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Vaccination Coverage by Age 24 Months Among Children Born in 2016 and 2017 — National Immunization Survey-Child, United States, 2017–2019

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Immunization has been described as a "global health and development success story," and worldwide is estimated to prevent 2–3 million deaths annually.* In the United States, the Advisory Committee on Immunization Practices (ACIP) currently recommends vaccination against 14 potentially serious illnesses by the time a child reaches age 24 months (*1*). CDC monitors coverage with ACIP-recommended vaccines through the National Immunization Survey-Child (NIS-Child); data from the survey were used to estimate vaccination coverage at the national, regional, state, territorial, and selected local area levels† among children born in 2016 and 2017. National coverage by age 24 months was ≥90% for ≥3 doses of poliovirus vaccine, ≥3 doses of hepatitis B vaccine (HepB), and ≥1 dose of varicella vaccine (VAR); national coverage was ≥90% for ≥1 dose of measles, mumps, and rubella vaccine (MMR), although MMR coverage was <90% in 14 states. Coverage with ≥2 doses of influenza vaccine was higher for children born during 2016–2017 (58.1%) than for those born during 2014–2015 (53.8%) but was the lowest among all vaccines studied. Only 1.2% of children had received no vaccinations by age 24 months. Vaccination coverage among

* https://www.who.int/health-topics/vaccines-and-immunization#tab=tab_1.

† Estimates for states, selected local areas, and the territories of Guam and Puerto Rico are available online at https://www.cdc.gov/vaccines/imz-managers/coverage/childvaxview/data-reports/index.html. Certain local areas that receive federal Section 317 immunization funds are sampled separately and included in the NIS-Child sample every year (Chicago, Illinois; New York, New York; Philadelphia County, Pennsylvania; Bexar County, Texas; and Houston, Texas). Other local areas in Texas were sampled in some survey years from 2017–2019 and not others, including El Paso County (survey years 2017 and 2019); Dallas County (survey years 2017 and 2019); Hidalgo County (survey year 2018); and Tarrant County (survey year 2018). Data collection in Puerto Rico was suspended during 2017 because of the severity of the hurricane season and did not occur at all in 2018. Therefore, estimates for Puerto Rico are based on partial data from 2017 and data collected in the full 2019 survey year. National estimates in this report exclude all territories.

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children enrolled in Medicaid or with no health insurance was lower than that among children who were privately insured. The prevalence of being completely unvaccinated was highest among uninsured children (4.1%), lower among those enrolled in Medicaid (1.3%), and lowest among those with private insurance (0.8%). The largest disparities on the basis of health insurance status occurred for ≥2 doses of influenza vaccine and for completion of the rotavirus vaccination series. Considering the disruptions to health care provider operations caused by the coronavirus disease 2019 (COVID-19) pandemic, extra effort will be required to achieve and maintain high levels of coverage with routine childhood vaccinations. Providers, health care entities, and public health authorities can communicate with families about how children can be vaccinated safely during the pandemic, remind parents of vaccinations that are due for their children, and provide all recommended vaccinations to children during clinic visits. This will be especially important for 2020–21 seasonal influenza vaccination to mitigate the effect of two potentially serious respiratory viruses circulating in the community simultaneously.

The NIS-Child is conducted annually as a random-digit–dialed telephone survey[§] of parents and guardians of children aged 19–35 months. Sociodemographic information is collected during the telephone interview, and the respondent is asked to identify all providers who administered vaccines to the child. When consent is obtained, a survey is mailed to each provider requesting the child's vaccination history. If survey responses from multiple providers are returned for a given child, the information is synthesized into a single, comprehensive vaccination history, which is then used to calculate vaccination coverage estimates. NIS-Child data from survey years 2017–2019 were combined to identify 25,970 children with adequate provider data[¶] who were born in 2016 and 2017. For survey year 2019, the household response rate[**]

[§] The NIS-Child used a landline-only sampling frame from 1995 through 2010. From 2011 through 2017, the survey was conducted using a dual-frame design, with both mobile and landline sampling frames included. In 2018, the NIS-Child returned to a single-frame design, with all interviews conducted by mobile telephone.

