmedical injection-specific complications, those reported included abscess (37), cellulitis (41), infective endocarditis (two), sepsis (two), septic arthritis (two), unspecified injection-site infections (e.g., "hand infection" not further specified) (three), and noninfectious injection-specific complications (e.g., injection site thrombosis/ischemia) (14). The national estimates likely represent an undercount of the true number of visits for injection-related complications because patients might not disclose injections, and secondary chronic infections (e.g., human immunodeficiency virus or hepatitis C) might not be identified.

Buprenorphine treatment is an important component of the public health response to the opioid overdose epidemic. Patients evaluated in EDs and other settings with injection-related complications might be referred to syringe services programs, where available, and educated on infection prevention practices (*6*). Linking these patients to care for underlying substance use disorders and recovery support services might improve recovery rates. Counseling on risks of injecting buprenorphine could be incorporated into patient education regarding medication-assisted treatment and might reduce the frequency of injection complications.

* Nonmedical use included abuse (clinician diagnosis of abuse or documentation of recreational use), therapeutic misuse (documented therapeutic intent, but not used as directed; e.g., taking buprenorphine to self-treat withdrawal symptoms), or overdoses without documentation of therapeutic intent, self-harm, abuse, or misuse (e.g., patients who have documented overdoses but are unable or unwilling to describe the event).

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Corresponding author: Sukarma Tanwar, mgq3@cdc.gov, 678-431-9047.

[1]Epidemic Intelligence Service, CDC; [2]Division of Healthcare Quality Promotion, National Center for Emerging and Zoonotic Infectious Diseases, CDC.

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Notes from the Field:

Multidrug-Resistant Tuberculosis Among Workers at Two Food Processing Facilities — Ohio, 2018–2019

Amish Talwar, MD[1,2]; Rebekah Stewart, MSN, MPH[1]; Sandy P. Althomsons, MA, MHS[1]; Jessica Rinsky, PhD[3]; David A. Jackson, MD[2,3]; Maria E. Galvis[1]; Philip Graham[4]; Moises A. Huaman, MD[4]; James Karrer[5]; Karthik Kondapally, MBBS[6]; Sarah Mitchell, MS[6]; Jonathan Wortham, MD[1]; Sietske de Fijter, MS[6]

During 2018–2019, the Ohio Department of Health (ODH) reported three cases of multidrug-resistant tuberculosis (MDR TB)* in persons who worked in two food processing facilities. The National Tuberculosis Molecular Surveillance Center† performed whole genome sequencing of a *Mycobacterium tuberculosis* isolate from each patient; phylogenetic analysis revealed the isolates were genetically identical. Prompted by concern for MDR TB transmission associated with these workplaces and surrounding communities, ODH began an investigation in February 2019. CDC was invited to assist with the investigation and deployed a team to Ohio on April 14, 2019.

The CDC-ODH team, which included representatives from CDC's Division of Tuberculosis Elimination and the National Institute for Occupational Safety and Health (NIOSH), reviewed medical and employment records, conducted principal informant interviews, and conducted a tour of one of the facilities (facility A) where the three patients worked. The third patient also worked at a second facility (facility B), which had closed as part of an unrelated business restructuring before the CDC-ODH team could begin its investigation; facility A remained operational throughout the investigation. A separate NIOSH team had visited facility B before it closed to conduct a health hazard evaluation following notification that one the facility's employees had MDR TB; observations from that visit were used to guide the exposure assessment of facility B employees. The index case occurred in a person born in one of the 30 countries designated by the World Health Organization as having a high prevalence of MDR TB (*1*). According to available work schedules, during the index patient's infectious period, the second and third patients had worked for at least 54 days and 7 days,§ respectively, on the same food production line as the index patient. The investigation team was unable to find any other potential transmission venues or common exposures among the three patients.

No additional cases of MDR TB related to this group of patients were identified. However, 971 contacts of the three MDR TB patients were identified, including 941 who were workplace contacts; the majority of contacts were non–U.S.-born persons. Contacts were prioritized according to levels of possible TB exposure; 478 contacts, including 448 workplace and 30 personal contacts, had the highest risk of exposure (high-priority contacts).¶ As of April 26, 2019, a total of 160 (36%) of the 448 high-priority workplace contacts had been tested for TB infection, 59 (37%) of whom had positive results for a tuberculin skin test or interferon-γ release assay test, both of which test for TB infection. Among those with positive test results, 19 (32%) began latent tuberculosis infection treatment (Table). Among the overall U.S. population, an estimated 21% of non–U.S.-born persons have a positive tuberculin skin test in the United States, and 16% have a positive interferon-γ release assay result (*2*). The higher percentage of positive TB test results at the workplace provides evidence for likely workplace transmission. Based on principal informant interviews, likely contributors to the low level of TB testing and treatment for infection among contacts included difficulties in communication, perceived barriers to care, and mistrust of government authorities.

