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Prevalence of Self-Reported Hypertension and Antihypertensive Medication Use by County and Rural-Urban Classification — United States, 2017

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In 2017, approximately one in three U.S. adults reported having been told by a health care professional that they had high blood pressure (hypertension) (*1*). Although hypertension prevalence is well documented at national and state levels, less is known about rural-urban variation and county-level prevalence. To examine prevalence of self-reported hypertension and antihypertensive medication use by rural-urban classification and county, CDC analyzed data reported by 442,641 adults aged ≥18 years who participated in the 2017 Behavioral Risk Factor Surveillance System (BRFSS). In rural (noncore) areas, 40.0% (unadjusted prevalence) of adults reported having hypertension, whereas in the most urban (large central metro) areas, 29.4% reported having hypertension. Age-standardized hypertension prevalence was significantly higher in the most rural areas, compared with the most urban areas within nearly all categories of age, sex, and other demographic characteristics. Model-based hypertension prevalence across counties ranged from 18.0% to 55.0% and was highest in Southeastern* and Appalachian† counties. Model-based county-level prevalence of antihypertensive medication use among adults with hypertension ranged from 54.3% to 84.7%. Medication use also was higher in rural areas compared with use in most urban areas, with prevalence highest in Southeastern and Appalachian counties as well as counties in the Dakotas and Nebraska. CDC is working with states to enhance hypertension awareness and management through a strategy of team-based care that involves physicians, nurses, pharmacists, dietitians, and community health workers. The increased use of telemedicine to support this strategy might improve access to care among underserved populations.

* https://worldpopulationreview.com/states/southeast-states.

† https://www.arc.gov/appalachian_region/TheAppalachianRegion.asp.

BRFSS§ is an annual, random-digit–dialed landline and mobile phone survey that is representative of the noninstitutionalized adult population aged ≥18 years of the 50 states, the District of Columbia (DC), and U.S. territories. In 2017, 450,016 adults were interviewed, and data from 442,641 adults were included in this analysis. Data from 7,375 respondents were excluded because of incomplete survey responses or residence in U.S. territories (only data from residents of the 50 states and DC were included in this report). State-level response rates ranged from 30.6% to

§ https://www.cdc.gov/brfss/index.html.

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64.1% (median = 45.9%).¶ Respondents were classified as having hypertension if they answered "yes" to the question "Have you ever been told by a doctor, nurse, or other health professional that you have high blood pressure?" Borderline and pregnancy-related hypertension were classified as "no." Respondents were classified as currently taking antihypertensive medication if they answered "yes" to the question "Are you currently taking medicine for your high blood pressure?" Those with "do not know" and missing data were excluded from analysis. All analyses, except for county-level estimates, applied sampling weights to account for the complex sample design, and data were weighted using an iterative proportional weighting (raking) procedure.**

Hypertension and antihypertensive medication use were examined by age group, sex, race/ethnicity, education, household income, and current health care coverage. Using the 2000 U.S. standard population (*2*), the age-standardized prevalence and 95% confidence intervals (CIs) for hypertension and antihypertensive medication use were estimated overall and by respondent characteristics including county rural-urban classification as defined by CDC's National Center for Health Statistics (large central metro/city, large fringe metro/suburb, medium metro, small metro, micropolitan, noncore/rural) (*3*).

¶ https://www.cdc.gov/brfss/annual_data/2017/pdf/2017-sdqr-508.pdf.
** https://www.cdc.gov/brfss/annual_data/2017/pdf/weighting-2017-508.pdf.

Unadjusted prevalences of hypertension and antihypertensive medication use at the county level was estimated using a multilevel regression model and poststratification approach (*4*) for 3,142 counties in all 50 states and DC. The multilevel logistic regression model for hypertension included self-reported data stratified by respondents' age group, sex, race/ethnicity, and other demographic characteristics from the 2017 BRFSS; county-level poverty data (percent below 150% of the federal poverty level) from the American Community Survey 5-year estimates (2013–2017); and random effects at county and state levels (group/aggregate variables). Model parameter estimates were applied to U.S. Census 2010 block-level population estimates by age, sex, and race/ethnicity to compute the predicted probability of having hypertension, and then generated the estimated prevalence at county-level through poststratification. A similar process was performed for antihypertensive medication use, except that the poststratification was conducted using only the population that reported having hypertension. The distribution of these county-level estimates is presented in quintiles. All analyses were conducted using SAS-callable SUDAAN (version 11.0.3; RTI International).

The unadjusted (age-standardized) prevalence of hypertension was 32.4% overall and increased consistently with increasing rurality, from 29.4% (28.5%) among persons living in large cities to 40.0% (34.1%) among those living in the most rural areas (Table 1). Age-specific hypertension prevalence was significantly higher in the most rural compared with

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TABLE 1. Unadjusted and age-standardized* prevalence of self-reported hypertension† among adults aged ≥18 years, by urban-rural status§ and selected characteristics — Behavioral Risk Factor Surveillance System, 2017

Characteristic	Overall	Large central metro (city)	Large fringe metro (suburb)	Medium metro	Small metro	Micropolitan	Noncore (rural)
No. of respondents	442,641	70,197	84,608	92,346	61,579	66,711	67,200
Est. population (x 1000)¶	252,046	77,446	61,881	51,955	23,024	21,481	16,258
No. with hypertension	178,312	25,446	32,969	36,761	25,098	28,196	29,842
Est. population with hypertension (x 1000)¶	81,674	22,757	19,511	17,240	7,851	7,809	6,506
Prevalence, % (95% CI)							
Unadjusted	32.4 (32.1–32.7)	29.4 (28.7–30.0)	31.5 (31.0–32.1)	33.2 (32.6–33.7)	34.1 (33.4–34.8)	36.4 (35.6–37.1)	40.0 (39.1–40.9)
Age-standardized*	29.9 (29.6–30.2)	28.5 (27.9–29.2)	28.7 (28.2–29.2)	30.4 (29.9–30.9)	31.4 (30.7–32.1)	32.6 (31.9–33.3)	34.1 (33.3–35.0)
Age group (yrs), % (95% CI)							
18–44**	14.1 (13.8–14.5)	12.6 (11.9–13.4)	13.5 (12.8–14.2)	14.7 (14.0–15.4)	15.4 (14.4–16.5)	16.7 (15.6–17.8)	18.3 (17.0–19.6)
45–64**	40.5 (40.0–41.0)	39.5 (38.2–40.7)	38.0 (37.0–39.0)	40.5 (39.6–41.4)	43.1 (41.8–44.3)	44.6 (43.3–45.8)	46.1 (44.7–47.5)
≥65**	60.5 (60.0–61.1)	59.0 (57.4–60.6)	60.1 (58.9–61.2)	61.8 (60.7–62.8)	60.8 (59.6–62.0)	61.2 (59.9–62.4)	62.5 (60.9–64.0)
Sex,* % (95% CI)							
Male**	32.9 (32.5–33.3)	30.8 (29.9–31.7)	31.9 (31.1–32.7)	33.7 (32.9–34.4)	34.8 (33.7–35.9)	35.9 (34.8–37.0)	37.4 (36.1–38.7)
Female**	27.0 (26.6–27.3)	26.3 (25.5–27.2)	25.6 (24.9–26.2)	27.2 (26.6–27.9)	28.0 (27.2–28.9)	29.3 (28.4–30.2)	30.7 (29.7–31.8)
Race/Ethnicity,* % (95% CI)							
White, non-Hispanic**	29.0 (28.7–29.3)	26.6 (25.9–27.3)	28.1 (27.5–28.8)	29.3 (28.7–29.9)	30.2 (29.4–30.9)	31.5 (30.7–32.2)	33.3 (32.3–34.2)
Black, non-Hispanic**	40.0 (39.2–40.9)	39.1 (37.6–40.6)	36.6 (34.9–38.4)	41.8 (40.3–43.4)	43.5 (40.4–46.7)	47.8 (44.5–51.1)	46.1 (43.1–49.2)
Hispanic	28.2 (27.3–29.1)	27.4 (25.9–28.9)	27.5 (25.7–29.3)	30.0 (28.4–31.7)	30.6 (27.9–33.5)	28.2 (25.2–31.4)	28.5 (23.8–33.7)
American Indian/Alaska Native, non-Hispanic	37.1 (34.7–39.5)	37.7 (30.3–45.7)	35.2 (30.1–40.7)	35.4 (31.5–39.6)	36.8 (32.6–41.3)	38.7 (34.8–42.9)	38.1 (34.2–42.2)
Asian, non-Hispanic††	23.8 (21.9–25.8)	22.5 (19.5–25.8)	25.9 (22.7–29.3)	24.5 (21.8–27.4)	19.5 (15.1–24.9)	26.9 (22.2–32.0)	37.4 (24.3–52.7)
Native Hawaiian/Pacific Islander, non-Hispanic	33.0 (28.3–38.0)	26.0 (18.2–35.8)	39.8 (33.4–46.6)	40.2 (33.6–47.1)	30.3 (21.7–40.5)	35.3 (26.5–45.2)	—§§
Multiracial, non-Hispanic††	31.6 (29.9–33.4)	27.4 (23.6–31.5)	32.9 (29.3–36.7)	31.5 (28.4–34.8)	35.5 (31.6–39.5)	36.5 (32.5–40.6)	36.5 (30.8–42.6)
Other, non-Hispanic	28.9 (25.3–32.8)	27.5 (21.4–34.6)	22.7 (16.8–29.9)	32.6 (26.7–39.0)	45.8 (33.4–58.7)	22.3 (15.3–31.3)	34.5 (23.0–48.3)
Education,* % (95% CI)							
Less than high school**	35.4 (34.4–36.3)	32.6 (30.7–34.6)	35.7 (33.6–37.8)	37.1 (35.3–38.9)	36.0 (33.8–38.2)	36.9 (34.4–39.5)	39.4 (36.7–42.1)
High school or equivalent**	32.3 (31.8–32.8)	30.5 (29.3–31.7)	32.2 (31.1–33.3)	32.0 (31.0–33.0)	33.1 (31.9–34.4)	34.9 (33.7–36.1)	36.1 (34.7–37.5)
More than high school**	27.5 (27.2–27.8)	26.8 (26.1–27.6)	26.3 (25.7–26.8)	28.0 (27.5–28.6)	29.2 (28.3–30.2)	29.8 (28.9–30.7)	30.8 (29.7–31.9)
Household income,* % (95% CI)							
<$15,000††	37.9 (36.9–39.0)	35.1 (33.0–37.3)	40.5 (38.2–42.7)	38.4 (36.7–40.2)	38.1 (35.7–40.7)	40.3 (37.8–42.9)	41.8 (38.7–45.0)
$15,000 to <$25,000**	34.3 (33.6–35.1)	33.0 (31.4–34.6)	33.4 (31.7–35.1)	34.0 (32.6–35.4)	37.6 (35.8–39.4)	36.2 (34.4–38.1)	36.8 (35.0–38.7)
$25,000 to <$35,000**	31.9 (30.9–32.9)	30.8 (28.5–33.3)	29.7 (27.8–31.8)	32.6 (30.9–34.4)	31.2 (29.2–33.2)	35.9 (33.4–38.5)	36.3 (33.7–39.0)
$35,000 to <$50,000**	29.9 (29.1–30.7)	27.9 (26.1–29.8)	28.7 (27.2–30.3)	31.4 (30.0–32.9)	32.6 (30.6–34.6)	31.0 (29.2–32.8)	32.4 (30.0–34.8)
≥$50,000††	26.9 (26.5–27.3)	25.7 (24.8–26.6)	26.5 (25.7–27.2)	27.1 (26.3–27.8)	28.0 (26.8–29.3)	29.4 (28.2–30.5)	31.0 (29.5–32.5)
Health care coverage,* % (95% CI)							
Yes**	30.1 (29.8–30.4)	28.8 (28.2–29.5)	28.8 (28.2–29.3)	30.6 (30.0–31.1)	31.6 (30.8–32.3)	33.0 (32.3–33.8)	34.8 (33.9–35.7)
No**	27.5 (26.3–28.7)	25.0 (22.6–27.6)	27.2 (24.8–29.8)	29.4 (27.2–31.6)	30.2 (27.7–32.9)	28.2 (26.0–30.6)	30.6 (27.7–33.6)

Abbreviation: CI = confidence interval.

* All estimates, with the exception of age-group estimates, were age-standardized to the 2000 U.S standard population aged ≥18 years using three age groups (18–44, 45–64, and ≥65 years).

† Hypertension was defined as an affirmative response to "Have you ever been told by a doctor, nurse, or other health professional that you have high blood pressure?" Preeclampsia, borderline high, or prehypertensive was categorized as "no."

§ County urbanization levels were determined using the 2013 National Center for Health Statistics Urban-Rural Classification Scheme for Counties. https://www.cdc.gov/nchs/data/series/sr_02/sr02_166.pdf.

¶ Weighted number of adults in the population with hypertension.

** Age-standardized prevalence significantly higher in the most rural (noncore) compared with the most urban (large central metro) areas at p<0.01.

†† Age-standardized prevalence significantly higher in the most rural (noncore) compared with the most urban (large central metro) areas at p<0.05.

§§ Estimates are unreliable and are suppressed (sample size <50 or relative standard error >30%).

the most urban areas for each age group. Age-standardized hypertension prevalence was significantly higher in the most rural compared with the most urban areas for men, women, non-Hispanic whites, non-Hispanic blacks, non-Hispanic Asians, non-Hispanic multiracial adults, all levels of education and income, and among respondents with or without current health care coverage. Among those with hypertension, the unadjusted (age-standardized) percentage of those currently taking antihypertensive medication ranged from 73.0% (56.2%) to 80.2% (64.8%) (Table 2). Age-specific prevalence

TABLE 2. Unadjusted and age-standardized* prevalence of current antihypertensive medication use† among adults aged ≥18 years reporting hypertension, by urban-rural status§ and selected characteristics – Behavioral Risk Factor Surveillance System, 2017

Characteristic	Overall	Large central metro (city)	Large fringe metro (suburb)	Medium metro	Small metro	Micropolitan	Noncore (rural)
No. of respondents	178,312	25,446	32,969	36,761	25,098	28,196	29,842
Est. population (x 1000)¶	81,527	22,728	19,481	17,209	7,836	7,780	6,492
No. using antihypertensive medication	146,754	20,422	27,171	30,286	20,652	23,291	24,932
Est. population using antihypertensive medication (x 1000)¶	61,927	16,586	14,886	13,219	5,963	6,063	5,210
Prevalence, % (95% CI)							
Unadjusted	76.0 (75.5–76.4)	73.0 (71.7–74.2)	76.4 (75.4–77.4)	76.8 (75.9–77.7)	76.1 (74.9–77.3)	77.9 (76.8–79.0)	80.2 (79.1–81.4)
Age-standardized*	59.6 (58.8–60.3)	56.2 (54.6–57.9)	59.7 (58.2–61.2)	60.8 (59.4–62.1)	60.2 (58.2–62.2)	62.6 (60.6–64.5)	64.8 (62.6–66.9)
Age group (yrs), % (95% CI)							
18–44**	37.9 (36.5–39.2)	32.7 (29.9–35.7)	38.2 (35.5–40.9)	39.5 (37.0–42.1)	38.8 (35.2–42.6)	42.5 (39.0–46.0)	46.2 (42.3–50.1)
45–64**	79.6 (78.9–80.3)	77.8 (76.0–79.4)	79.4 (78.0–80.7)	80.7 (79.5–81.9)	79.8 (78.1–81.4)	81.4 (79.9–82.7)	82.1 (80.5–83.7)
≥65	92.0 (91.5–92.4)	91.7 (90.6–92.8)	92.0 (91.0–92.8)	91.9 (91.1–92.6)	92.3 (91.4–93.1)	92.1 (90.8–93.3)	92.4 (91.5–93.2)
Sex,* % (95% CI)							
Male**	56.7 (55.8–57.6)	52.4 (50.5–54.3)	57.5 (55.6–59.3)	58.1 (56.3–59.9)	57.8 (55.0–60.5)	59.5 (57.1–61.9)	61.5 (58.7–64.3)
Female**	64.0 (62.7–65.2)	61.6 (58.7–64.3)	63.2 (60.7–65.6)	64.8 (62.6–67.0)	64.1 (61.2–66.9)	67.5 (64.2–70.6)	69.7 (66.4–72.8)
Race/Ethnicity,* % (95% CI)							
White, non-Hispanic**	59.0 (58.1–59.9)	53.7 (51.6–55.8)	58.9 (57.0–60.8)	60.4 (58.6–62.2)	59.4 (57.2–61.5)	60.5 (58.4–62.5)	64.8 (62.4–67.0)
Black, non-Hispanic	68.1 (66.2–70.0)	65.1 (61.7–68.3)	66.4 (62.3–70.3)	69.9 (66.5–73.1)	72.4 (65.4–78.5)	77.4 (70.8–82.8)	71.3 (65.0–76.8)
Hispanic††	54.0 (51.9–56.0)	51.5 (48.1–55.0)	55.1 (50.8–59.3)	54.6 (51.0–58.0)	55.8 (50.0–61.4)	61.1 (53.7–68.0)	65.1 (51.8–76.5)
American Indian/Alaska Native, non-Hispanic	58.6 (53.6–63.5)	59.2 (44.9–72.1)	56.1 (43.6–67.9)	61.6 (52.1–70.3)	57.9 (46.7–68.4)	57.0 (49.1–64.5)	57.8 (50.5–64.7)
Asian, non-Hispanic	58.0 (52.8–63.0)	55.9 (47.4–64.0)	61.7 (54.2–68.6)	64.5 (53.9–73.9)	40.9 (33.3–48.9)	61.4 (46.4–74.6)	47.1 (36.3–58.1)
Native Hawaiian/Pacific Islander, non-Hispanic	54.9 (45.8–63.6)	—§§	—§§	53.2 (38.0–67.7)	—§§	—§§	—§§
Multiracial, non-Hispanic	56.7 (52.8–60.6)	62.9 (53.0–71.9)	51.0 (45.0–57.0)	57.9 (51.4–64.0)	49.3 (41.2–57.5)	54.6 (47.6–61.4)	52.6 (43.7–61.3)
Other, non-Hispanic	54.9 (45.4–64.0)	49.8 (35.0–64.6)	47.7 (37.7–57.7)	66.2 (48.1–80.5)	70.2 (43.4–87.9)	38.7 (25.1–54.2)	44.8 (25.4–65.9)
Education,* % (95% CI)							
Less than high school††	58.6 (56.4–60.8)	55.1 (50.4–59.7)	58.3 (53.5–62.8)	60.0 (55.7–64.3)	56.3 (51.4–61.0)	65.5 (59.1–71.4)	64.4 (58.1–70.2)
High school or equivalent**	59.6 (58.4–60.9)	56.8 (53.7–59.9)	58.8 (55.9–61.6)	59.9 (57.4–62.4)	60.7 (57.3–63.9)	62.2 (59.2–65.1)	64.4 (61.2–67.5)
More than high school**	59.8 (58.8–60.8)	56.4 (54.4–58.5)	60.5 (58.6–62.4)	61.5 (59.7–63.2)	60.9 (57.9–63.8)	61.8 (59.2–64.3)	65.4 (62.2–68.5)
Household income,* % (95% CI)							
<$15,000	61.5 (59.3–63.7)	58.1 (53.5–62.4)	63.2 (58.2–67.9)	63.5 (59.5–67.5)	58.8 (53.6–63.8)	65.0 (58.8–70.8)	64.6 (58.2–70.6)
$15,000 to <$25,000††	59.7 (57.9–61.5)	54.6 (50.7–58.3)	59.5 (55.1–63.7)	60.4 (57.0–63.8)	62.6 (58.0–66.9)	65.7 (61.1–69.9)	66.4 (61.7–70.8)
$25,000 to <$35,000	60.4 (57.5–63.2)	58.7 (51.7–65.3)	62.2 (56.7–67.3)	60.1 (55.1–64.8)	60.5 (54.8–65.9)	60.5 (54.2–66.5)	62.8 (57.1–68.2)
$35,000 to <$50,000	56.9 (54.9–58.8)	56.6 (51.5–61.6)	55.8 (51.7–59.9)	57.0 (53.5–60.4)	52.8 (49.0–56.5)	60.8 (56.1–65.3)	61.8 (56.4–66.9)
≥$50,000††	59.7 (58.5–60.9)	56.0 (53.4–58.4)	59.7 (57.4–61.9)	61.7 (59.3–64.0)	61.9 (57.8–65.8)	61.2 (58.0–64.3)	65.7 (61.5–69.7)
Health care coverage,* % (95% CI)							
Yes**	61.6 (60.8–62.4)	58.6 (56.8–60.4)	61.0 (59.4–62.6)	62.8 (61.3–64.3)	62.3 (60.1–64.5)	64.3 (62.2–66.4)	67.7 (65.4–69.9)
No	47.2 (45.3–49.1)	43.3 (39.8–46.8)	50.3 (45.9–54.7)	49.0 (45.2–52.8)	44.5 (38.7–50.5)	52.1 (47.4–56.8)	48.5 (43.5–53.5)