[¶] Children with at least one vaccination reported by a provider and those who had received no vaccinations were considered to have adequate provider data. "No vaccinations" indicates that the vaccination status is known because the parent or guardian indicated that there were no vaccinations, and the providers returned no immunization history forms or returned them indicating that no vaccinations had been given.

[**] The Council of American Survey Research Organizations (CASRO) household response rate is calculated as the product of the resolution rate (percentage of the total telephone numbers called that were classified as nonworking, nonresidential, or residential), screening completion rate (percentage of known households that were successfully screened for the presence of age-eligible children), and the interview completion rate (percentage of households with one or more age-eligible children that completed the household survey). The CASRO household response rate is equivalent to the American Association for Public Opinion Research type 3 response rate http://www.aapor.org/AAPOR_Main/media/publications/Standard-Definitions20169theditionfinal.pdf. CASRO response rates and the proportions of children with household interviews that had adequate provider data for survey years 2015–2018 are available at https://www.cdc.gov/vaccines/imz-managers/nis/downloads/NIS-PUF18-DUG.pdf.

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TABLE 1. Estimated vaccination coverage by age 24 months,* among children born during 2014–2017 for selected vaccines and doses — National Immunization Survey-Child, United States, 2015–2019

	Birth years†		Difference (2016–2017) to (2014–2015)
	2014–2015	2016–2017	
Vaccine/Dose	**% (95% CI)**	**% (95% CI)**	**% (95% CI)**
DTaP§			
≥3 doses	93.4 (92.9 to 94.0)	93.3 (92.5 to 94.0)	−0.2 (−1.1 to 0.7)
≥4 doses	80.4 (79.4 to 81.3)	80.6 (79.4 to 81.8)	0.2 (−1.3 to 1.7)
Poliovirus (≥3 doses)	91.8 (91.1 to 92.5)	92.1 (91.4 to 92.9)	0.3 (−0.7 to 1.4)
MMR (≥1 dose)¶	90.3 (89.6 to 90.9)	90.7 (89.8 to 91.5)	0.4 (−0.7 to 1.5)
Hib**			
Primary series	92.3 (91.7 to 93.0)	92.2 (91.3 to 93.0)	−0.1 (−1.2 to 0.9)
Full series	79.6 (78.6 to 80.6)	79.9 (78.6 to 81.1)	0.3 (−1.3 to 1.8)
HepB			
Birth dose††	72.1 (70.9 to 73.3)	76.3 (75.0 to 77.5)	4.2 (2.5 to 5.9)§§
≥3 doses	90.4 (89.6 to 91.1)	91.4 (90.5 to 92.2)	1.0 (−0.1 to 2.1)
VAR (≥1 dose)¶	89.7 (88.9 to 90.3)	90.0 (89.1 to 90.9)	0.4 (−0.8 to 1.5)
PCV			
≥3 doses	91.5 (90.8 to 92.2)	91.6 (90.8 to 92.4)	0.1 (−0.9 to 1.2)
≥4 doses	81.2 (80.2 to 82.1)	81.7 (80.5 to 82.8)	0.5 (−1.0 to 2.0)
HepA			
≥1 dose	84.0 (83.1 to 84.8)	85.8 (84.7 to 86.8)	1.8 (0.5 to 3.2)§§
≥2 doses (by age 35 mos)	74.9 (73.5 to 76.3)	76.9 (75.2 to 78.5)	2.0 (−0.2 to 4.1)
Rotavirus (by age 8 mos)¶¶	72.2 (71.0 to 73.3)	75.3 (74.1 to 76.5)	3.2 (1.5 to 4.8)§§
Influenza (≥2 doses)***	53.8 (52.6 to 55.0)	58.1 (56.7 to 59.5)	4.3 (2.5 to 6.2)§§
Combined 7-vaccine series†††	68.4 (67.3 to 69.5)	70.5 (69.1 to 71.9)	2.1 (0.3 to 3.9)§§
No vaccinations	1.3 (1.1 to 1.5)	1.2 (1.0 to 1.4)	−0.1 (−0.3 to 0.2)

Abbreviations: CI = confidence interval; DTaP = diphtheria, tetanus toxoids, and acellular pertussis vaccine; HepA = hepatitis A vaccine; HepB = hepatitis B vaccine; Hib = *Haemophilus influenzae* type b conjugate vaccine; MMR = measles, mumps, and rubella vaccine; PCV = pneumococcal conjugate vaccine, VAR = varicella vaccine.