After the investigation concluded on April 26, 2019, all three patients with MDR TB disease had either recovered or were continuing to recover, and no additional cases have been identified. ODH continues to work with its local partners to facilitate TB testing and treatment of contacts with latent TB infection and to monitor for new cases.

MDR TB is rare in the United States (<3% of TB cases annually since 1993) (*3*,*4*); in 2018, there were 98 MDR TB cases in the United States out of a total of 9,025 TB cases (*5*). Although the TB transmission source for the index patient remains uncertain, the low prevalence of MDR TB in the United States and the absence of other genotype-matched TB cases in the national TB molecular surveillance database indicate that the patient was likely infected in the patient's country of origin. Given the nonspecific signs and symptoms of TB, health care providers should consider TB when examining persons with cough, chest pain,

* MDR TB is a form of tuberculosis caused by *M. tuberculosis* resistant to isoniazid and rifampin, two cornerstone drugs used in the first-line TB treatment regimen.
† https://www.cdc.gov/tb/topic/laboratory/default.htm.
§ These reflect minimum counts because complete daily employment records were unavailable.
¶ High-priority contacts include named contacts and workplace contacts with documented direct exposure to an MDR TB patient, health care workers with documented direct exposure to an MDR TB patient when the patient was contagious and not under airborne infection isolation, and contacts with risk factors for TB, such as human immunodeficiency virus infection, diabetes mellitus, end stage renal disease, or immunosuppression.

TABLE. Tuberculosis (TB) care cascade for high-priority* contacts of three patients with multidrug-resistant TB — Ohio, April 2019

Contact type	No. of high-priority contacts	No. (%) Tested†	Tested, with positive TB test result†	Tested, with positive TB test result and started on LTBI treatment
Workplace	448	160 (36)	59 (37)	19 (32)
Facility A	247	120 (49)	39 (33)	19 (49)
Facility B	201	40 (20)	20 (50)	0§ (0)
Personal¶	30	16 (53)	13 (81)	8 (62)
Total	**478**	**176 (37)**	**72 (41)**	**27 (38)**

Abbreviation: LTBI = latent tuberculosis infection.

* Includes named contacts and workplace contacts with documented direct exposure to a multidrug-resistant (MDR) TB patient, health care workers with documented direct exposure to an MDR TB patient when the patient was contagious and not under airborne infection isolation, and contacts with risk factors for TB, such as human immunodeficiency virus infection, diabetes mellitus, end stage renal disease, or immunosuppression.

† Includes five contacts who were tested with interferon-γ release assay (QuantiFERON-TB Gold In-Tube test), three of whom had positive test results (all personal contacts).

§ Initiation of treatment was pending drug-susceptibility testing results, as of April 26, 2019.

¶ Includes contacts who spent substantial time with patients at home.

hemoptysis, weight loss, fever, chills, night sweats, weakness, fatigue, or loss of appetite, especially when the person has TB risk factors, including birth in areas with high rates of TB.**,†† In addition, providers should consider prompt molecular detection of drug-resistance testing for TB patients with risk factors for drug-resistant TB.§§,¶¶ Finally, public health agencies need to facilitate engagement with communities with higher rates of TB to build trust, which is important for successful disease investigations. Activities might include communicating in a culturally sensitive manner with community members, offering patients incentives for getting tested or treated, providing transportation to clinics, using mobile clinics, and conducting communitywide education efforts.

** https://www.cdc.gov/tb/topic/basics/signsandsymptoms.htm.

†† https://www.cdc.gov/tb/topic/basics/risk.htm.

§§ Risk factors for drug-resistant TB include failure to adhere to or complete TB treatment, incorrect TB treatment (i.e., incorrect dose or length of treatment prescribed), prior TB treatment, residence in areas of the world where drug-resistant TB is common, and known contact with patients with drug-resistant TB.

¶¶ https://www.cdc.gov/tb/topic/drtb/default.htm.

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Corresponding author: Amish Talwar, atalwar@cdc.gov, 404-718-7207.

[1]Division of Tuberculosis Elimination, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, CDC; [2]Epidemic Intelligence Service, CDC; [3]National Institute for Occupational Safety and Health, CDC; [4]Hamilton County Public Health, Ohio; [5]Butler County General Health District, Ohio; [6]Ohio Department of Health.