Abbreviation: CI = confidence interval.

* Estimates for antihypertensive medication use among adults with hypertension were age-standardized to the 2000 U.S standard population aged ≥18 years using three age groups (18–44, 45–64, and ≥65 years).

† Current antihypertensive medication use was defined as an affirmative response to "Are you currently taking medicine prescribed by a doctor or other health professional for your high blood pressure?"

§ County urbanization levels were determined using the 2013 National Center for Health Statistics Urban-Rural Classification Scheme for Counties. https://www.cdc.gov/nchs/data/series/sr_02/sr02_166.pdf.

¶ Weighted number of adults in the population currently using antihypertensive medication.

** Age-standardized prevalence significantly higher in the most rural (noncore) compared with the most urban (large central metro) areas at p<0.01.

†† Age-standardized prevalence significantly higher in the most rural (noncore) compared with the most urban (large central metro) areas at p<0.05.

§§ Estimates are unreliable and are suppressed (sample size <50 or relative standard error >30%).

of current medication use among persons reporting hypertension was significantly higher in the most rural compared with the most urban areas for respondents aged <65 years, but similar for those aged ≥65 years. Age-standardized prevalence of medication use was significantly higher in the most rural compared with the most urban areas for men, women, non-Hispanic whites, Hispanic adults, all levels of education, and among respondents with current health care coverage. In each rural-urban category, hypertension prevalence was higher among men than women, but among adults with hypertension, prevalence of medication use was higher among women than among men.

County-level predicted hypertension prevalence ranged from 18.0% to 55.0% (Figure). The majority of counties in the Southeast and Appalachia were in the highest quintile, which is consistent with the rurality of most of the counties in these regions. Among persons reporting hypertension, the predicted prevalence of antihypertensive medication use ranged from 54.3% to 84.7%. Counties in the Southeast, Appalachia, and Great Plains[††] were in the highest quintile for current medication use among adults with hypertension. Within the Southeastern states with high hypertension prevalences, estimated prevalences of medication use varied widely across counties.

Discussion

This report provides the most recent data on self-reported prevalence of diagnosed hypertension and antihypertensive medication use. Geographic variability was evident by both rural-urban status and at the county level using model-based estimates. Results suggest that as many as one in two adults in some counties might have hypertension.

Rural populations in the United States have a higher prevalence of many chronic conditions and risk factors (*5*) and experience disparities in access to care such as limited access to health care personnel and lack of public transportation (*6*). Results from studies examining the prevalence of risk factors for hypertension and other cardiovascular diseases highlight that prevalences of obesity (*7*), cigarette smoking (*5*), and physical inactivity (*5*) are higher in rural areas. Rural communities might also be more affected by poor access to affordable healthy food options (*8*).

Age-standardized hypertension prevalence was 28.5% in the most urban and 34.1% in the most rural areas, respectively. This is consistent with data from the 2013 BRFSS, which showed that respondents in nonmetropolitan counties were more likely to report hypertension (38.1%) than were those in metropolitan counties (32.6%) (*9*). Those data also showed that hypertension prevalence decreased as county economic status improved for both metropolitan and nonmetropolitan counties. However, within every level of county economic status, hypertension prevalence was lower in metropolitan counties than in nonmetropolitan counties (*9*). In the present study, hypertension prevalence was higher in the most rural compared with the most urban areas within every level of household income.

[††] https://www.newworldencyclopedia.org/entry/Great_Plains.

Summary

What is already known about this topic?

Prevalence of hypertension increases with age, is higher among men and among non-Hispanic blacks, and has been consistently higher in the Southeastern region of the United States.

What is added by this report?

The unadjusted prevalence of hypertension was 40.0% in the most rural areas and 29.4% in the most urban areas. County-level prevalence of hypertension ranged from 18.0% to 55.0% (highest in the Southeast and Appalachia). County-level prevalence of antihypertensive medication use (among persons reporting hypertension) ranged from 54.4% to 84.7% (highest in the Southeast).

What are the implications for public health practice?

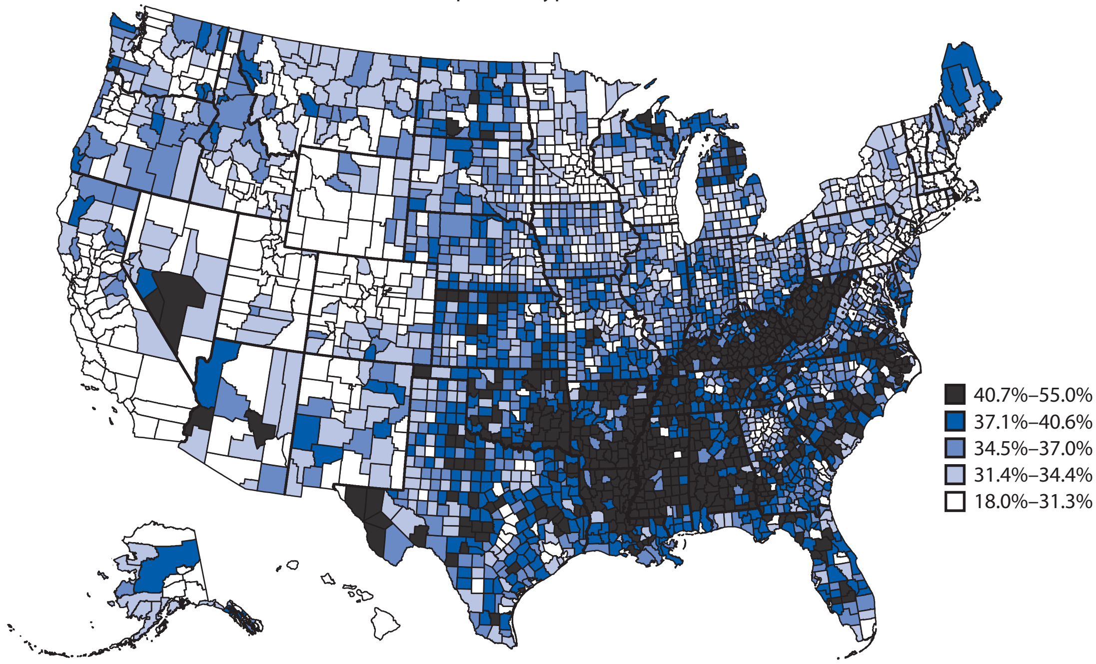
CDC is working with states to improve hypertension treatment and control through team-based care interventions that include the increased use of telemedicine.

Antihypertensive medication use prevalence overall was higher in older age groups and highest among non-Hispanic blacks in each category of rural-urban classification, consistent with the higher prevalence of hypertension observed in these subgroups. Differences in prevalence of medication use by urban-rural status decreased with increasing age, and prevalence was similar across all urban-rural categories for those aged ≥65 years. Prevalence of medication use was higher among women despite the higher prevalence of hypertension among men. This overall gender difference has been reported elsewhere (*1*), but the reasons for it are unclear. Data from Medicare Part D beneficiaries aged ≥65 years suggest that antihypertensive medication nonadherence is similar for men (25.8%) and women (26.7%) (*10*). In addition to counties in the Southeast and Appalachia, prevalence of antihypertensive medication use among persons with self-reported hypertension was also highest in Nebraska and the Dakotas, despite a relatively lower prevalence of hypertension in these states. Medication use is the most important intervention to control hypertension, although lifestyle interventions can be adopted among those with stage 1 hypertension (blood pressure range = 130–139/80–89mmHg) with low estimated cardiovascular risk.[§§] More information is needed to understand variation in antihypertensive medication use prevalence, such as the percentage of persons who choose to adopt lifestyle changes in lieu of medication and how this might vary by age, gender, and urban-rural status.

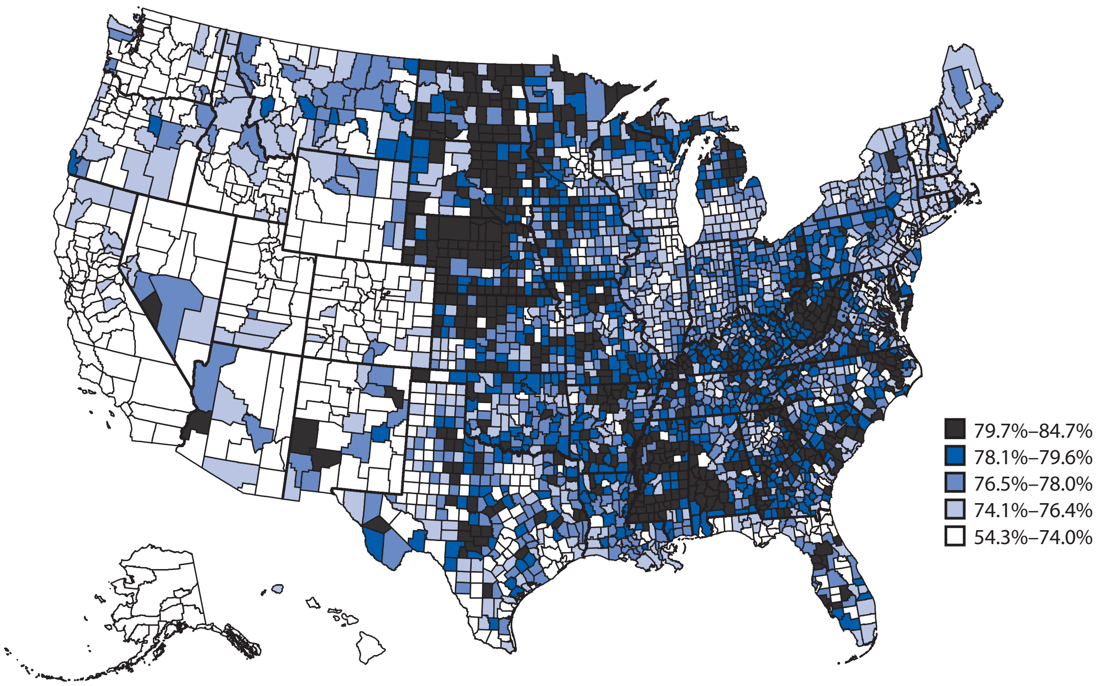
[§§] https://www.acc.org/~/media/Non-Clinical/Files-PDFs-Excel-MS-Word-etc/Guidelines/2017/Guidelines_Made_Simple_2017_HBP.pdf.

FIGURE. Model-based prevalence of self-reported hypertension (A) and antihypertensive medication use (B) among adults aged ≥18 years, by county — Behavioral Risk Factor Surveillance System, 2017*

A. Self-reported hypertension



B. Self-reported antihypertensive medication use among adults with hypertension



* Map A includes the 442,641 respondents to the 2017 Behavioral Risk Factor Surveillance System; Map B is limited to the 178,312 respondents with hypertension.

The findings in this report are subject to at least three limitations. First, results are based on self-reported data and might or might not reflect hypertension estimates based on clinical measurements of blood pressure. Second, low median response rates might limit the representativeness of the 2017 BRFSS sample, potentially resulting in either under- or overestimates of prevalence, although application of sampling weights is likely to reduce the impact of some of the nonresponse bias on the overall estimates. Finally, county-level prevalence was estimated via small area estimation, and the modeling process could introduce bias. The validation and limitations of this methodology have been fully discussed (*4*).

Hypertension is a major risk factor for cardiovascular disease and is a substantial public health concern. CDC is working with states to improve hypertension treatment and control through team-based care interventions that involve physicians, nurses, pharmacists, dietitians, and community health workers. The increased use of telemedicine to support this strategy might improve the quality and availability of care among underserved populations.

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References

1. Samanic CM, Barbour KE, Liu Y, Fang J, Lu H, Schieb L, Greenlund KJ. Prevalence of self-reported hypertension and antihypertensive medication use among adults—United States, 2017. MMWR Morb Mortal Wkly Rep 2020;69:393–8. http://dx.doi.org/10.15585/mmwr.mm6914a1
2. Klein RJ, Schoenborn CA. Age adjustment using the 2000 projected U.S. population. Healthy people statistical notes, no. 20. Hyattsville, MD: US Department of Health and Human Services, CDC, National Center for Health Statistics; 2001. https://www.cdc.gov/nchs/data/statnt/statnt20.pdf
3. Ingram DD, Franco SJ. 2013 NCHS urban-rural classification scheme for counties. Vital Health Stat 2 2014;166:1–73.
4. Zhang X, Holt JB, Yun S, Lu H, Greenlund KJ, Croft JB. Validation of multilevel regression and poststratification methodology for small area estimation of health indicators from the behavioral risk factor surveillance system. Am J Epidemiol 2015;182:127–37. https://doi.org/10.1093/aje/kwv002
5. Matthews KA, Croft JB, Liu Y, et al. Health-related behaviors by urban-rural county classification—United States, 2013. MMWR Surveill Summ 2017;66(No. SS-5). https://doi.org/10.15585/mmwr.ss6605a1
6. Douthit N, Kiv S, Dwolatzky T, Biswas S. Exposing some important barriers to health care access in the rural USA. Public Health 2015;129:611–20. https://doi.org/10.1016/j.puhe.2015.04.001
7. Lundeen EA, Park S, Pan L, O'Toole T, Matthews K, Blanck HM. Obesity prevalence among adults living in metropolitan and nonmetropolitan counties—United States, 2016. MMWR Morb Mortal Wkly Rep 2018;67:653–8. https://doi.org/10.15585/mmwr.mm6723a1
8. Larson NI, Story MT, Nelson MC. Neighborhood environments: disparities in access to healthy foods in the U.S. Am J Prev Med 2009;36:74–81.e10. https://doi.org/10.1016/j.amepre.2008.09.025
9. Shaw KM, Theis KA, Self-Brown S, Roblin DW, Barker L. Chronic disease disparities by county economic status and metropolitan classification, Behavioral Risk Factor Surveillance System, 2013. Prev Chronic Dis 2016;13:160088. https://doi.org/10.5888/pcd13.160088
10. Ritchey M, Chang A, Powers C, et al. Vital signs: disparities in antihypertensive medication nonadherence among Medicare Part D beneficiaries—United States, 2014. MMWR Morb Mortal Wkly Rep 2016;65:967–76. https://doi.org/10.15585/mmwr.mm6536e1

Improving Detection and Response to Respiratory Events — Kenya, April 2016–April 2020

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Respiratory pathogens, such as novel influenza A viruses, Middle East respiratory syndrome coronavirus (MERS-CoV), and now, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), are of particular concern because of their high transmissibility and history of global spread (*1*). Clusters of severe respiratory disease are challenging to investigate, especially in resource-limited settings, and disease etiology often is not well understood. In 2014, endorsed by the Group of Seven (G7),* the Global Health Security Agenda (GHSA) was established to help build country capacity to prevent, detect, and respond to infectious disease threats.† GHSA is a multinational, multisectoral collaboration to support countries towards full implementation of the World Health Organization's International Health Regulations (IHR).§ Initially, 11 technical areas for collaborator participation were identified to meet GHSA goals. CDC developed the Detection and Response to Respiratory Events (DaRRE) strategy in 2014 to enhance country capacity to identify and control respiratory disease outbreaks. DaRRE initiatives support the four of 11 GHSA technical areas that CDC focuses on: surveillance, laboratory capacity, emergency operations, and workforce development.¶ In 2016, Kenya was selected to pilot DaRRE because of its existing respiratory disease surveillance and laboratory platforms and well-developed Field Epidemiology and Laboratory Training Program (FELTP) (*2*). During 2016–2020, Kenya's DaRRE partners (CDC, the Kenya Ministry of Health [MoH], and Kenya's county public health officials) conceptualized, planned, and implemented key components of DaRRE. Activities were selected based on existing capacity and determined by the Kenya MoH and included 1) expansion of severe acute respiratory illness (SARI) surveillance sites; 2) piloting of community event-based surveillance; 3) expansion of laboratory diagnostic capacity; 4) training of public health practitioners in detection, investigation, and response to respiratory threats; and 5) improvement of response capacity by the national emergency operations center (EOC). Progress on DaRRE activity implementation was assessed throughout the process. This pilot in Kenya demonstrated that DaRRE can support IHR requirements and can capitalize on a country's existing resources by tailoring tools to improve public health preparedness based on countries' needs.