* Includes vaccinations received by age 24 months (before the day the child turns 24 months), except for the HepB birth dose, rotavirus vaccination, and ≥2 HepA doses by 35 months. For all vaccines except the HepB birth dose and rotavirus vaccination, the Kaplan-Meier method was used to estimate vaccination coverage to account for children whose vaccination history was ascertained before age 24 months (35 months for ≥2 HepA doses).

† Data for the 2014 birth year are from survey years 2015, 2016, and 2017; data for the 2015 birth year are from survey years 2016, 2017, and 2018; data for the 2016 birth year are from survey years 2017, 2018, and 2019; data for the 2017 birth year are considered preliminary and come from survey years 2018 and 2019 (data from survey year 2020 are not yet available).

§ Includes children who might have been vaccinated with diphtheria and tetanus toxoids vaccine or diphtheria, tetanus toxoids, and pertussis vaccine.

¶ Includes children who might have been vaccinated with measles, mumps, rubella, and varicella combination vaccine.

** Hib primary series: receipt of ≥2 or ≥3 doses, depending on product type received; full series: primary series and booster dose, which includes receipt of ≥3 or ≥4 doses, depending on product type received.

†† One dose HepB administered from birth through age 3 days.

§§ Statistically significantly different from zero at p<0.05.

¶¶ Includes ≥2 doses of Rotarix monovalent rotavirus vaccine (RV1), or ≥3 doses of RotaTeq pentavalent rotavirus vaccine (RV5); if any dose in the series is RotaTeq or unknown, a 3-dose series was assumed. The maximum age for the final rotavirus dose is 8 months, 0 days.

*** Doses must be ≥24 days apart (4 weeks with a 4-day grace period); doses could have been received during two influenza seasons.

††† The combined 7-vaccine series (4:3:1:3*:3:1:4) includes ≥4 doses of DTaP, ≥3 doses of poliovirus vaccine, ≥1 dose of measles-containing vaccine, the full series of Hib (≥3 or ≥4 doses, depending on product type), ≥3 doses of HepB, ≥1 dose of VAR, and ≥4 doses of PCV.

was 21.1%, and 49.4% of children with completed household interviews had adequate provider data. Kaplan-Meier (time to event) analysis was used to estimate vaccination coverage for most vaccines by age 24 months while still using information from children whose vaccination status was assessed at age 19–23 months. The birth dose of HepB was assessed at age 3 days, and the rotavirus series was assessed at age 8 months to correspond with timing of ACIP recommendations for those vaccines. Coverage with ≥2 doses of hepatitis A vaccine (HepA) was estimated by age 35 months (the maximum age included in the survey) using Kaplan-Meier methods, because the second HepA dose can be administered as late as 41 months under the current recommended immunization schedule. Coverage estimates for children born in 2016 and 2017 were compared with corresponding estimates for children born in 2014 and 2015. Estimates for children born in 2014 and 2015 were calculated using NIS-Child data from 2015–2018. Differences were evaluated using t-tests on weighted data; p-values <0.05 were considered statistically significant. Analyses were performed using SAS (version 9.4; SAS Institute) and SUDAAN (version 11; Research Triangle Institute).

National Vaccination Coverage

Among children born in 2016 and 2017, the percentage with up to date coverage by age 24 months was highest for

≥3 doses of poliovirus vaccine (92.1%), ≥3 doses of HepB (91.4%), ≥1 dose of MMR (90.7%), and ≥1 dose of VAR (90.0%) (Table 1). Compared with children born in 2014 and 2015, coverage increased for ≥2 doses of influenza vaccine (4.3 percentage points), the HepB birth dose (4.2 percentage points), completion of the rotavirus vaccination series (3.2 percentage points), the combined 7-vaccine series[††] (2.1 percentage points), and ≥1 dose of HepA (1.8 percentage points). However, coverage remained lowest for ≥2 doses of influenza vaccine (58.1%), the combined 7-vaccine series (70.5%), completion of the rotavirus vaccination series (75.3%), and the HepB birth dose (76.3%). The proportion of children who received no vaccinations by age 24 months was 1.2%.