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Erratum:

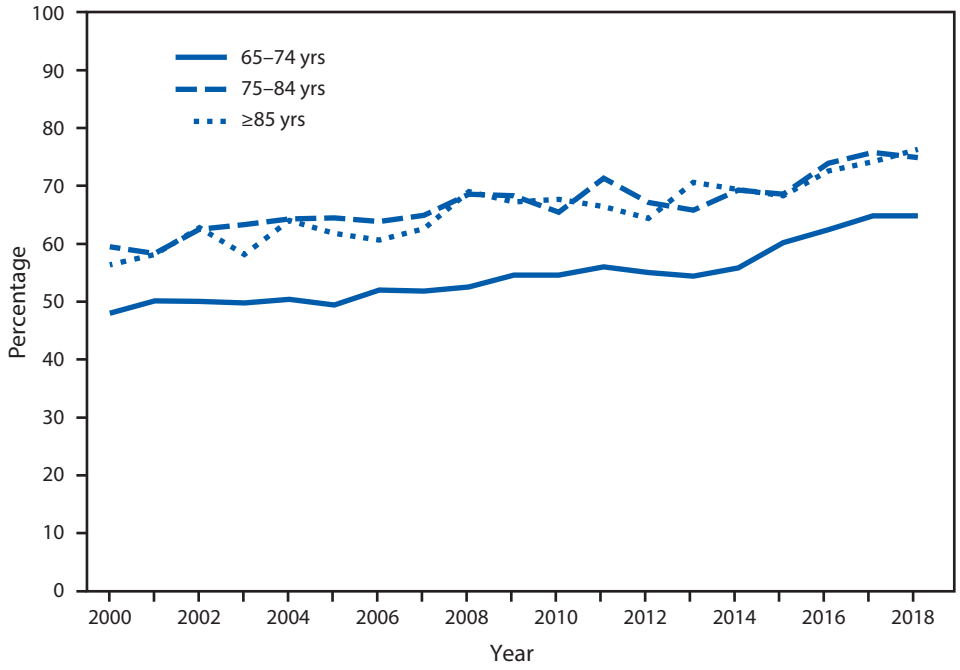
Vol. 69, No. 29

In the report, "Population Point Prevalence of SARS-CoV-2 Infection Based on a Statewide Random Sample — Indiana, April 25–29, 2020," on page 961, the sentence beginning at the bottom of the first column should have read "Statewide, 1.74% of persons (unweighted n = 47) had a positive RT-PCR test result (95% CI = 1.10%–2.54%), and 1.01% (95% CI = 0.76%– 1.45%) (unweighted n = 38) had samples that were seropositive, resulting in an estimated overall population SARS-CoV-2 prevalence of **current or previous** infection in Indiana of 2.79% (95% CI = 2.02%–3.70%)."

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage of Adults Aged ≥65 Years Who Had Ever Received Pneumococcal Vaccination,* by Age Group — National Health Interview Survey,† United States, 2000–2018



* Based on the survey question "Have you ever had a pneumonia shot? This shot is usually given only once or twice in a person's lifetime and is different from the flu shot. It is also called the pneumococcal vaccine." In 2000, the question wording included the following statement: "This shot is usually given only once in a person's lifetime and is different from the flu shot." Practice recommendations regarding who should receive pneumococcal vaccination and the types and number of vaccines have changed over time, and trends in vaccination receipt could reflect changes in recommendations.

† Estimates are based on household interviews of a sample of the civilian, noninstitutionalized U.S. population and are derived from the National Health Interview Survey Sample Adult component. Unknowns for vaccination status were not included in the denominators when calculating percentages.

During 2000–2018, the percentage of adults aged ≥65 years who had ever received a pneumonia vaccine increased. The percentage increased from 48.0% to 64.8% among adults aged 65–74 years, from 59.5% to 74.9% among adults aged 75–84 years, and from 56.4% to 76.3% among adults aged ≥85 years. Throughout the period, adults aged 65–74 years were less likely to have ever received a pneumonia vaccine than adults aged ≥75 years.

Source: National Health Interview Survey, 2000–2018. https://www.cdc.gov/nchs/nhis.htm.

Reported by: Ellen A. Kramarow, PhD, ekramarow@cdc.gov, 301-458-4325; Nazik Elgaddal, MS.

For more information on this topic, CDC recommends the following link: https://www.cdc.gov/vaccines/hcp/acip-recs/vacc-specific/pneumo.html.

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