Improving Respiratory Disease Surveillance

Expanding SARI surveillance. SARI is defined as an acute respiratory illness requiring hospitalization, characterized by a subjective history of fever or measured temperature of 100.4°F (≥38°C) and cough, with onset within the past 10 days (*3*). Kenya currently has eight SARI surveillance sites. From these sites, nasal and throat swabs collected during Monday–Wednesday from patients who meet the surveillance case definition are sent to the National Influenza Center in Nairobi for influenza testing (Figure). In 2006, six of the eight surveillance sites were established in public health referral hospitals to monitor influenza disease trends (*4*). DaRRE partners expanded this surveillance network to include hospitals serving patients at increased risk for emerging respiratory diseases. In June 2017, Marsabit county was added to Kenya's SARI network because of the county's experience with a high prevalence of MERS-CoV seropositivity among camels (a natural reservoir host for MERS-CoV), which has been linked to human infections (*5*). In addition, the surveillance capacity at the refugee camp in Kakuma was strengthened by adding a trained surveillance officer and standardization of the case definition to be consistent with that used at other SARI sites. Because of the extensive air travel between Nairobi, Kenya, and the Middle East (where MERS-CoV has been reported) and China (where avian influenza A/H7N9 has been reported), SARI surveillance will be established in two large private hospitals in Nairobi during the current year to improve ascertainment of cases among international travelers, particularly persons who do not often seek care at public hospitals. Because of the

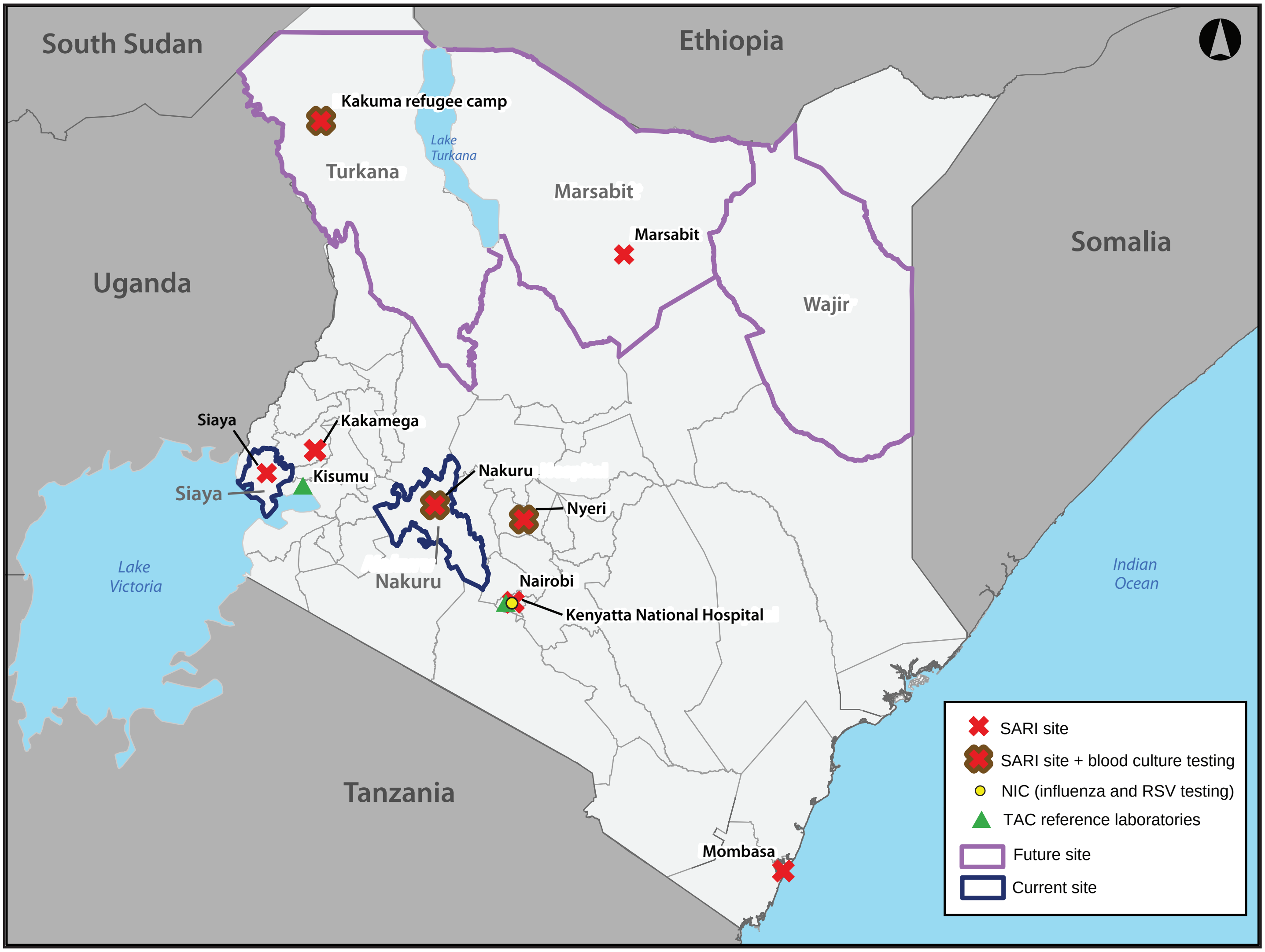
* G7 is a group of seven industrialized nations (Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States) that meets annually to discuss issues such as global economic governance, international security, and energy policy.

† GHSA is an effort by a group of countries, international organizations, nongovernmental organizations, and private sector companies with the goals of accelerating progress toward a world safe and secure from infectious diseases threats, promoting global health security as an international priority, and progressing towards full implementation of global health security frameworks, such as the World Health Organization International Health Regulations https://www.cdc.gov/globalhealth/healthprotection/ghs/pdf/ghsa-action-packages_24-september-2014.pdf.

§ https://www.who.int/ihr/publications/9789241580496/en/.

¶ https://www.cdc.gov/globalhealth/security/ghsa5year/cdc-5-years-ghsa.html.

FIGURE. Current and proposed sites implementing severe acute respiratory illness (SARI)*,† and event-based surveillance§ as part of the Detection and Response to Respiratory Events (DaRRE) strategy — Kenya, April 2020



Abbreviations: NIC = National Influenza Center; RSV = respiratory syncytial virus; TAC = TaqMan array card.

* The eight hospital-based, sentinel SARI surveillance sites include Kakamega County Referral Hospital, Marsabit County Referral Hospital, Mombasa County Referral Hospital, Nakuru County Referral Hospital, Nyeri County Referral Hospital, Siaya County Referral Hospital, the Kenyatta National Hospital in Nairobi, and the refugee camp in Kakuma.

† TAC diagnostic capacities are housed at KEMRI National Laboratory locations in Nairobi and Kisumu.

§ Five Kenyan counties selected for the event-based surveillance pilot program are Siaya and Nakuru (current sites) and Marsabit, Turkana, and Wajir (proposed sites).

ongoing coronavirus disease 2019 (COVID-19) pandemic, the DaRRE surveillance platform is being used for COVID-19 case detection.

Piloting community event-based surveillance. Event-based surveillance, defined as "the organized collection, monitoring, assessment, and interpretation of mainly unstructured ad hoc information regarding health events or risks, which may represent an acute risk to human health" (*6*), complements routine public health surveillance by including real-time reporting from multiple informal sources in the community (e.g., teachers, village health workers, community leaders, police, or media) (*7*). Event-based surveillance allows for detection of health events among populations often not included in routine surveillance, including certain groups of persons (e.g., refugees) and animals (e.g., birds). A mobile phone–based electronic reporting system to enable rapid reporting of events from the community level to the county and national levels has been developed and will complement the national EOC hotline system. Both systems were integrated into the EOC dashboard at the county and national levels for real-time reporting and response coordination. In March 2019, the first stakeholder meeting on community event-based surveillance in Kenya was held, engaging Kenya's MoH and Ministry of Agriculture, Livestock and Irrigation, CDC, the U.S. Agency for International Development, Kenya Red Cross, the International Federation of Red Cross and Red Crescent Societies, Africa Centres for Disease Control and Prevention, and other partners to outline a unified strategy for community event-based surveillance in Kenya. In September 2019, a total of 397 community volunteers were trained in two pilot counties (Nakuru and Siaya). During the current year, three additional counties will be added as pilot sites, and DaRRE partners plan to train community volunteers on signals that focus on COVID-19 case detection.

Enhancing Multilevel Diagnostic Capacity

DaRRE partners improved diagnostic capacity for identifying respiratory pathogens at both the national and county levels (Table 1). Because respiratory syncytial virus was known to be a leading cause of pneumonia resulting in hospitalization of children aged <5 years in low- and middle-income countries (*8*), molecular testing of SARI specimens for the virus at the National Influenza Center was initiated to provide further context to viral circulation within the country. A multipathogen diagnostic test using the TaqMan array card (TAC), available at the Kenya Medical Research Institute laboratories in Nairobi and Kisumu, was customized for respiratory disease outbreaks in Kenya and includes testing for MERS-CoV. TAC is a flexible platform that is currently being configured to detect SARS-CoV-2, among other high-impact targets, and is expected to be available in the next several weeks. To strengthen pathogen detection through blood culture, automated blood culture diagnostic systems and blood culture supplies were provided to the referral hospital laboratories in three counties and laboratory technicians were trained at these locations.

TABLE 1. Diagnostic capacity strengthening through implementation of the Detection and Response to Respiratory Events strategy — Kenya, April 2016–April 2020

Administrative level	Type of test	Pathogens
National		
National Influenza Center, Nairobi	PCR	Influenza (detection and subtyping) Respiratory syncytial virus
KEMRI Centre for Global Health Research Laboratory, Nairobi and Kisumu	TAC*	*Bordetella pertussis* *Chlamydia pneumoniae* *Haemophilus influenzae* (all types) *Klebsiella pneumoniae* *Legionella* *Mycobacterium tuberculosis* *Mycoplasma pneumoniae* Pan-*Salmonella* *Streptococcus,* Group A *Streptococcus pneumoniae* Adenovirus Enterovirus Human coronavirus 229E/NL63 Human coronavirus OC43/HKU1 Human metapneumovirus Influenza A Influenza B MERS-U/MERS-N Parainfluenza virus1 Parainfluenza virus2 Parainfluenza virus3 Respiratory syncytial virus Rhinovirus
County		
Kakuma, Nakuru, and Nyeri	Automated blood culture system	Bacterial pathogens

Abbreviations: KEMRI = Kenya Medical Research Institute; MERS = Middle East respiratory syndrome; PCR = polymerase chain reaction; TAC = TaqMan array card.
* Specimen types that can be tested include respiratory specimens (e.g., nasopharyngeal/oropharyngeal swabs, sputum, and bronchoalveolar lavage).

Improving Response Capacity

Trainings to support workforce development. CDC has supported extensive competency-based training for workforce development in Kenya through FELTP,** a field epidemiology training program. Through a collaboration between the Kenya MoH and CDC, the Kenya FELTP†† was established within the Kenya MoH in 2004, with a mandate to increase epidemiologic capacity through development of a skilled public health workforce that supports disease surveillance systems and public health emergency responses. After implementation of DaRRE, the Kenya FELTP developed and added a respiratory disease outbreak curriculum, now offered to public health practitioners and FELTP fellows via an annual workshop. Since 2016, the Kenya FELTP infectious diseases elective course has covered principal pathogens that can cause respiratory disease outbreaks and concepts that are important for early detection and response to respiratory events. As of April 2020, four Kenya FELTP participant groups had completed the course (Table 2). In addition, training on respiratory diseases outbreak investigation and public health response was offered to surveillance officers at all SARI sites. Hospital personnel (clinicians and nurses) and public health practitioners from county health departments also attended the course trainings (Table 2).

EOC and hotline. The EOC and a telephone hotline are important for any public health action in Kenya. Therefore, a 2-week EOC rotation for Kenya MoH officers and FELTP fellows was established in 2017 to monitor media, rumor logs, and calls of public health events of concern (e.g., natural disasters, clusters of severe infectious diseases, and reportable diseases including SARI, polio, cholera, and measles). In addition, DaRRE partners established a toll-free, mobile

** https://www.cdc.gov/globalhealth/healthprotection/fetp/index.htm.
†† https://www.tephinet.org/training-programs/kenya-field-epidemiology-and-laboratory-training-program.

TABLE 2. Summary of trainings to support workforce development — CDC Kenya Detection and Response to Respiratory Events Strategy (DaRRE), April 2016–April 2020

Type of training	Personnel trained	Training site	No. of trainings provided	No. of persons trained
FELTP infectious diseases elective respiratory session on DaRRE*	FELTP fellows	Ministry of health facilities in Nairobi	4	80
Influenza surveillance and DaRRE†	SARI surveillance officers	Kakamega, Kakuma, Marsabit, Mombasa, Nakuru, and Nyeri counties; Kenyatta National Hospital	2	75
Influenza surveillance and acute febrile illness	SARI surveillance officers	Kakamega, Kakuma, Marsabit, Mombasa, Nakuru, and Nyeri counties; Kenyatta National Hospital	1	35
Bacteriology for respiratory pathogens	Laboratory technicians	Kakuma, Kitale, Nakuru, Nyeri, and Thika counties; KEMRI laboratories at Kisumu	2	20
Assessor training on the Antimicrobial Resistance Laboratory Quality scorecard	Laboratory technicians	Nakuru, Nyeri, and Thika counties	1	10
Integrated disease surveillance with influenza surveillance	Public health officials, county disease surveillance officers, and clinicians	Kakamega, Marsabit, Mombasa Nakuru, Nyeri, and Thika counties	2	80
Event-based surveillance†	National and county trainers of trainers	Nairobi; Nakuru and Siaya counties	2	70
	Community and animal health assistants	Nakuru and Siaya counties	2	26
	Community health volunteers	Nakuru and Siaya counties	2	397

Abbreviations: FELTP = Field Epidemiology and Laboratory Training Program; KEMRI = Kenya Medical Research Institute; SARI = severe acute respiratory infection.
* Areas covered during training included respiratory outbreak investigation, specimen collection, and pathogen-specific topics.
† Topics covered during training included use of electronic reporting, signals to identify priority diseases, principles of event-based surveillance (EBS), and differences between EBS and indicator-based surveillance.

phone–based hotline in the EOC that is monitored 24 hours each day of the week and allows for expedited notification of such events. Event-based surveillance reports received through the hotline or mobile phone–based electronic reporting system were incorporated into the EOC database and dashboard in real-time. The database will also capture information on county and national public health response (e.g., timeliness, information quality, and usefulness) to inform the government of required resources.

Discussion

Under the World Health Organization's IHR, countries are required to strengthen their capacity to respond promptly and effectively to public health events of international concern (*9*). Timely detection of acute respiratory events and an effective, rapid public health response rely on successful integration of multiple systems. DaRRE initiatives, which can be implemented together or in modular format, support IHR requirements and allow for flexibility to fit the country's needs and available resources. Efforts have been made to fully integrate DaRRE into Kenya's existing event detection and reporting systems to ensure sustainability.

Since the implementation of DaRRE activities in Kenya, the Kenya MoH effectively responded to several respiratory events. One recent investigation illustrates its success. In July 2019, a hospital physician called the EOC hotline to report increased numbers of persons hospitalized with an unknown severe respiratory illness, including two patients who had died. The Kenya MoH initiated a prompt response and FELTP teams were deployed to the field within 24 hours. Respiratory specimens were collected and tested at the National Influenza Center and at the Kenya Medical Research Institute laboratory where TAC was used. The patients who died and others associated with this cluster were found to be infected with influenza A/H1N1pdm09 virus, the pathogenic cause of the 2009 influenza pandemic. Patient cohorting was implemented

Summary

What is already known about this topic?