Vaccination by Selected Sociodemographic Characteristics and Geographic Location

Coverage with all vaccines except the HepB birth dose was lower among uninsured children and those insured by any Medicaid plan (with or without another type of insurance) than among privately insured children (Table 2). Differences in coverage between uninsured children and those with private insurance ranged from 9.5 percentage points (≥3 HepB) to 33.9 percentage points (≥2 doses of influenza vaccine). Disparities between children insured by any Medicaid and those with private insurance tended to be smaller, ranging from 2.7 percentage points (≥1 VAR) to 20.3 percentage points (≥2 doses of influenza vaccine). The proportion of children who had received no vaccines was higher among uninsured (4.1%) and Medicaid-insured children (1.3%) than those privately insured (0.8%). Disparities in coverage were also observed by race/ethnicity (Supplementary Table 1, https://stacks.cdc.gov/view/cdc/95228), poverty level (Supplementary Table 2, https://stacks.cdc.gov/view/cdc/95260), and metropolitan statistical area (MSA)[§§] status (Supplementary Table 2, https://stacks.cdc.gov/view/cdc/95260). The disparities, although smaller in magnitude than those associated with health insurance status, were present for nearly all vaccines based on poverty status but were much less consistent for race/ethnicity or MSA status. Estimated coverage varied widely by state/local area (Supplementary Table 3, https://stacks.cdc.gov/view/cdc/95261), most notably for ≥2 doses of influenza vaccine, with estimates ranging from 38.9% in Florida to 81.7% in Massachusetts (Figure).

Discussion

For most ACIP-recommended childhood vaccines, coverage was stable by year of birth from 2011 to 2017.[¶¶] The percentage of children who received no vaccinations ranged from 0.9% for those born in 2011 and 2017 to 1.5% for those born in 2016; the linear relationship between the prevalence of children receiving no vaccinations and birth year was not statistically significant.[***] More recent increases have been observed for ≥2 doses of influenza vaccine, the HepB birth dose, completion of the rotavirus vaccination series, ≥1 dose of HepA, and the combined 7-vaccine series. However, not all children have benefited from the high and increasing national-level coverage. Coverage among uninsured children and those insured by Medicaid is lower than that among privately insured children. The lowest coverage and largest insurance-related disparities were associated with ≥2 doses of influenza vaccine; increasing influenza vaccination coverage is particularly important this season, given the likely cocirculation of influenza virus and SARS-CoV-2, the virus that causes COVID-19.

Children aged 6–59 months are at increased risk for severe illness and complications from influenza and for influenza-related outpatient, emergency department, or hospital visits (*2*). Most children are recommended to receive 3 doses of influenza vaccine by age 24 months, depending on their month of birth and the months considered as the seasonal influenza vaccination period (*2*). Thus, the percentage of children fully vaccinated by age 24 months per ACIP recommendations is lower than the estimates for receipt of ≥2 influenza vaccine doses in this report, which are based on criteria from the Healthcare Effectiveness Data and Information Set (HEDIS).[†††] Current efforts to increase influenza vaccination coverage are especially important, given that SARS-CoV-2 and influenza virus are likely to be circulating in the population simultaneously during the fall and winter of 2020–21. Both viruses are associated with significant morbidity and mortality, and together they could impose considerable strain on the public health and medical systems in the United States (*3*,*4*).

Coverage with influenza and most other vaccines was lower for children with Medicaid or no health insurance. The

[††] The combined 7-vaccine series (4:3:1:3*:3:1:4) includes ≥4 doses of diphtheria and tetanus toxoids and acellular pertussis vaccine; ≥3 doses of poliovirus vaccine; ≥1 dose of measles-containing vaccine; ≥3 or ≥4 doses (depending upon product type) of *Haemophilus influenzae* type b conjugate vaccine; ≥3 doses of hepatitis B vaccine; ≥1 dose of varicella vaccine; and ≥4 doses of pneumococcal conjugate vaccine.

[§§] MSA status was determined based on household reported city and county of residence and was grouped into three categories: MSA principal city, MSA nonprincipal city, and non-MSA. MSAs and principal cities were as defined by the U.S. Census Bureau (https://www.census.gov/programs-surveys/metro-micro.html). Non-MSA areas include urban populations not located within an MSA as well as completely rural areas.

[¶¶] https://www.cdc.gov/vaccines/imz-managers/coverage/childvaxview/pubs-presentations/NIS-child-vac-coverage-2016-2017-tables.html#supp-figure-01.

[***] https://www.cdc.gov/vaccines/imz-managers/coverage/childvaxview/pubs-presentations/NIS-child-vac-coverage-2016-2017-tables.html#supp-figure-02.

[†††] https://www.ncqa.org/hedis/measures/childhood-immunization-status/.

TABLE 2: Estimated vaccination coverage by age 24 months* among children born during 2016–2017,† by selected vaccines and doses and health insurance status§ — National Immunization Survey-Child, United States, 2017–2019

	Health insurance status, % (95% CI)			
	Private only (referent)	Any Medicaid	Other insurance	Uninsured
Vaccine/Dose	n = 13,659	n = 9,278	n = 2,226	n = 807
DTaP¶				
≥3 doses	95.9 (94.9–96.7)	91.3 (90.0–92.5)**	93.5 (91.5–95.1)**	84.7 (80.5–88.5)**
≥4 doses	86.0 (84.3–87.5)	76.6 (74.5–78.5)**	79.6 (75.6–83.2)**	65.6 (59.8–71.3)**
Poliovirus (≥3 doses)	95.0 (93.9–95.9)	90.1 (88.7–91.4)**	92.0 (89.7–93.8)**	82.7 (78.2–86.7)**
MMR (≥1 dose)††	92.8 (91.4–94.0)	89.4 (87.9–90.8)**	90.7 (88.3–92.8)	79.6 (74.9–84.0)**
Hib§§				
Primary series	94.6 (93.3–95.7)	90.4 (89.0–91.8)**	92.8 (90.7–94.6)**	82.9 (78.5–86.9)**
Full series	85.2 (83.5–86.7)	75.7 (73.6–77.7)**	81.3 (77.5–84.8)**	61.7 (56.0–67.5)**
HepB				
Birth dose¶¶	77.3 (75.6–78.9)	76.3 (74.2–78.3)	72.4 (67.5–76.8)	72.5 (67.1–77.3)
≥3 doses	93.2 (92.1–94.1)	90.1 (88.5–91.5)**	92.1 (90.0–94.0)	83.7 (79.4–87.5)**
VAR (≥1 dose)††	92.2 (90.8–93.4)	89.5 (88.0–90.9)**	87.9 (85.0–90.4)**	74.8 (69.3–80.1)**
PCV				
≥3 doses	94.2 (93.0–95.3)	89.8 (88.4–91.1)**	92.1 (89.9–93.9)	81.3 (76.8–85.4)**
≥4 doses	87.5 (86.0–89.0)	77.3 (75.3–79.3)**	81.1 (77.3–84.6)**	64.0 (58.0–70.0)**
HepA				
≥1 dose	88.0 (86.4–89.5)	84.7 (83.0–86.3)**	85.4 (82.5–88.1)	71.5 (65.9–76.9)**
≥2 doses (by age 35 mos)	80.5 (78.5–82.5)	75.7 (72.6–78.6)**	75.1 (70.3–79.6)**	49.2 (41.9–57.1)**
Rotavirus (by age 8 mos)***	84.6 (83.2–85.9)	67.5 (65.3–69.6)**	76.3 (72.7–79.6)**	55.7 (49.5–61.7)**
Influenza (≥2 doses)†††	69.6 (67.7–71.4)	49.3 (47.1–51.6)**	53.8 (48.7–59.1)**	35.7 (30.2–41.9)**
Combined 7-vaccine series§§§	76.9 (75.1–78.7)	65.7 (63.4–67.9)**	70.4 (65.8–74.8)**	50.6 (44.7–56.8)**
No vaccinations	0.8 (0.6–1.1)	1.3 (1.0–1.6)**	1.7 (1.0–2.7)	4.1 (2.7–5.9)**

Abbreviations: CI = confidence interval; DTaP = diphtheria, tetanus toxoids, and acellular pertussis vaccine; HepA = hepatitis A vaccine; HepB = hepatitis B vaccine; Hib = *Haemophilus influenzae* type b conjugate vaccine; MMR = measles, mumps, and rubella vaccine; PCV = pneumococcal conjugate vaccine; VAR = varicella vaccine.