Severe respiratory disease clusters are challenging to investigate in resource-limited settings, and disease etiology is not always identified; these factors might limit the capacity to respond to respiratory disease clusters.

What is added by this report?

In 2016, Kenya was selected to pilot the Detection and Response to Respiratory Events (DaRRE) strategy, developed by CDC to enhance country capacity for identifying and controlling respiratory disease outbreaks. During April 2016–April 2020, laboratory capacity, surveillance, and emergency operations were strengthened in Kenya.

What are the implications for public health practice?

DaRRE can support International Health Regulation requirements and is sufficiently flexible to accommodate country needs and available resources.

and hospital personnel were advised regarding recommended infection control practices. Evaluation of the community event-based surveillance pilot is planned to begin in September 2020.

Severe respiratory disease clusters are often poorly investigated, and disease etiology is not well understood, limiting capacity to respond appropriately (*10*). This is especially challenging in resource-limited settings. Targeted investments and timely detection and response to acute respiratory disease clusters are, therefore, key for the GHSA. During the current COVID-19 pandemic, Kenya has been able to leverage resources that were strengthened through DaRRE to detect and respond to COVID-19 cases. DaRRE provides an integrated approach and capitalizes on existing resources that could lead to sustainable improvement in public health preparedness and might be a model for other countries in the region.

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

References

1. Al-Tawfiq JA, Memish ZA. Emerging respiratory viral infections: MERS-CoV and influenza. Lancet Respir Med 2014;2:23–5. https://doi.org/10.1016/S2213-2600(13)70255-8
2. CDC. Global health – Kenya: improving detection and response to respiratory events in Kenya. Atlanta, GA: US Department of Health and Human Services, CDC; 2018. https://www.cdc.gov/globalhealth/countries/kenya/blog/respiratory-events-in-kenya.html
3. World Health Organization. Influenza: WHO surveillance case definitions for ILI and SARI. Geneva, Switzerland: World Health Organization; 2014. https://www.who.int/influenza/surveillance_monitoring/ili_sari_surveillance_case_definition/en/
4. Katz MA, Muthoka P, Emukule GO, et al. Results from the first six years of national sentinel surveillance for influenza in Kenya, July 2007–June 2013. PLoS One 2014;9:e98615. https://doi.org/10.1371/journal.pone.0098615
5. Ommeh S, Zhang W, Zohaib A, et al. Genetic evidence of Middle East respiratory syndrome coronavirus (MERS-Cov) and widespread seroprevalence among camels in Kenya. Virol Sin 2018;33:484–92. https://doi.org/10.1007/s12250-018-0076-4
6. Africa Centres for Disease Control and Prevention. Africa CDC Event Based Surveillance Framework, interim version. Addis Ababa, Ethiopia: Africa Centres for Disease Control and Prevention; 2018. https://africacdc.org/download/africa-cdc-event-based-surveillance-framework/
7. Clara A, Do TT, Dao ATP, et al. Event-based surveillance at community and healthcare facilities, Vietnam, 2016–2017. Emerg Infect Dis 2018;24:1649–58. https://doi.org/10.3201/eid2409.171851
8. O'Brien KL, Baggett HC, Brooks WA, et al.; Pneumonia Etiology Research for Child Health (PERCH) Study Group. Causes of severe pneumonia requiring hospital admission in children without HIV infection from Africa and Asia: the PERCH multi-country case-control study. Lancet 2019;394:757–79. https://doi.org/10.1016/S0140-6736(19)30721-4
9. World Health Organization. International health regulations. 3rd ed. Geneva, Switzerland: World Health Organization; 2005. https://www.who.int/ihr/publications/9789241580496/en/
10. CDC. Unexplained Respiratory Disease Outbreak working group activities—worldwide, March 2007–September 2011. MMWR Morb Mortal Wkly Rep 2012;61:480–3.

Characteristics and Clinical Outcomes of Adult Patients Hospitalized with COVID-19 — Georgia, March 2020

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SARS-CoV-2, the novel coronavirus that causes coronavirus disease 2019 (COVID-19), was first detected in the United States during January 2020 (*1*). Since then, >980,000 cases have been reported in the United States, including >55,000 associated deaths as of April 28, 2020 (*2*). Detailed data on demographic characteristics, underlying medical conditions, and clinical outcomes for persons hospitalized with COVID-19 are needed to inform prevention strategies and community-specific intervention messages. For this report, CDC, the Georgia Department of Public Health, and eight Georgia hospitals (seven in metropolitan Atlanta and one in southern Georgia) summarized medical record–abstracted data for hospitalized adult patients with laboratory-confirmed* COVID-19 who were admitted during March 2020. Among 305 hospitalized patients with COVID-19, 61.6% were aged <65 years, 50.5% were female, and 83.2% with known race/ethnicity were non-Hispanic black (black). Over a quarter of patients (26.2%) did not have conditions thought to put them at higher risk for severe disease, including being aged ≥65 years. The proportion of hospitalized patients who were black was higher than expected based on overall hospital admissions. In an adjusted time-to-event analysis, black patients were not more likely than were nonblack patients to receive invasive mechanical ventilation† (IMV) or to die during hospitalization (hazard ratio [HR] = 0.63; 95% confidence interval [CI] = 0.35–1.13). Given the overrepresentation of black patients within this hospitalized cohort, it is important for public health officials to ensure that prevention activities prioritize communities and racial/ethnic groups most affected by COVID-19. Clinicians and public officials should be aware that all adults, regardless of underlying conditions or age, are at risk for serious illness from COVID-19.

Hospitalized cases were selected to describe patients with severe manifestations of COVID-19 that warranted inpatient management. Data were collected from a convenience sample of 305 patients at seven hospitals in metropolitan Atlanta (five community hospitals, one university hospital, and one public hospital) and one community hospital in southern Georgia. Patients were selected sequentially from lists provided in real time by hospitals from a total of 698 patients aged ≥18 years who were hospitalized with laboratory-confirmed COVID-19 during March 1–March 30, 2020, including stays for observation and deaths in the emergency department. Over a 3-week period, data were abstracted from electronic medical records and recorded using Research Electronic Data Capture software (version 8.8.0; Vanderbilt University) (*3*). Hospitalizations for patients transferred between participating hospitals or admitted multiple times to the same hospital were analyzed as a single hospitalization. Data on patient race/ethnicity, age, sex, body mass index (BMI), insurance status, residence (e.g., in a long-term care facility), risk factors for severe COVID-19 (based on currently available data and clinical expertise)§ (*4*), and outcomes were abstracted from medical records. Race was categorized as black (non-Hispanic) or nonblack (all other racial/ethnic groups), and age was analyzed in three groups: 18–49, 50–64, and ≥65 years. Fisher's exact tests for proportions and the Wilcoxon rank sum test or the Kruskal-Wallis H test for medians were used to test differences identified in descriptive analyses. Multivariable Cox proportional-hazards analysis was performed on the association between race and time to meeting a composite outcome of IMV or death, adjusting for age, sex, BMI, hospital, admission date, and underlying medical conditions (selected through a stepwise Akaike information criterion approach, which balances a model's fit against its complexity); censoring was used to account for patients still

* COVID-19 was confirmed with laboratory detection of SARS-CoV-2 by reverse transcription-polymerase chain reaction.

† Endotracheal intubation and mechanical ventilation.

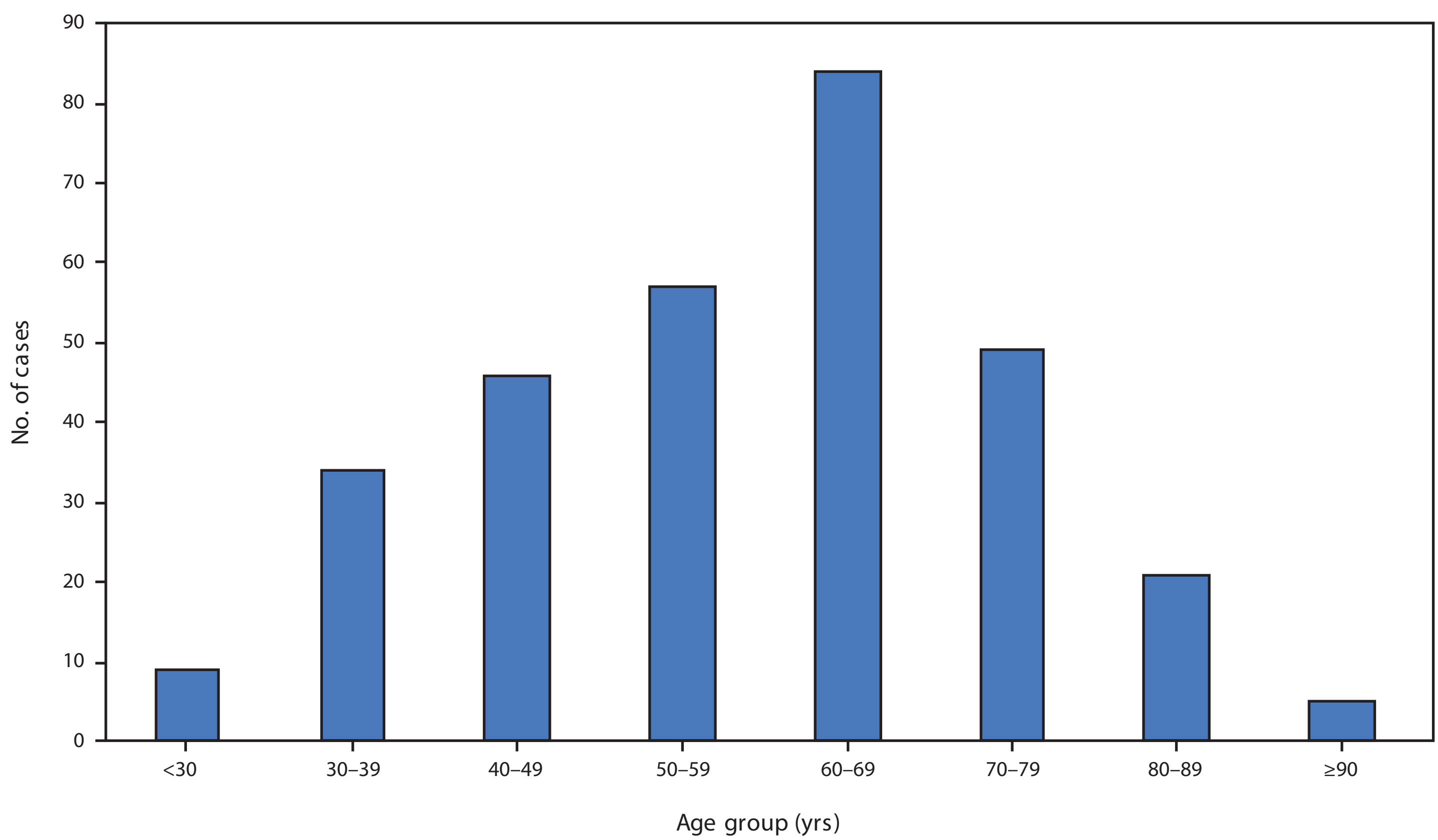
§ Persons aged ≥65 years, persons living in a nursing home or long-term care facility, persons of any age with underlying medical conditions (particularly if the condition is not well controlled), including chronic lung disease or moderate to severe asthma, serious heart conditions, immunocompromise (including cancer treatment, bone marrow or organ transplantation, immune deficiencies, poorly controlled human immunodeficiency virus infection or acquired immunodeficiency syndrome, prolonged use of corticosteroids and other immune system–weakening medications), smoking, severe obesity (body mass index ≥40 kg per m^2), diabetes mellitus, chronic kidney disease undergoing dialysis, or liver disease.

hospitalized without receiving IMV. P-values <0.05 were considered statistically significant. R statistical software (version 3.6.3; The R Foundation) was used to conduct all analyses.

Among 305 patients hospitalized with COVID-19, the median age was 60 years (range = 23–95 years, interquartile range [IQR] = 46–69 years) (Figure 1); 50.5% of patients were female, and 284 (93%) were hospitalized in metropolitan Atlanta. Data on race/ethnicity were available for 297 (97.4%) patients, among whom, 247 (83.2%) were black, 32 (10.8%) were non-Hispanic white, eight (2.7%) were non-Hispanic Asian or Pacific Islander, and 10 (3.4%) were Hispanic (Figure 2). Median age was not significantly different between black patients (60 years, IQR = 45.5–69.0 years) and nonblack patients (64.5 years, IQR = 44.8–74.0 years). Most patients had private insurance (40.1%) or Medicare (33.4%); 10.9% had Medicaid, and 14.9% were uninsured. Compared with nonblack patients, black patients were more likely to have Medicaid (13.5% versus 0.0%, p = 0.002) but not more likely to be uninsured. Overall, 20 (6.6%) patients resided in long-term care facilities before hospitalization. Current smoking was reported for 5.2% of patients.

Overall, 225 (73.8%) patients had conditions considered high-risk for severe COVID-19 (Table 1). Diabetes was documented in 39.7% of patients. Diabetes was most common in patients aged 50–64 years (46.5%; p = 0.001) but was not significantly more common in black patients than in nonblack patients (41.7% versus 32.0%; p = 0.21). Cardiovascular disease, documented in 25.6% of patients, was more prevalent in those aged ≥65 years (47.0%; p<0.001) but prevalence was similar in black (25.1%) and nonblack patients (30.0%) (p = 0.48). Overall, 20.3% of patients had chronic lung disease, with no significant differences by age or race. Asthma was documented in 10.5% of all patients and chronic obstructive pulmonary disease in 5.2%. Severe obesity (BMI ≥40), present in 12.7% of patients, was most common in those aged 18–49 years (21.8%; p<0.001). Severe obesity did not differ significantly by race, although median BMI was higher in black (31.4 [IQR = 27.6–36.9]) than in nonblack patients (29.6 [IQR = 24.3–32.5]; p = 0.003). Hypertension (not considered a high-risk condition) was documented in 67.5% of patients and was more common among black versus nonblack patients (69.6% versus 54.0%; p=0.047).

FIGURE 1. Age distribution of adults hospitalized with COVID–19 (N = 305) — eight hospitals, Georgia, March 2020



Abbreviation: COVID-19 = coronavirus disease 2019.

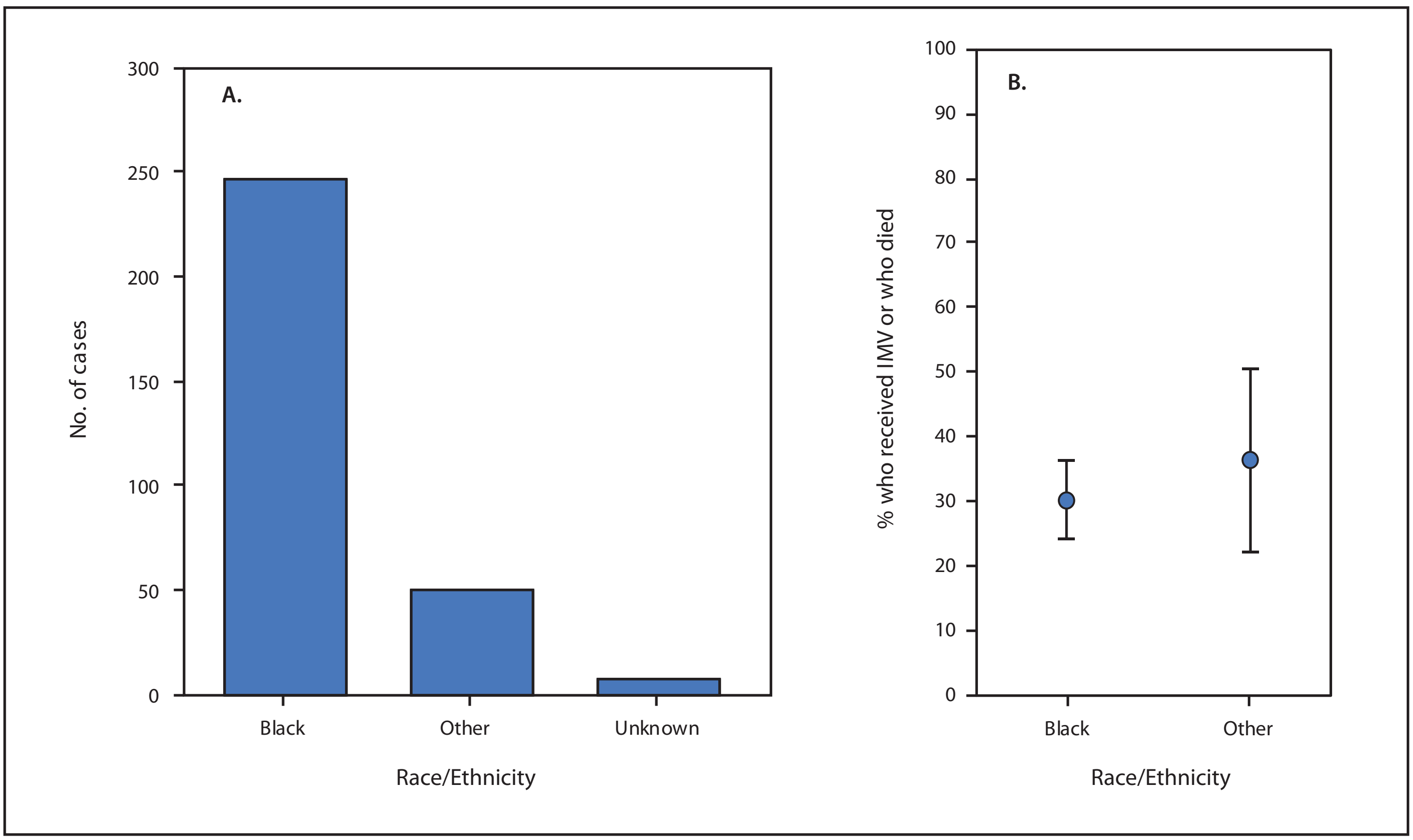
Among the 305 hospitalized patients, the median duration of hospitalization was 8.5 days and duration increased with age (Table 2). Intensive care unit (ICU) admission occurred among 119 (39.0%) patients and increased significantly with age group: among patients aged ≥65 years, 53.8% were admitted to an ICU (p<0.001). Overall, 92 (30.2%) patients received IMV, representing 77.3% of those admitted to an ICU.