* Includes vaccinations received by age 24 months (before the day the child turns 24 months), except for the HepB birth dose, rotavirus vaccination, and ≥2 HepA doses by age 35 months. For all vaccines except the HepB birth dose and rotavirus vaccination, the Kaplan-Meier method was used to estimate vaccination coverage to account for children whose vaccination history was ascertained before age 24 months (35 months for ≥2 HepA doses).

† Data for the 2016 birth year are from survey years 2017, 2018, and 2019; data for the 2017 birth year are considered preliminary and come from survey years 2018 and 2019 (data from survey year 2020 are not yet available).

§ Children's health insurance status was reported by parent or guardian. "Other insurance" includes the Children's Health Insurance Program (CHIP), military insurance, coverage via the Indian Health Service, and any other type of health insurance not mentioned elsewhere.

¶ Includes children who might have been vaccinated with diphtheria and tetanus toxoids vaccine or diphtheria, tetanus toxoids, and pertussis vaccine.

** Statistically significant ($p<0.05$) difference compared with the referent group.

†† Includes children who might have been vaccinated with measles, mumps, rubella, and varicella combination vaccine.

§§ Hib primary series: receipt of ≥2 or ≥3 doses, depending on product type received; full series: primary series and booster dose, which includes receipt of ≥3 or ≥4 doses, depending on product type received.

¶¶ One dose HepB administered from birth through age 3 days.

*** Includes ≥2 doses of Rotarix monovalent rotavirus vaccine (RV1), or ≥3 doses of RotaTeq pentavalent rotavirus vaccine (RV5); if any dose in the series is RotaTeq or unknown, a 3-dose series was assumed. The maximum age for the final rotavirus dose is 8 months, 0 days.

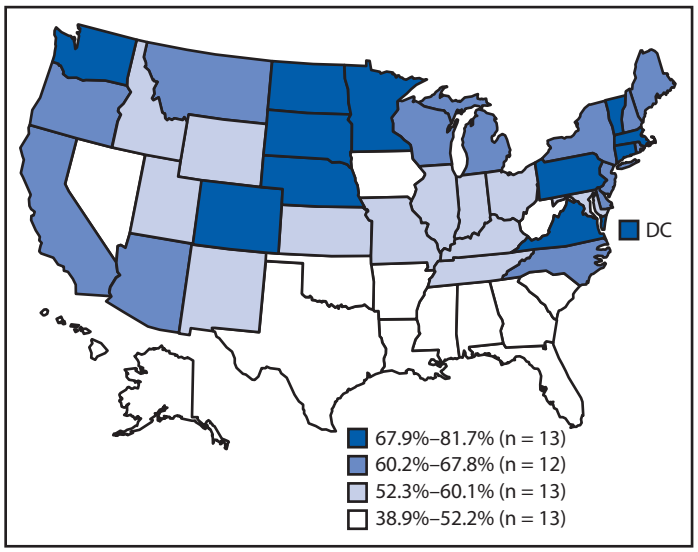
††† Doses must be ≥24 days apart (4 weeks with a 4-day grace period); doses could have been received during two influenza seasons. Children aged 6 months to 8 years should receive 2 doses separated by ≥4 weeks if they did not receive ≥2 doses during the previous flu season.

§§§ The combined 7-vaccine series (4:3:1:3*:3:1:4) includes ≥4 doses of DTaP, ≥3 doses of poliovirus vaccine, ≥1 dose of measles-containing vaccine, the full series of Hib (≥3 or ≥4 doses, depending on product type), ≥3 doses of HepB, ≥1 dose of VAR, and ≥4 doses of PCV.