Among 281 (92.1%) patients who were no longer hospitalized at the time of data abstraction, 48 (17.1%) died. Case fatality among patients aged 18–49 years, 50–64 years, and ≥65 years was 3.4%, 9.8%, and 35.6%, respectively (p<0.001). Black patients were not more likely than were nonblack patients to receive IMV, to die, or to experience the composite outcome of IMV or death (Figure 2). Among patients without high-risk conditions, 22.5% were admitted to the ICU, 15.0% received IMV, and 5.1% died while in the hospital. As of April 24, 2020, 24 (7.9%) patients remained hospitalized, including 14 (58.3%) in the ICU and nine (37.5%) on IMV. Overall, the estimated percentage of deaths among patients who received ICU care ranged from 37.0%, assuming all remaining ICU patients survived, to 48.7%, assuming all remaining ICU patients died. In an adjusted time-to-event analysis of IMV or death as a composite outcome, no significant difference was found between black and nonblack patients (HR = 0.63; 95% CI = 0.35–1.13).

Discussion

This report characterizing a cohort of hospitalized adults with COVID-19 in Georgia (primarily metropolitan Atlanta) found that most patients in the cohort were black, and black patients had a similar probability of receiving IMV or dying during hospitalization compared with nonblack patients. Although a larger proportion of older patients had worse outcomes (IMV or death), a considerable proportion of patients aged 18–64 years who lacked high-risk conditions received ICU-level care and died (23% and 5%, respectively). Estimated

FIGURE 2. Number of hospitalized patients with COVID-19 (N = 305)* (A) and percentage who received invasive mechanical ventilation or died (B),† by race/ethnicity§ — eight hospitals, Georgia, March 2020



Abbreviations: COVID-19 = coronavirus disease 2019; IMV = invasive mechanical ventilation.
* A total of 273 patients had available race/ethnicity data and known hospitalization outcomes.
† Vertical bars represent 95% confidence intervals for proportions.
§ Black was defined as non-Hispanic black race/ethnicity; other includes all other racial/ethnic groups.

TABLE 1. Underlying medical conditions of adults hospitalized with COVID-19 (N = 305), by age group and race/ethnicity* — eight hospitals, Georgia, March 2020

Characteristic	All patients, no. (%) (N = 305)	Age group (yrs) No. (%) 18–49 (n = 89)	50–64 (n = 99)	≥65 (n = 117)	P-value†	Race/Ethnicity*,§ No. (%) Black (n = 247)	Other (n = 50)	P-value†
High-risk conditions								
None¶	80 (26.2)	47 (52.8)	33 (33.3)	N/A	0.008	62 (25.1)	16 (32.0)	0.38
Any	225 (73.8)	42 (47.2)	66 (66.7)	N/A	N/A	185 (74.9)	34 (68.0)	N/A
Diabetes mellitus	121 (39.7)	21 (23.6)	46 (46.5)	54 (46.2)	0.001	103 (41.7)	16 (32.0)	0.21
Cardiovascular disease	78 (25.6)	10 (11.2)	13 (13.1)	55 (47.0)	<0.001	62 (25.1)	15 (30.0)	0.48
Coronary artery disease	35 (11.5)	1 (1.1)	8 (8.1)	26 (22.2)	<0.001	27 (10.9)	7 (14.0)	0.63
Congestive heart failure	33 (10.8)	8 (9.0)	4 (4.0)	21 (17.9)	0.004	29 (11.7)	4 (8.0)	0.62
Arrhythmia	18 (5.9)	2 (2.2)	1 (1.0)	15 (12.8)	<0.001	11 (4.5)	7 (14.0)	0.018
Chronic lung disease	62 (20.3)	14 (15.7)	26 (26.3)	22 (18.8)	0.18	53 (21.5)	6 (12.0)	0.17
Asthma	32 (10.5)	12 (13.5)	13 (13.1)	7 (6.0)	0.12	30 (12.1)	2 (4.0)	0.13
COPD	16 (5.2)	0 (—)	7 (7.1)	9 (7.7)	0.011	14 (5.7)	1 (2.0)	0.48
Severe obesity (BMI ≥40)**	37 (12.7)	19 (21.8)	14 (14.6)	4 (3.7)	<0.001	33 (13.9)	2 (4.2)	0.088
Immunocompromising conditions or therapies§§	28 (9.2)	9 (10.1)	8 (8.1)	11 (9.4)	0.91	20 (8.1)	7 (14.0)	0.18
End-stage renal disease, on dialysis	16 (5.2)	4 (4.5)	5 (5.1)	7 (6.0)	0.95	15 (6.1)	1 (2.0)	0.49
Liver disease	7 (2.3)	0 (—)	4 (4.0)	3 (2.6)	0.18	4 (1.6)	2 (4.0)	0.27
Other underlying conditions								
No underlying conditions	18 (5.9)	13 (14.6)	1 (1.0)	4 (3.4)	<0.001	12 (4.9)	6 (12.0)	0.094
Hypertension	206 (67.5)	30 (33.7)	75 (75.8)	101 (86.3)	<0.001	172 (69.6)	27 (54.0)	0.047
Neurologic disorder	38 (12.5)	8 (9.0)	10 (10.1)	20 (17.1)	0.17	30 (12.1)	6 (12.0)	>0.99
Chronic kidney disease, without dialysis	32 (10.5)	2 (2.2)	12 (12.1)	18 (15.4)	0.003	24 (9.7)	8 (16.0)	0.21
Cancer	12 (3.9)	3 (3.4)	3 (3.0)	6 (5.1)	0.76	10 (4.0)	2 (4.0)	>0.99
Rheumatologic or autoimmune condition	8 (2.6)	1 (1.1)	5 (5.1)	2 (1.7)	0.22	6 (2.4)	2 (4.0)	0.63

Abbreviations: BMI = body mass index; COPD = chronic obstructive pulmonary disease; COVID-19 = coronavirus disease 2019; IQR = interquartile range; N/A = not applicable.

* Black was defined as non-Hispanic black race/ethnicity; other includes all other racial/ethnic groups.
† P-values were calculated using Fisher's exact tests for proportions.
§ Eight patients were excluded from race comparisons because race and ethnicity data were missing.
¶ Age ≥65 years was considered a high-risk condition.
** BMI data were missing for 13 patients.
§§ Documented conditions included solid organ transplant (eight), human immunodeficiency virus infection (eight), cancer with chemotherapy receipt within the previous year (three), stem cell transplant (three), and leukemia (two); 16 patients were taking immunosuppressive medications.

case fatality among patients who received ICU care was high (37%–49%) but comparable with that observed in a smaller case series of COVID-19 patients in the state of Washington (*5*). Among hospitalized patients, 26% lacked high-risk factors for severe COVID-19, and few patients (7%) lived in institutional settings before admission, suggesting that SARS-CoV-2 infection can cause significant morbidity in relatively young persons without severe underlying medical conditions. Community mitigation recommendations (e.g., social distancing) should be widely instituted, not only to protect older adults and those with underlying medical conditions, but also to prevent the spread of SARS-CoV-2 among persons in the general population who might not consider themselves to be at risk for severe illness (*6*).

The proportion of hospitalized patients who were black was higher than expected based on overall hospitalizations. At four affiliated hospitals, which accounted for 67% of patients in the cohort, 80% of cohort patients were black compared with 47% of hospitalized patients overall during March 2020 (D. Murphy, personal communication, April 7, 2020). Similarly, COVID-NET, which conducts population-based surveillance for laboratory-confirmed COVID-19–associated hospitalizations across 14 sites nationwide,¶ found that black persons were disproportionately represented among hospitalized patients with COVID-19 (*7*). It is important to continue ongoing efforts to understand why black persons are disproportionately hospitalized for COVID-19, including the role of social and economic factors (including occupational exposures) in SARS-CoV-2 acquisition risk. It is critical that public health officials ensure that prevention activities prioritize communities and racial groups most affected by COVID-19.

¶ https://gis.cdc.gov/grasp/COVIDNet/COVID19_5.html.

TABLE 2. Health care use, interventions, and outcomes in adults hospitalized with COVID-19 (N = 305), by age group and race/ethnicity* — eight hospitals, Georgia, March 2020

Characteristic of hospitalization	Total no. (%) (N = 305)	Age group (yrs) No. (%) 18–49 (n = 89)	50–64 (n = 99)	≥65 (n = 117)	P-value§	Race/Ethnicity*,† No. (%) Black (n = 247)	Other (n = 50)	P-value§
Health care use								
Median hospital duration, days¶	8.5 (5.0–14.0)	7.0 (4.3–11.8)	8.0 (5.0–12.8)	10.0 (6.0–16.0)	0.001	8.0 (5.0–13.8)	8.0 (4.0–14.0)	0.084
Any supplemental oxygen	232 (76.1)	58 (65.2)	70 (70.7)	104 (88.9)	<0.001	186 (75.3)	40 (80.0)	0.59
Nasal cannula	220 (72.1)	57 (64.0)	67 (67.7)	96 (82.1)	0.007	177 (71.7)	37 (74.0)	0.86
Noninvasive ventilation	11 (3.6)	2 (2.2)	4 (4.0)	5 (4.3)	0.80	10 (4.0)	0 (—)	0.22
High-flow nasal cannula	69 (22.6)	13 (14.6)	17 (17.2)	39 (33.3)	0.002	55 (22.3)	14 (28.0)	0.37
ICU admission and interventions								
Admitted to ICU	119 (39.0)	24 (27.0)	32 (32.3)	63 (53.8)	<0.001	96 (38.9)	21 (42.0)	0.75
Median ICU duration, days¶	8.0 (5.0–12.0)	7.0 (4.0–14.0)	8.0 (6.0–11.0)	9.0 (5.0–12.0)	0.74	8.0 (5.0–12.0)	9.0 (6.0–11.0)	0.92
Invasive mechanical ventilation	92 (30.2)	17 (19.1)	27 (27.3)	48 (41.0)	0.003	75 (30.4)	16 (32.0)	0.87
Median ventilator days¶	9.0 (5.0–12.0)	8.5 (5.0–13.3)	9.0 (5.5–10.5)	10.0 (6.0–12.0)	0.74	9.0 (5.0–11.5)	9.5 (6.3–13.3)	0.20
Acute renal replacement therapy	23 (7.5)	2 (2.2)	8 (8.1)	13 (11.1)	0.037	19 (7.7)	3 (6.0)	>0.99
Vasopressor support	84 (27.5)	13 (14.6)	21 (21.2)	50 (42.7)	<0.001	70 (28.3)	13 (26.0)	0.86
Cardiopulmonary resuscitation	13 (4.3)	2 (2.2)	3 (3.0)	8 (6.8)	0.25	11 (4.5)	2 (4.0)	>0.99
Outcome								
Discharged alive	233 (76.4)	85 (95.5)	83 (83.8)	65 (55.6)	<0.001	192 (77.7)	34 (68.0)	0.15
Still hospitalized	24 (7.9)	1 (1.1)	7 (7.1)	16 (13.7)	0.002	18 (7.3)	6 (12.0)	0.26
Died**	48 (17.1)	3 (3.4)	9 (9.8)	36 (35.6)	<0.001	37 (16.2)	10 (22.7)	0.28
Invasive mechanical ventilation or death**	86 (30.6)	16 (18.2)	22 (23.9)	48 (47.5)	<0.001	69 (30.1)	16 (36.4)	0.48

Abbreviations: COVID-19 = coronavirus disease 2019; ICU = intensive care unit; IQR = interquartile range.
* Black was defined as non-Hispanic black race/ethnicity; other includes all other racial/ethnic groups.
† Eight patients were excluded from race comparisons because race and ethnicity data were missing.
§ P-values were calculated using Fisher's exact tests for proportions and the Wilcoxon rank-sum test or the Kruskal-Wallis H test for medians.
¶ Continuous variables are presented as median (IQR).
** Among 281 total patients who were no longer hospitalized, 88 (31.3%) were aged 18–49 years, 92 (32.7%) were aged 50–64 years, and 101 (35.9%) were aged ≥65 years; among 273 patients with available race/ethnicity data who were no longer hospitalized, 229 (83.9%) were non-Hispanic black, and 44 (16.1) were of other race/ethnicity.

The findings in this report are subject to at least three limitations. First, the data are from a convenience sample of hospitalized adult patients in metropolitan Atlanta and southern Georgia, and data collection for this assessment was limited by the intention to conduct the investigation quickly. These patients do not necessarily represent all hospitalized patients with COVID-19 at those hospitals, or within Georgia. Second, patients were not tracked after discharge in this investigation. Finally, race and ethnicity were abstracted from medical records, and methods for recording these categories might have differed across hospitals, which could result in misclassification.

This report provides valuable clinical data on a large cohort of hospitalized patients. Although frequency of IMV and fatality did not differ by race, black patients were disproportionately represented among hospitalized patients, reflecting greater severity of COVID-19 among this population. Public officials should consider racial differences among patients affected by COVID-19 when planning prevention activities. Approximately one quarter of patients had no high-risk

Summary

What is already known about this topic?

Older adults and persons with underlying medical conditions are at higher risk for severe COVID-19. Non-Hispanic black patients are overrepresented among hospitalized U.S. COVID-19 patients.

What is added by this report?

In a cohort of 305 hospitalized adults with COVID-19 in Georgia (primarily metropolitan Atlanta), black patients were overrepresented, and their clinical outcomes were similar to those of nonblack patients. One in four hospitalized patients had no recognized risk factors for severe COVID-19.

What are the implications for public health practice?

Prevention activities should prioritize communities and racial groups most affected by severe COVID-19. Increased awareness of the risk for serious illness among all adults, regardless of underlying medical conditions or age, is needed.

conditions, and 5% of these patients died, suggesting that all adults, regardless of underlying conditions or age, are at risk for serious COVID-19–associated illness.

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References

1. Holshue ML, DeBolt C, Lindquist S, et al.; Washington State 2019-nCoV Case Investigation Team. First case of 2019 novel coronavirus in the United States. N Engl J Med 2020;382:929–36.
2. CDC. Coronavirus disease 2019 (COVID-19): cases of coronavirus disease 2019 (COVID-19) in the U.S. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/coronavirus/2019-ncov/cases-in-us.html
3. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform 2009;42:377–81.
4. CDC. Coronavirus disease 2019 (COVID-19): people who are at higher risk for severe illness. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/people-at-higher-risk.html
5. Bhatraju PK, Ghassemieh BJ, Nichols M, et al. Covid-19 in critically ill patients in the Seattle region—case series. N Engl J Med 2020. Epub March 30, 2020.
6. Qualls N, Levitt A, Kanade N, et al.; CDC Community Mitigation Guidelines Work Group. Community mitigation guidelines to prevent pandemic influenza—United States, 2017. MMWR Recomm Rep 2017;66(No. RR-1).
7. Garg S, Kim L, Whitaker M, et al. Hospitalization rates and characteristics of patients hospitalized with laboratory-confirmed coronavirus disease 2019—COVID-NET, 14 states, March 1–30, 2020. MMWR Morb Mortal Wkly Rep 2020;69:458–64.

Public Health Response to the Initiation and Spread of Pandemic COVID-19 in the United States, February 24–April 21, 2020

Anne Schuchat, MD; CDC COVID-19 Response Team

On May 1, 2020, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

From January 21 through February 23, 2020, a total of 14 cases of coronavirus disease 2019 (COVID-19) were diagnosed in six U.S. states, including 12 cases in travelers arriving from China and two in household contacts of persons with confirmed infections. An additional 39 cases were identified in persons repatriated from affected areas outside the United States (*1*). Starting in late February, reports of cases with no recent travel to affected areas or links to known cases signaled the initiation of pandemic spread in the United States (*2*). By mid-March, transmission of SARS-CoV-2, the virus that causes COVID-19, had accelerated, with rapidly increasing case counts indicating established transmission in the United States. Ongoing traveler importation of SARS-CoV-2, attendance at professional and social events, introduction into facilities or settings prone to amplification, and challenges in virus detection all contributed to rapid acceleration of transmission during March. Public health responses included intensive efforts to detect cases and trace contacts, and implementation of multiple community mitigation strategies. Because most of the population remains susceptible to infection, recognition of factors associated with amplified spread during the early acceleration period will help inform future decisions as locations in the United States scale back some components of mitigation and strengthen systems to detect a potential transmission resurgence. U.S. circulation of SARS-CoV-2 continues, and sustained efforts will be needed to prevent future spread within the United States.

The first cases of COVID-19 in the United States occurred in January and February 2020 in travelers from China's Hubei Province, where the virus was first recognized, and their household contacts (*1*). Beginning in late February, cases with no history of international travel and no contact with infected persons were recognized (*1*). By mid-March, transmission had become widespread, and by April 21, a total of 793,669 confirmed COVID-19 cases had been reported in the United States, the majority resulting from widespread community transmission (Figure 1). Factors that contributed to the acceleration of dissemination in March included 1) continued importation of the virus by travelers infected elsewhere (e.g., on cruise ships or in countries experiencing outbreaks); 2) attendance at professional and social events, resulting in amplification in the host locations and multistate spread; 3) introduction of the virus into facilities or settings prone to amplification (e.g., long-term care facilities and high-density urban areas) with the potential for seeding the broader community; and 4) challenges in virus detection, including limited testing, emergence during the peak months of influenza circulation and influenza and pneumonia hospitalizations, and other cryptic transmission including from persons who were asymptomatic or presymptomatic. During March 2020, national, state, and local public health responses also intensified and adapted, augmenting case detection, contact tracing, and quarantine with targeted layered community mitigation measures. Because SARS-CoV-2, the virus that causes COVID-19, remains in circulation and a large proportion of the population remains susceptible, the potential for future acceleration remains.

Travel and COVID-19 Spread

Continued introductions of SARS-CoV-2 from outside the United States contributed to the initiation and acceleration of domestic COVID-19 cases in March. After Chinese authorities halted travel from Wuhan and other cities in Hubei Province on January 23, followed by U.S. restrictions on non-U.S. travelers from China issued on January 31 (effective February 2), air passenger journeys from China decreased 86%, from 505,560 in January to 70,072 in February. However, during February, 139,305 travelers arrived from Italy and 1.74 million from all Schengen countries,* where the outbreak was spreading widely and rapidly. Travelers from Italy and all Schengen countries decreased 74% to 35,877 and 50% to 862,432, respectively, in March.† Genomic analysis of outbreak strains suggested an introduction from China to the state of Washington around February 1.§ However, examination of strains collected from northern California during early February to mid-March indicated multiple introductions resulting from international travel (from China and Europe) as well as from interstate travel.¶ Sequencing of strains collected in the New York metropolitan area in March also suggested origins in Europe and other U.S. regions.** Returning cruise ship travelers also contributed to amplification during this time (*3*). Persons from many countries are in close contact on cruises, and crew members continue

* Includes Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, and Switzerland. Travel within the Schengen Area is permitted without border controls.

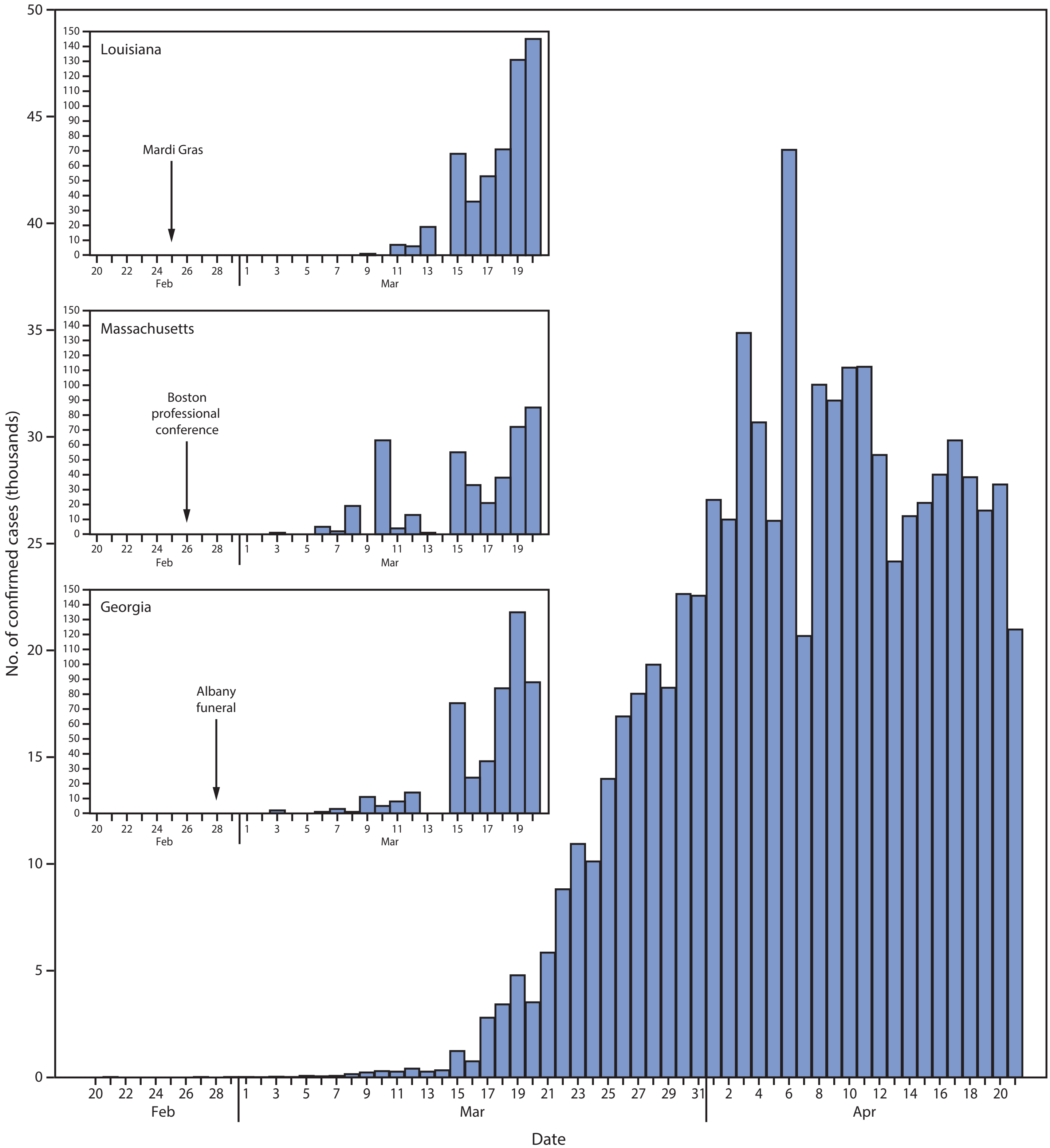
† Air travel data provided by U.S. Customs and Border Protection's Office of Planning, Program Analysis, and Evaluation (PPAE).

§ https://www.medrxiv.org/content/10.1101/2020.04.02.20051417v2.

¶ https://www.medrxiv.org/content/10.1101/2020.03.27.20044925v1.

** https://www.medrxiv.org/content/10.1101/2020.04.08.20056929v2.

FIGURE 1. Number of confirmed COVID-19 cases, by date of report, in the United States during February 20–April 21, 2020,* with initiation and early acceleration periods highlighted in Louisiana, Massachusetts, and Georgia



Abbreviation: COVID-19 = coronavirus disease 2019.
* Cumulative case count was 13 before February 20, 2020.

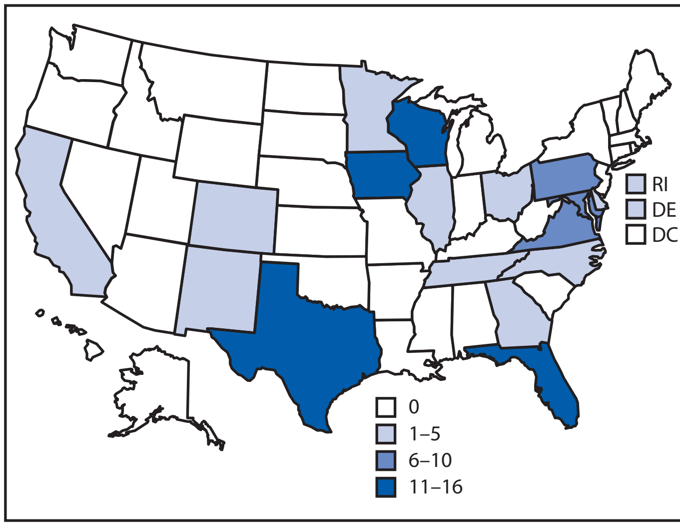
to work on ships for multiple voyages. As a result, passengers returning from cruises contributed to the early acceleration phase. For example, 101 persons who had been on nine separate Nile River cruises during February 11–March 5 returned to 18 states and had a positive test result for SARS-CoV-2, nearly doubling the total number of known COVID-19 cases in the United States at that time (Figure 2).

Public health steps to mitigate continued importations of the virus included travel restrictions for non-U.S. citizens or permanent residents arriving from China beginning in early February and later expanded to include other countries with widespread sustained transmission (Table). Travel health notices were issued for countries with known outbreaks as the pandemic evolved, and ultimately warnings were issued to avoid nonessential international travel as well as all cruise ship travel (*1*,*4*). Quarantine measures were implemented for arriving international travelers with known exposure to locations and settings of concern, such as Hubei Province and the *Diamond Princess* cruise ship docked off the coast of Yokohama, Japan. Screening and public health risk assessment of travelers in selected U.S. airports, initiated on January 17, were also expanded. As of April 21, 2020, CDC staff members and U.S. Customs and Border Protection officers had screened approximately 268,000 returning travelers, among whom testing confirmed 14 COVID-19 cases. State and local health departments were advised to supervise self-monitoring of travelers who had been directed to stay home after returning from countries with widespread sustained transmission. On March 14, 2020, the CDC Director issued a No Sail Order for cruise ships, suspending operation in U.S. waters; the order was renewed April 9, effective April 15.

Events and Gatherings

Various gatherings of persons from different locations, followed by return to their home communities, played a notable role in the early U.S. spread of COVID-19. During February 2020, the number of confirmed cases originating in the United States was low and appeared contained; thus, federal and local jurisdictions did not recommend restrictions on gatherings. However, during the last week of February, several large events led to further spread of the disease. These included Mardi Gras celebrations in Louisiana with more than 1 million attendees, an international professional conference held in Boston, Massachusetts, with approximately 175 attendees, and a funeral in Albany, Georgia, with more than 100 attendees (Figure 1). In the weeks after these events, amplifications in the host locations contributed to increasing U.S. case counts (*5*). Dougherty County, Georgia, a small rural county that includes Albany, had one of the highest cumulative incidences of COVID-19 (1,630/100,000 population) in the country. The substantial transmissibility of the virus and severity of

FIGURE 2. Number of confirmed COVID-19 cases (N = 101) linked to nine Nile River cruises held during February 11–March 5, 2020, by patient state of residence — 18 states



Abbreviations: COVID-19 = coronavirus disease 2019; DC = District of Columbia; DE = Delaware; RI = Rhode Island.

COVID-19 triggered a series of recommendations, beginning in mid-March, to limit mass gatherings and travel (Table).

Workplaces and Settings Contributing to Accelerated Spread

Skilled nursing and long-term care facilities (*6*) and hospitals (*7*) are settings in which persons at higher risk for severe COVID-19 illness are in close contact with staff members, many of whom work at multiple facilities. Other workplaces also facilitated amplification of virus transmission, including critical infrastructure sectors, such as multiple meat packing facilities in rural areas. Clusters of cases related to religious service attendance have been reported within the United States and worldwide (*8*). Congregate, high-density settings also might contribute to the spread of COVID-19 (*9*). For example, population density might account for the very high numbers of COVID-19 cases in the New York metropolitan area (Box). Public health actions aimed at reducing COVID-19 spread in high-risk settings have focused on infection control measures, including identifying and isolating ill persons, cleaning and disinfection, restricting visitors, physical distancing through shift work, and appropriate use of personal protective equipment (Table). To protect health care capacity and slow community spread of COVID-19, local, state, and federal authorities issued stay-at-home orders, and closed schools and nonessential workplaces. On April 3, CDC issued guidance for use of cloth face coverings in public areas to reduce spread, based on increasing evidence of transmission in the absence of symptoms.[††]

[††] https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/cloth-face-cover.html.

TABLE. Factors contributing to COVID-19 acceleration and corresponding public health actions — United States, January–April 2020

Factor contributing to acceleration	Examples	Public health actions
Continued travel-associated importations of the virus	Travelers arriving from countries or cruise ships with ongoing transmission	Travel health notices, traveler screening (including risk assessment, public health management and monitoring), travel restrictions, federal isolation and quarantine orders, educating travelers and clinicians regarding symptoms and evaluation
Large gatherings	Social, cultural, and professional gatherings where persons convene and then disperse over broad areas	Restricting mass gatherings; global travel restrictions and domestic travel recommendations, recommending transition to virtual events
Introductions into high-risk workplaces/settings	Long-term care facilities, hospitals, correctional facilities, and homeless shelters	Restricting visitor access, establishing cohort units or facilities for residential settings, vigorous contact tracing around persons with confirmed cases, increased infection control, environmental surface cleaning, use of recommended personal protective equipment
Crowding and high population density	Densely populated areas, crowded workplaces, schools, and public spaces	Stay-at-home orders, recommendations for hand washing and social distancing, cloth face covering guidance, school dismissals, extended telework, environmental surface cleaning
Cryptic transmission	Presymptomatic or asymptomatic spread, limited testing, co-occurrence with circulation of other respiratory viruses	Increased testing, COVID-19–specific surveillance, cloth face covering guidance, aggressive contact tracing accompanied by quarantine and/or testing of asymptomatic contacts, stay-at-home orders

Abbreviation: COVID-19 = coronavirus disease 2019.

Cryptic Transmission

Unrecognized transmission played a key role in the initiation and acceleration phases of the U.S. outbreak. Cases were not detected during this time for various reasons. First, introduction of the virus into the United States occurred during the annual influenza season. Although syndromic surveillance systems tracked respiratory illness in outpatient settings and emergency departments in many U.S. jurisdictions, including areas where early COVID-19 clusters were detected, such as Seattle, Washington, none of these systems detected unusual trends during the early part of the acceleration period because of the preponderance of seasonal influenza illness. After the first community case in Santa Clara, California, was confirmed on February 27, the county conducted COVID-19 surveillance with polymerase chain reaction–based virus testing during March 5–14 at four urgent care centers. Influenza accounted for 23% of respiratory illnesses; among those who had a negative test result for influenza, 11% had a positive test result for SARS-CoV-2, representing approximately 8% of patients with respiratory symptoms (*10*). Seroprevalence data from Seattle during March 2020, a period when transmission of the virus was rapidly accelerating, suggested that there were limited undetected infections in healthy adults without respiratory illness (1 of 221 remnant clinical sera representing a convenience sample tested seropositive [Helen Chu, University of Washington School of Public Health, personal communication, April 2020]); at the population level, this still translates into substantial numbers of unrecognized community infections. No samples from 59 children with acute respiratory infections during January–March were seropositive (Janet Englund, Seattle Children's Hospital and University of Washington, personal communication, April 2020). Because the incidence of SARS-CoV-2 infections was still relatively low during the initiation and early acceleration periods, as evidenced by seroprevalence data, widespread testing would have been needed to detect all cases. The contribution of spread from persons without symptoms also complicated detection and containment (*11*). Public health actions included expanded surveillance and testing capacity and community measures, such as enhanced teleworking and stay-at-home orders, school closures, social distancing, and use of cloth face coverings (Table).

Discussion

The acceleration phase of a pandemic is complex and requires a multifaceted and rapidly adapting public health response. During a 3-week period in late February to early March, the number of U.S. COVID-19 cases increased more than 1,000-fold. Various community mitigation interventions were implemented with the aim of reducing further spread and controlling the impact on health care capacity. Recognition of factors associated with amplified spread during this early acceleration period will help inform future decisions as locations in the United States scale back some components of mitigation and strengthen systems to detect transmission resurgence.

The findings in this report are subject to at least five limitations. First, the various factors facilitating viral spread described in this report occurred simultaneously; therefore, it is not possible to quantify the relative contribution of each to the outbreak trajectory in the United States. Second, the examples of factors contributing to amplification are illustrative and not meant to be comprehensive. Third, because

Summary

What is already known about this topic?

The first confirmed coronavirus disease 2019 (COVID-19) case in the United States was reported on January 21, 2020. The outbreak appeared contained through February, and then accelerated rapidly.

What is added by this report?

Various factors contributed to accelerated spread during February–March 2020, including continued travel-associated importations, large gatherings, introductions into high-risk workplaces and densely populated areas, and cryptic transmission resulting from limited testing and asymptomatic and presymptomatic spread. Targeted and communitywide mitigation efforts were needed to slow transmission.

What are the implications for public health practice?

Factors that amplified the March acceleration and associated mitigation strategies that were implemented can inform public health decisions as the United States prepares for potential re-emergences.

the mitigation strategies highlighted here were implemented concurrently, the ability to estimate the relative impact of each intervention is limited. Fourth, the epidemic curve presented was likely affected by limited testing, particularly in the early phases of the outbreak. Finally, the case counts presented are an underestimate of the actual number of COVID-19 cases in the United States.

As the pandemic evolves, control efforts must be continuously refined. Certain interventions that were critical in the early stages, such as quarantine and airport screening, might have less impact when transmission is widespread in the community. However, many elements of the mitigation strategies used during the acceleration phase will still be needed in later stages of the outbreak. Preliminary results from serologic surveys suggest that even in the U.S. regions with the largest numbers of recognized cases, most persons have not been infected and remain susceptible.[§§,¶¶] Therefore, sustained and concerted efforts will be needed to prevent future spread of SARS-CoV-2 within the United States.

§§ https://www.governor.ny.gov/news/video-audio-photos-rush-transcript-amid-ongoing-covid-19-pandemic-governor-cuomo-announces-12.

¶¶ https://www.medrxiv.org/content/10.1101/2020.04.14.20062463v1.

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BOX. Critical factors contributing to COVID-19 spread in New York

Multiple interrelated factors that complicated identification and isolation of cases and tracing of contacts contributed to the COVID-19 outbreak in New York.