Vaccines for Children (VFC) program§§§ provides recommended vaccines at no cost to children aged ≤18 years who are Medicaid-eligible, uninsured, American Indian/Alaska Native, or insured by health plans that do not fully cover all routine immunization; however, parents of eligible children might be unaware of VFC or might face difficulty accessing vaccination services. Increased awareness of the program and assistance locating VFC providers could facilitate improved vaccination coverage among eligible children. Observed coverage was also lower among children living in poverty. Although this could indicate challenges accessing VFC, for which many of these children likely qualify, lower family income has also been associated with more parental vaccine hesitancy (*5*). Strategies for responding to vaccine hesitancy and other barriers to vaccination are described in a framework newly developed by CDC and its partners called Vaccinate with Confidence (*6*), which outlines activities designed to increase vaccination coverage by helping to protect communities, empower families, and stop vaccination-related myths.

§§§ https://www.cdc.gov/vaccines/programs/vfc/.

FIGURE. Estimated vaccination coverage with ≥2 doses of influenza vaccine* by age 24 months, among children born during 2016–2017† — National Immunization Survey-Child, United States, 2017–2019



Abbreviation: DC = District of Columbia.
* Doses must be ≥24 days apart (4 weeks with a 4-day grace period); doses could have been received during two influenza seasons.
† Data from the 2016 birth year are from survey years 2017, 2018, and 2019; data for the 2017 birth year are considered preliminary and come from survey years 2018 and 2019 (data from survey year 2020 are not yet available).

Summary

What is already known about this topic?

The National Immunization Survey-Child monitors coverage with vaccines recommended for children age <24 months to protect against 14 potentially serious illnesses.

What is added by this report?

National coverage with many recommended vaccines has remained high and stable, with recent increases for several vaccines for children born during 2016–2017 compared with those born during 2014–2015. Large coverage disparities by health insurance and poverty status persist.

What are the implications for public health practice?

The COVID-19 pandemic has disrupted routine medical care. Extra effort will be required to achieve and maintain high levels of coverage with recommended childhood vaccinations. This is especially important for seasonal influenza vaccination to mitigate the effect of cocirculation of two serious respiratory viruses.

The findings in this report are subject to at least two limitations. First, the low response rate and exclusion of phoneless and landline-only households creates the possibility for bias if study participants are not representative of U.S. children of the corresponding age. Second, coverage could be underestimated as a result of an incomplete list of vaccination providers identified by parents or providers not returning the vaccination history survey. A recent assessment of total survey error¶¶¶ has shown that NIS-Child estimates might slightly underestimate true coverage for MMR and ≥4 DTaP, and by as much as nine percentage points for the combined 7-vaccine series. Evidence for a change in survey accuracy from 2018 to 2019 was not apparent.**** Estimates of coverage with ≥2 influenza vaccine doses by age 24 months might differ from other CDC estimates that are specific to each influenza season or based on parent report of their child's vaccination status (*7*).

By the early spring of 2020, the COVID-19 pandemic was rapidly expanding in the United States, and as the number of cases increased over the subsequent weeks and months, state and local governments increasingly imposed stay-at-home orders in an effort to slow the spread of disease.†††† Although CDC continued to emphasize the importance of well child exams and immunization during the pandemic, disruptions occurred in nearly all parts of society, including routine medical care such as vaccination (*8*). Extra effort to ensure that children continue receiving life-saving vaccines, especially uninsured children and those insured by Medicaid, is critical. Many providers' ability to deliver routinely recommended childhood vaccines has likely recovered following the initial impact of the pandemic (*9*,*10*). Health care and public health authorities can communicate with families about how vaccinations can be provided safely during the pandemic, remind parents of vaccinations that are due or overdue for their children, and administer all recommended vaccinations to children during clinic visits. Providers should use every opportunity to safely administer recommended vaccines to children during the COVID-19 pandemic, with particular attention to influenza vaccination during fall and winter.§§§§

¶¶¶ https://www.cdc.gov/vaccines/imz-managers/nis/downloads/NIS-PUF18-DUG.pdf.
**** https://www.cdc.gov/vaccines/imz-managers/coverage/childvaxview/pubs-presentations/NIS-child-vac-coverage-2016-2017-tables.html#supp-table-01.

†††† https://www.finra.org/rules-guidance/key-topics/covid-19/shelter-in-place.
§§§§ https://www.cdc.gov/vaccines/pandemic-guidance/index.html.