Population density

- New York City's boroughs represent the top four population-dense U.S. counties.
- Reliance on mass transit (subways, buses, and ferries) results in frequent, prolonged close contact.
- High prevalence of apartment living contributed to household spread.

Domestic and global destination

- Three major airports serve as domestic and global hubs, serving >1 million air passengers per week.
- Approximately 1.6 million persons commute into Manhattan daily during the work week, primarily using mass transit.

Large number of crowded settings housing vulnerable populations

- Long-term care facilities, skilled nursing facilities: At least 80 facilities in the state have reported five or more cases as of April 21; initial infections were noted in early March.
- Correctional institutions: As of April 21, incidence in Department of Corrections and Community Supervision facilities was approximately seven times that in the state overall.
- Homeless shelters: As of the week of April 21, approximately 600 cases were confirmed among shelter residents and other persons experiencing homelessness.

Large gatherings

- Initial cases in Westchester County were associated with attendance at large gatherings in late February.
- All types of large work and social gatherings accelerated transmission across jurisdictional boundaries.

References

1. Jernigan DB; CDC COVID-19 Response Team. Update: public health response to the coronavirus disease 2019 outbreak—United States, February 24, 2020. MMWR Morb Mortal Wkly Rep 2020;69:216–9. https://doi.org/10.15585/mmwr.mm6908e1
2. Qualls N, Levitt A, Kanade N, et al.; CDC Community Mitigation Guidelines Work Group. Community mitigation guidelines to prevent pandemic influenza—United States, 2017. MMWR Recomm Rep 2017;66(No. RR-1). https://doi.org/10.15585/mmwr.rr6601a1

3. Moriarty LF, Plucinski MM, Marston BJ, et al.; CDC Cruise Ship Response Team; California Department of Public Health COVID-19 Team; Solano County COVID-19 Team. Public health responses to COVID-19 outbreaks on cruise ships—worldwide, February–March 2020. MMWR Morb Mortal Wkly Rep 2020;69:347–52. https://doi.org/10.15585/mmwr.mm6912e3
4. Patel A, Jernigan DB; 2019-nCoV CDC Response Team. Initial public health response and interim clinical guidance for the 2019 novel coronavirus outbreak—United States, December 31, 2019–February 4, 2020. MMWR Morb Mortal Wkly Rep 2020;69:140–6. https://doi.org/10.15585/mmwr.mm6905e1
5. Bialek S, Bowen V, Chow N, et al.; CDC COVID-19 Response Team. COVID-19 Response Team. Geographic differences in covid-19 cases, deaths, and incidence—United States, February 12–April 7, 2020. MMWR Morb Mortal Wkly Rep 2020;69:465–71. https://doi.org/10.15585/mmwr.mm6915e4
6. McMichael TM, Currie DW, Clark S, et al. Epidemiology of Covid-19 in a long-term care facility in King County, Washington. N Engl J Med 2020;NEJMoa2005412. https://doi.org/10.1056/NEJMoa2005412
7. Heinzerling A, Stuckey MJ, Scheuer T, et al. Transmission of COVID-19 to health care personnel during exposures to a hospitalized patient—Solano County, California, February 2020. MMWR Morb Mortal Wkly Rep 2020;69:472–6. https://doi.org/10.15585/mmwr.mm6915e5
8. Pung R, Chiew CJ, Young BE, et al.; Singapore 2019 Novel Coronavirus Outbreak Research Team. Investigation of three clusters of COVID-19 in Singapore: implications for surveillance and response measures. Lancet 2020;395:1039–46. https://doi.org/10.1016/S0140-6736(20)30528-6
9. Rocklöv J, Sjödin H. High population densities catalyze the spread of COVID-19. J Travel Med 2020; Epub March 29, 2020. https://doi.org/10.1093/jtm/taaa038
10. Zwald ML, Lin W, Sondermeyer Cooksey GL, et al. Rapid sentinel surveillance for COVID-19—Santa Clara County, California, March 2020. MMWR Morb Mortal Wkly Rep 2020;69:419–21. https://doi.org/10.15585/mmwr.mm6914e3
11. Gandhi M, Yokoe DS, Havlir DV. Asymptomatic transmission, the Achilles' Heel of current strategies to control Covid-19. 2020. N Engl J Med 2020; Epub April 24, 2020. https://doi.org/10.1056/NEJMe2009758

COVID-19 Among Workers in Meat and Poultry Processing Facilities — 19 States, April 2020

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Congregate work and residential locations are at increased risk for infectious disease transmission including respiratory illness outbreaks. SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19), is primarily spread person to person through respiratory droplets. Nationwide, the meat and poultry processing industry, an essential component of the U.S. food infrastructure, employs approximately 500,000 persons, many of whom work in proximity to other workers (*1*). Because of reports of initial cases of COVID-19, in some meat processing facilities, states were asked to provide aggregated data concerning the number of meat and poultry processing facilities affected by COVID-19 and the number of workers with COVID-19 in these facilities, including COVID-19–related deaths. Qualitative data gathered by CDC during on-site and remote assessments were analyzed and summarized. During April 9–27, aggregate data on COVID-19 cases among 115 meat or poultry processing facilities in 19 states were reported to CDC. Among these facilities, COVID-19 was diagnosed in 4,913 (approximately 3%) workers, and 20 COVID-19–related deaths were reported. Facility barriers to effective prevention and control of COVID-19 included difficulty distancing workers at least 6 feet (2 meters) from one another (*2*) and in implementing COVID-19-specific disinfection guidelines.* Among workers, socioeconomic challenges might contribute to working while feeling ill, particularly if there are management practices such as bonuses that incentivize attendance. Methods to decrease transmission within the facility include worker symptom screening programs, policies to discourage working while experiencing symptoms compatible with COVID-19, and social distancing by workers. Source control measures (e.g., the use of cloth face covers) as well as increased disinfection of high-touch surfaces are also important means of preventing SARS-CoV-2 exposure. Mitigation efforts to reduce transmission in the community should also be considered. Many of these measures might also reduce asymptomatic and presymptomatic transmission (*3*). Implementation of these public health strategies will help protect workers from COVID-19 in this industry and assist in preserving the critical meat and poultry production infrastructure (*4*).

In early April, CDC was alerted to COVID-19 cases among workers in several meat and poultry processing facilities and responded to state and local authorities' requests for on-site or remote technical assistance. Qualitative on-site and remote risk assessments were conducted. All states that had reported at least one case of COVID-19 in a meat or poultry processing facility were contacted for further information. CDC requested aggregate data on the number of meat or poultry facilities affected, number of workers in affected facilities, number of workers with a COVID-19 diagnosis, and number of COVID-19–related deaths among workers. States reported COVID-19 among workers using their own case definitions.

By April 27, CDC had received aggregate data on COVID-19 cases from 19 of 23 states reporting at least one case related to this industry; there were 115 meat or poultry processing facilities with COVID-19 cases, including 4,913 workers with diagnosed COVID-19 (Table 1). Among 17 states reporting the number of workers in their affected facilities, 3.0% of 130,578 workers received diagnoses of COVID-19. The percentage of workers with diagnosed COVID-19 ranged

* https://www.cdc.gov/coronavirus/2019-ncov/community/disinfecting-building-facility.html.

from 0.6% to 18.2%. Twenty COVID-19–related deaths were reported among workers.

Qualitative data from the facility risk assessments identified common characteristics among processing facilities and their workers that might increase risk for transmitting or acquiring SARS-CoV-2 (Table 2). Facility challenges included structural and operational practices that made it difficult to maintain a 6-foot (2-meter) distance while working, especially on production lines, and in nonproduction settings during breaks and while entering and exiting facilities. The pace and physical demands of processing work made adherence to face covering recommendations difficult, with some workers observed covering only their mouths and frequently readjusting their face coverings while working. Some sites were also observed to have difficulty adhering to the heightened cleaning and disinfection guidance recommended for all worksites to reduce SARS-CoV-2 transmission.

Solutions to structural and operational challenges that some facilities adopted included adjusting start and stop times of shifts and breaks to increase physical distance between workers. Outdoor break areas were added at some facilities to decrease contact between workers. Some facilities installed physical (e.g., plexiglass) barriers between workers; however, this was not practical for all worker functions. Symptom and temperature screening of workers was newly instituted in some facilities and improved in others.

Sociocultural and economic challenges to COVID-19 prevention in meat and poultry processing facilities (Table 2) include accommodating the needs of workers from diverse backgrounds who speak different primary languages; one facility reported a workforce with 40 primary languages. This necessitates innovative approaches to educating and training employees and supervisors on safety and health information. In addition, some employees were incentivized to work while ill as a result of medical leave and disability policies and attendance bonuses that could encourage working while experiencing symptoms. Finally, many workers live in crowded, multigenerational settings and sometimes share transportation to and from work, contributing to increased risk for transmission of COVID-19 outside the facility itself. Changing transportation to and from the facilities to increase the number of vehicles and reduce the number of passengers per vehicle helped maintain physical distancing in some facilities.

Discussion

Cases of COVID-19 have been observed in other congregate settings, including long-term care facilities (*5*), acute care hospitals (*6*), correctional facilities (*7*), and homeless shelters (*8*). Similarly, the crowded conditions for workers in meat and poultry processing facilities could result in high risk for SARS-CoV-2 transmission. Respiratory disease outbreaks in this type of setting demonstrate the need for heightened attention to worker safety (*9*). However, COVID-19 among

TABLE 1. COVID-19 among workers in meat and poultry processing plants — 19 states, April 2020*

State	Types of meat or poultry in affected plants	No. of plants affected	No. of workers in affected plants	No. (%) of confirmed COVID-19 cases among workers	No. (%)† COVID-19–related deaths
Colorado	Beef, bison, lamb, poultry	5	7,248	139 (1.9)	5 (3.6)
Delaware	Poultry	6	9,411	336 (3.6)	4 (1.2)
Georgia	Poultry	14	16,500	388 (2.4)	1 (0.3)
Illinois	Beef, pork, poultry	5	6,680	112 (1.7)	1 (0.9)
Iowa	Beef, pork	2	2,075	377 (18.2)	N/A
Kansas	Beef, poultry, other	6	16,600	106 (0.6)	0 (0)
Kentucky	Pork, poultry	2	1,333	18 (1.4)	1 (5.6)
Mississippi	Poultry	9	9,548	123 (1.3)	0 (0)
Missouri	Beef, pork, poultry	3	3,690	36 (1.0)	0 (0)
Nebraska	Beef, pork, poultry	12	19,911	588 (3.0)	1 (0.2)
North Carolina	Pork, poultry	5	14,600	166 (1.1)	0 (0)
Ohio	Pork	1	710	10 (1.4)	0 (0)
Pennsylvania	N/A	22	N/A	858 (—)	1 (0.1)
South Dakota	Beef, pork	2	4,600	794 (17.3)	2 (0.3)
Tennessee	N/A	3	N/A	132 (—)	0 (0)
Texas	Beef, poultry	2	4,800	113 (2.4)	1 (0.9)
Virginia	Poultry	10	7,072	128 (1.8)	2 (1.6)
Washington	Beef	1	1,400	100 (7.1)	1 (1.0)
Wisconsin	Beef, pork	5	4,400	389 (8.8)	0 (0)
Total	**Beef, bison, lamb, pork, poultry, other**	**115**	**130,578**	**4,913 (3.0)§**	**20 (0.4)¶**

Abbreviations: COVID-19 = coronavirus disease 2019; N/A = not available.
* Data submitted during April 20–27, 2020.
† Percentage of deaths among cases.
§ Excludes cases from Pennsylvania and Tennessee because number of workers (denominator) is not available from these states.
¶ Excludes cases from Iowa in the denominator because information on number of deaths is not available from this state.

TABLE 2. Observed challenges and recommended changes in practice in response to COVID-19 among workers in meat and poultry processing facilities — selected states,* April 2020

Category	Challenges to effective prevention and control of COVID-19	Recommended changes in facility practice†
Structural	Maintaining physical distancing during breaks and when employees enter and exit the facility	Adjust start and stop times of breaks and shifts Add outdoor breakrooms
	Maintaining physical distancing on production line	Install physical barriers between workers
	Excluding symptomatic workers	Screen all workers and visitors entering facility and plan for effective isolation for workers who become ill at work
Operational	Maintaining physical distancing on production line	Reduce rate of animal processing
	Adhering to face covering recommendations	Require universal face covering Ensure face coverings conformed to CDC guidance Provide training on donning and doffing
	Adhering to heightened cleaning and disinfection guidelines	Assign additional staff to sanitize "high touch" areas (e.g., handles, buttons, railings) more frequently Add several hand sanitizer dispensers and handwashing stations Implement touch-free time clocks
Sociocultural	Communicating through language and cultural barriers	Engage community partners to develop culturally informed messaging Disseminate messaging in languages spoken among the work force
	Employees live in crowded, multigenerational settings	Include messaging about behaviors employees should take to limit the spread of the virus while at home
	Employees share transportation to and from work	Add additional vehicles to shuttle routes Require use of face coverings during commute
Economic	Employees incentivized to work while ill	Implement personnel policies that provide additional medical leave and disability benefits without loss of seniority or pay Remove financial incentives, such as attendance bonuses

Abbreviation: COVID-19 = coronavirus disease 2019.
* Based on CDC field team deployments to four sites and information gathered from calls with state health departments.
† Based on on-site and remote technical assistance, many facilities have implemented or are planning to implement these strategies.

workers in meat and processing facilities could be due to viral transmission at the workplace or in the community.

The food production industry is considered critical infrastructure, as described by the U.S. Department of Homeland Security, and its workers must be able to operate in an environment of enhanced safety.† CDC has provided guidance for critical infrastructure workers.§ For decisions about workers returning to work after an exposure or COVID-19, CDC suggests consultation with health care providers, occupational safety and health professionals, and state and local health departments.¶ As testing becomes more widely available, consideration should be given to its role in rapidly identifying and addressing COVID-19 in this occupational setting. General interim recommendations for meat and poultry processing facilities will need to be interpreted and applied for each facility (*4*).

To shield workers from various hazards in meat and poultry processing facilities, the preferred approaches are to eliminate a hazard or exposure source, install engineering controls, and implement effective sanitation and cleaning; enhanced administrative measures might also be needed. Employee and visitor screening procedures, such as temperature monitoring and symptom screening, are important to prevent introduction of COVID-19 into a facility from symptomatic persons. Whenever feasible, the workplace should be organized so that workers can be at least 6 feet (2 meters) apart. The nature of workplace modifications that might be needed to accomplish this will vary in each workplace; modifications might require changes in production practice, and feasibility will vary by workplace. Additional engineering options include stationing workers so that they are not facing each other and positioning fans so that they do not blow air from one worker directly onto another. Maintaining recommended hand hygiene requires access not only to handwashing stations, but also sufficient availability and use of alcohol-based hand sanitizer in areas where handwashing is not feasible.

Meat and poultry processing facilities typically employ extensive procedures for cleaning and sanitation as required by the U.S. Department of Agriculture for food safety. Surfaces should be thoroughly cleaned and then disinfected according

† https://www.cisa.gov/sites/default/files/publications/Version_3.0_CISA_Guidance_on_Essential_Critical_Infrastructure_Workers_2.pdf.
§ https://www.cdc.gov/coronavirus/2019-ncov/community/critical-workers/implementing-safety-practices.html.
¶ https://www.cdc.gov/coronavirus/2019-ncov/hcp/disposition-in-home-patients.html.

to usual facility standard operating procedures. "High-touch" areas (e.g., handles, buttons, and railings) should be disinfected with products that meet Environmental Protection Agency criteria for use against SARS-CoV-2 and are approved under the facility's disinfection standard operating procedures.**

Administrative controls can support the infection control plan, including programs that actively encourage symptomatic workers to stay home. Personnel policies that allow the use of leave when ill without loss of seniority or pay can enable symptomatic workers to stay home. Similarly, avoidance of any incentives that might encourage workers to come to work while symptomatic can reduce risk in the workplace. Active symptom screening including temperature monitoring of all workers and visitors entering the facility can also reduce risk for COVID-19 introduction and transmission from symptomatic workers. Other important administrative controls to consider are plans for isolation of workers who become ill while at work and policies that promote social distancing and hand washing in all worksite settings.

To aid in source control, cloth face coverings are recommended by CDC in public settings to potentially help prevent transmission as a complement to social distancing.†† Their use in facilities should be considered when distancing is not feasible but are not a replacement for adequate distancing (*9*). Face coverings should also be worn in nonproduction areas such as entrances, exits, break rooms, shared vehicles, and other areas in which maintenance of social distancing is challenging. Other factors, including potential for contamination and the need for replacement of face coverings, are also important to consider.

Use of personal protective equipment (PPE) in the usual operation of meat and poultry processing facilities is common to protect against hazards, and workers should continue using PPE required for their jobs. In the course of using PPE, facilities should emphasize correct donning and doffing of PPE to prevent contamination of the worker. PPE should be disposed of or properly disinfected and stored when not in use. Face shields are equipment that might serve as both PPE and source control in certain situations.

Periodic infection control and occupational safety and health training should be provided for all workers and supervisors tailored to literacy levels and preferred languages. Specifics of training should include, but are not limited to, what workers should do when they feel ill before or at work, symptoms of COVID-19, medical leave policies, social distancing recommendations, correct donning and doffing of PPE and face coverings, hand hygiene practices, opportunities to access testing as it becomes more widely available, and potential routes of transmission at work and in the community. Training should be provided by culturally competent trainers, in a setting where social distancing can be maintained, in languages spoken by workers and with consideration given to varying levels of education.

The findings in this report are subject to at least four limitations. First, not all states with COVID-19 cases in meat and poultry facilities submitted data for this report. Second, differences in case counts and percentage of workers with COVID-19 are affected by the testing strategies employed, with more infected workers identified in settings with more testing. As a result, data provided on worker infections should not be interpreted as the prevalence of infection for all meat and poultry facility workers. Third, lag time in reporting to the local and state health departments also affects the counts reported, as does the time from disease onset to death in fatal cases. Finally, widespread community transmission in some settings makes determining the source of exposure and infection difficult.

As part of the national COVID-19 response, the recognized risk to meat and poultry facility operation requires prompt action to decrease risks to workers, preserve facility function, and maintain the food supply. Collaborative implementation of engineering controls, administrative controls, enhanced cleaning and disinfection, and source control in meat and poultry processing facilities might reduce COVID-19 among workers supporting this critical industry.

Summary

What is already known about this topic?

Persons in congregate work and residential locations are at increased risk for transmission and acquisition of respiratory infections.

What is added by this report?

COVID-19 cases among U.S. workers in 115 meat and poultry processing facilities were reported by 19 states. Among approximately 130,000 workers at these facilities, 4,913 cases and 20 deaths occurred. Factors potentially affecting risk for infection include difficulties with workplace physical distancing and hygiene and crowded living and transportation conditions.

What are the implications for public health practice?

Improving physical distancing, hand hygiene, cleaning and disinfection, and medical leave policies, and providing educational materials in languages spoken by workers might help reduce COVID-19 in these settings and help preserve the function of this critical infrastructure industry.

** https://www.epa.gov/pesticide-registration/list-n-disinfectants-use-against-sars-cov-2.
†† https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/diy-cloth-face-coverings.html.

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References

1. Bureau of Labor Statistics. May 2019 national industry-specific occupational employment and wage estimates, NAICS 311600—animal slaughtering and processing. Washington, DC: US Department of Labor, Bureau of Labor Statistics; 2019. https://www.bls.gov/oes/current/naics4_311600.htm
2. CDC. Social distancing, quarantine, and isolation. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/social-distancing.html
3. Wei WE, Li Z, Chiew CJ, Yong SE, Toh MP, Lee VJ. Presymptomatic transmission of SARS-CoV-2—Singapore, January 23–March 16, 2020. MMWR Morb Mortal Wkly Rep 2020;69:411–5. http://dx.doi.org/10.15585/mmwr.mm6914e1
4. CDC. Meat and poultry processing workers and employers. Atlanta, GA: US Department of Health and Human Services, CDC; 2020. https://www.cdc.gov/coronavirus/2019-ncov/community/organizations/meat-poultry-processing-workers-employers.html
5. McMichael TM, Clark S, Pogosjans S, et al.; Public Health – Seattle & King County; EvergreenHealth; CDC COVID-19 Investigation Team. COVID-19 in a long-term care facility—King County, Washington, February 27–March 9, 2020. MMWR Morb Mortal Wkly Rep 2020;69:339–42. https://doi.org/10.15585/mmwr.mm6912e1
6. Heinzerling A, Stuckey MJ, Scheuer T, et al. Transmission of COVID-19 to health care personnel during exposures to a hospitalized patient—Solano County, California, February 2020. MMWR Morb Mortal Wkly Rep 2020;69:472–6. https://dx.doi.org/10.15585/mmwr.mm6915e5
7. Akiyama MJ, Spaulding AC, Rich JD. Flattening the curve for incarcerated populations—Covid-19 in jails and prisons. N Engl J Med. Epub Apr 2, 2020. https://dx.doi.org/10.1056/NEJMp2005687
8. Mosites E, Parker EM, Clarke KE, et al. Assessment of SARS-CoV-2 infection prevalence in homeless shelters—four U.S. cities, March 27–April 15, 2020. MMWR Morb Mortal Wkly Rep. 2020. Epub April 22, 2020. https://www.cdc.gov/mmwr/volumes/69/wr/mm6917e1.htm?s_cid=mm6917e1_w
9. Shaw KA, Szablewski CM, Kellner S, Kornegay L, Bair P, Brennan S, et al. Psittacosis outbreak among workers at chicken slaughter plants, Virginia and Georgia, USA, 2018. Emerg Infect Dis 2019;25:2143–5. https://dx.doi.org/10.3201/eid2511.190703

Notes from the Field

Large Measles Outbreak in Orthodox Jewish Communities — Jerusalem District, Israel, 2018–2019

Chen Stein-Zamir, MD, PhD[1,2]; Nitza Abramson MD[1]; Hanna Shoob, MPH[1]

During March 2018–May 2019, an outbreak of 4,115 measles cases occurred in Israel, following international importations, mainly from Ukraine. Approximately one half of the cases (2,202) occurred in residents of Jerusalem District, primarily in unvaccinated children in orthodox Jewish communities. The district's population (1.25 million, approximately 14% of the national population) is 70% Jewish, approximately one third of whom are orthodox Jews. Children in those orthodox communities have lower rates of routine vaccination coverage; for measles vaccine, first dose coverge is 78.4%, compared with 90.1% among children in all other communities. Measles outbreak control in communities with long-standing inadequate vaccination coverage is challenging (*1*). Urgent response measures led to containment of this outbreak; however, sustaining vaccination coverage will require targeted interventions and resources.

The measles outbreak emerged in March 2018 in Israel's Central and Northern districts. The first two cases in Jerusalem were in a student aged 20 years at a religious boarding school and a child aged 2 years. Both were unvaccinated and came to Jerusalem in August 2018 from measles-affected communities in the Northern district. Contacts included 300 of the student's school contacts and 40 of the child's relatives and neighbors. The outbreak quickly spread through the densely populated, low-income orthodox neighborhoods in Jerusalem District, where families have an average of seven children, and households might include 12–15 persons. Transmission intensified during the September–October Jewish high-holiday season, with 1,029 cases reported by October 31, 2018.

Overall, 2,202 cases were reported in Jerusalem District during August 2018–May 2019 (reported incidence = 176 per 100,000 population). Cases were confirmed by reverse transcription–polymerase chain reaction testing or detection of measles-specific immunoglobulin M in 708 (32%) patients and by epidemiologic linkage in 1,494 (68%). Approximately 8% of patients (176) were hospitalized (*2*). Two deaths occurred, one in an unvaccinated child aged 18 months, and the second in an immunocompromised adult, aged 82 years. Most cases (1,660, 75%) occurred in children aged <15 years. The highest reported incidence (1,174 per 100,000 population) occurred in infants aged <1 year, who accounted for 412 (19%) cases. Israel's immunization schedule includes 2 measles-containing vaccine* doses at age 12 months and 6 years. Among 1,248 children with measles aged 1–14 years, 1,104 (88.4%) were unvaccinated; 128 (10.3%) and 16 (1.3%) had received 1 and 2 doses, respectively (Figure).

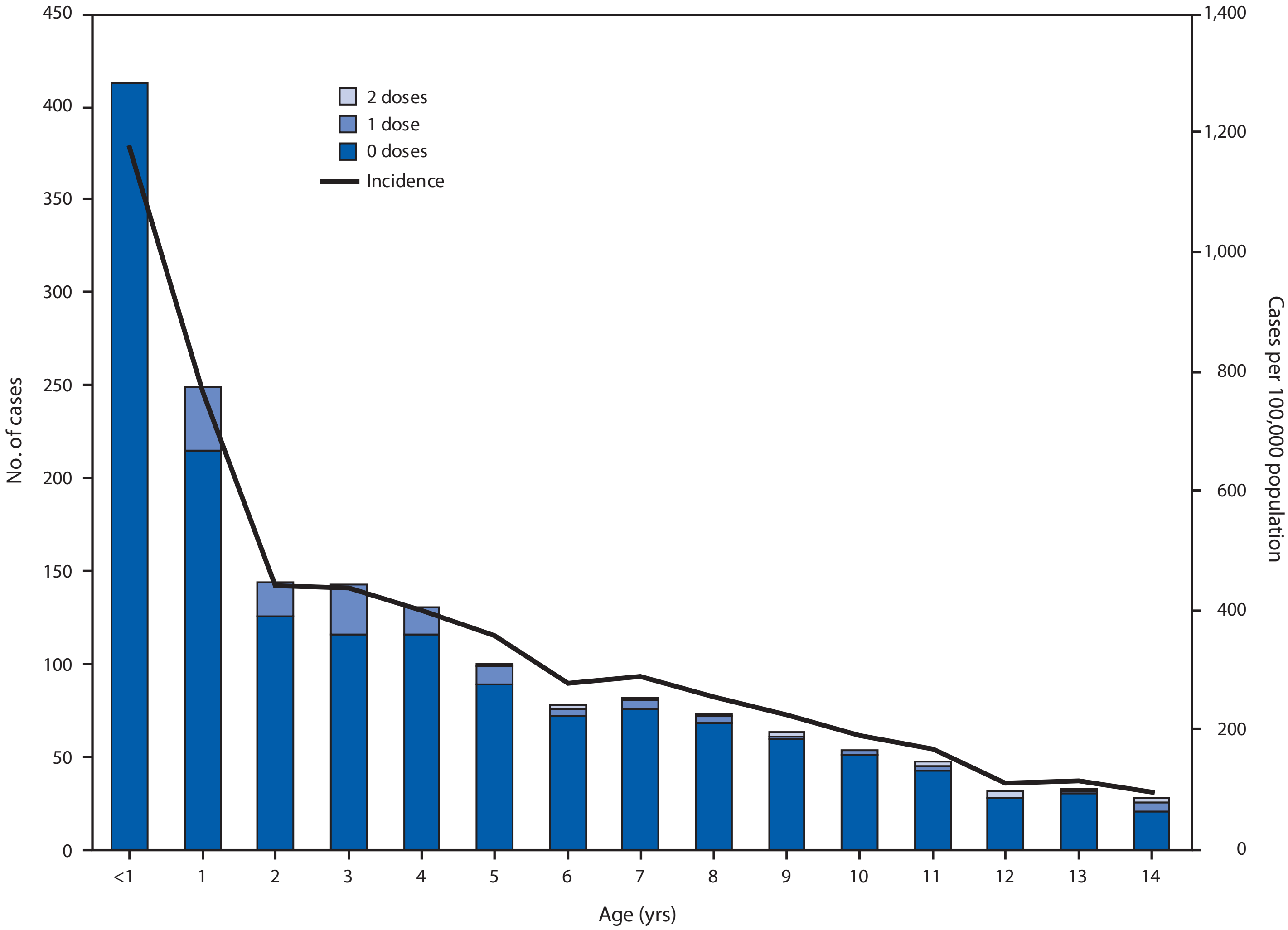
Jerusalem District Health Office teams conducted case finding and confirmation and contact tracing and distributed updates to health care providers. Measles patients and their parents were instructed to self-isolate; however, epidemiologic investigations revealed inadequate adherence. Infectious patients participated in crowded social events, attended child-care facilities, and used public transportation. Because of the large number of close contacts, tracing proved challenging. Outbreak response measures involved providing postexposure prophylaxis† and conducting measles mass vaccination campaigns in the affected neighborhoods, targeting children and adolescents aged 1–14 years. The vaccination campaigns took place during September–December 2018 in outbreak neighborhoods in maternal-child preventive health services clinics (operated in 12-hour working shifts, in all clinics daily, exclusively for vaccinations), school health services, and a mobile vaccination unit. Culturally adapted approaches included dissemination of messages and outreach activities using telephone calls, community visits, and wall posters, and conveying information and guidance through word of mouth.

The emergence of a large number of measles cases and the very high incidence among young children in the orthodox communities engendered parental and societal anxiety and concern. Rabbinic leaders supported the vaccination campaign by issuing positive written statements, resulting in high levels of acceptance and compliance with control activities at the peak of the epidemic. Following the campaign, first-dose measles vaccination coverage in all maternal-child health clinics in orthodox neighborhoods increased from 76.3% in June 2018 to 96.1% in November. Since December 2018, the number of cases has decreased considerably. During October–December 2018, Jerusalem District accounted for 66% (1,652 of 2,486)

* The vaccines used are measles-mumps-rubella-varicella for children aged 12 months–12 years and measles-mumps-rubella vaccine for all other age groups.

† Postexposure prophylaxis with measles vaccine was recommended for infants aged 6–8 months if it could be administered within 72 hours of exposure; otherwise, these infants were recommended to receive immune globulin until 6 days postexposure. Exposed persons aged ≥9 months were offered measles vaccine until 6 days following exposure. Immune globulin (within 6 days of exposure) was recommended for persons at high risk for measles complications, including infants aged <6 months, persons who were immunocompromised, and pregnant women.

FIGURE. Age distribution of measles cases in persons aged <15 years (N = 1,660), by number of doses of measles vaccine received and age-specific measles incidence* — Jerusalem District, Israel, August 2018–May 5, 2019



* Cases per 100,000 population.

of all measles cases in Israel; that percentage declined to 25% (248 of 969) during January–April 2019. As measles outbreaks continue to spread globally (*3*), achieving high, sustainable 2-dose coverage with measles-containing vaccine among age-eligible persons is essential to protect vulnerable groups, including infants too young for vaccination.

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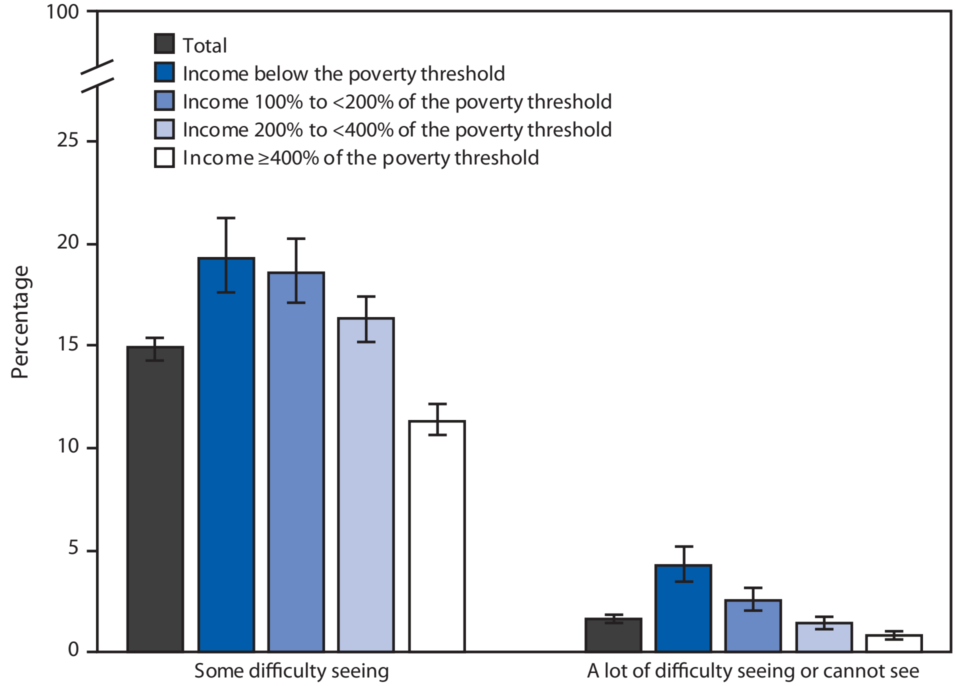
References

1. Stein-Zamir C, Israeli A. Timeliness and completeness of routine childhood vaccinations in young children residing in a district with recurrent vaccine-preventable disease outbreaks, Jerusalem, Israel. Euro Surveill 2019;24. https://doi.org/10.2807/1560-7917.ES.2019.24.6.1800004
2. Ben-Chetrit E, Oster Y, Jarjou'i A, et al. Measles-related hospitalizations and associated complications in Jerusalem, 2018–2019. Clin Microbiol Infect 2019. Epub September 6, 2019. https://doi.org/10.1016/j.cmi.2019.08.022
3. World Health Organization. New measles surveillance data from WHO. Geneva, Switzerland: World Health Organization; 2019. https://www.who.int/immunization/newsroom/new-measles-data-august-2019/en/

QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Age-Adjusted Percentage* of Adults Aged ≥18 Years Who Have Difficulty Seeing Even When Wearing Glasses,† by Poverty Status§ — National Health Interview Survey, United States, 2018¶



* With 95% confidence intervals indicated by error bars.

† Based on the response to survey question that asked "Do you have difficulty seeing, even when wearing glasses? Would you say no difficulty, some difficulty, a lot of difficulty, or are you unable to do this?"

§ Family income groups were defined based on family income as a percentage of the federal poverty threshold. Poverty thresholds, which are published by the U.S. Census Bureau, vary by family size and the number of children in the family. When missing, family income was imputed using multiple imputation methodology.

¶ Estimates are based on household interviews of a sample of the civilian, noninstitutionalized U.S. population, are shown for sample adults aged ≥18 years, and are age-adjusted using the projected 2000 U.S. population as the standard population and using four age groups: 18–44, 45–64, 65–74, and ≥75 years.

In 2018, 14.9% of adults aged ≥18 years had some difficulty seeing even when wearing glasses, and 1.6% had a lot of difficulty or could not see at all. The percentage of adults who had some difficulty seeing even when wearing glasses decreased as income increased, from 19.3% among those with income below the poverty threshold to 11.3% among those with income ≥400% of the poverty threshold. The percentage of adults who had a lot of difficulty or could not see at all also decreased as income increased, from 4.2% among those with income below the poverty threshold to 0.8% among those with income ≥400% of the poverty threshold.

Source: National Center for Health Statistics, National Health Interview Survey, 2018. https://www.cdc.gov/nchs/nhis.htm.

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