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Morbidity and Mortality Weekly Report

Valley Fever (Coccidioidomycosis) Awareness — California, 2016–2017

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Valley fever (coccidioidomycosis) is endemic in the southwestern United States and caused by inhalation of *Coccidioides* spp. fungal spores from soil or dust; 97% of U.S. Valley fever cases are reported from Arizona and California (*1*). In California, Valley fever incidence increased 213% from 2014 to 2018 (*2*). In 2016, the California Department of Public Health (CDPH) added three questions to the adult California Behavioral Risk Factor Surveillance System (BRFSS) survey to better understand whether Californians had heard of Valley fever, knew the environmental risk where they live, and knew who is at risk for severe disease. A total of 2,893 BRFSS respondents aged ≥18 years answered at least one Valley fever question. Using the weighted California population, 42.4% of respondents reported general awareness of Valley fever; awareness was lowest among adults aged 18–44 years (32.9%) and Hispanic persons (26.4%). In addition, despite higher percentages reporting awareness of Valley fever, only 25.0% of persons living in a high-incidence region and 3.0% of persons living in a moderate-incidence region were aware that they lived in areas where *Coccidioides* spp. exist. Among persons with one or more risk factors for severe disease, 50.8% reported having heard about Valley fever, but only 3.5% knew they were at increased risk for severe disease. The findings from this survey helped to inform a statewide Valley fever awareness campaign implemented during 2019–2020 and to guide outreach to persons living in high- and moderate-incidence regions in California and potentially other southwestern states or who are at risk for severe disease.

Valley fever usually is a self-limited illness with cough, fever, chest pain, or fatigue; however, some persons develop severe disease, and in rare cases, death occurs (*3*). Persons at risk for severe disease include adults aged ≥65 years, Black persons, Filipino persons, pregnant women, persons who smoke, and persons with diabetes or weakened immune systems (*3*–*5*). Because there is no vaccine and *Coccidioides* is an environmental pathogen, public awareness of Valley fever, particularly in high- and moderate-incidence regions and among groups at risk for severe disease, can aid in earlier disease recognition and management. In Arizona, analysis of enhanced Valley fever surveillance suggested that increasing public and provider education might reduce unnecessary treatment, relieve patient anxiety, and improve early recognition, diagnosis, and proper treatment (*6*). Given recent increases in Valley fever incidence in California, CDPH has aimed to increase educational efforts in an evidence-based manner, with an extended statewide campaign during 2019–2020.

The California BRFSS is a telephone survey that collects data on health-related behaviors using random-digit dialing of landline and cell phone numbers (*7*), which afforded CDPH an opportunity to collect baseline information on whether Californians knew of Valley fever, risks for environmental transmission, or becoming severely ill. To assess Valley fever awareness, 3,485 California residents in the February 2016–February 2017 BRFSS survey were asked three Valley fever questions. Respondents were excluded from all analyses if sex, age, or race/ethnicity data were missing. Additional respondents were excluded from analyses of individual questions if they replied, "Don't know," refused to answer, or if data were otherwise missing. BRFSS survey design methodology and California BRFSS weighting were used to generate population response estimates (*7*).

First, general Valley fever awareness was assessed by asking, "Have you heard about the fungal disease called Valley fever, also known as coccidioidomycosis or cocci?" Second, environmental risk awareness was assessed by asking "The Valley fever fungus exists naturally in the soil in some areas, and persons living in these areas can get infected. Do you live in an area where the Valley fever fungus exists?" Third, knowledge of being at increased risk for severe disease was assessed by asking, "Some persons are at increased risk for severe Valley fever if infected. Are you one of these persons at increased risk for severe Valley fever?" The percentages of "Yes" responses for each question were analyzed by sex, age, race/ethnicity, severe disease risk groups, and incidence region as appropriate.

Groups at risk for severe disease were defined as adults aged ≥65 years, Black persons, Filipino persons, and persons with prediabetes or diabetes or who currently smoke. Incidence regions were defined based on the median county-specific number of Valley fever cases per 100,000 population per year during 2012–2017 and categorized into these regions: high incidence (≥10 per 100,000 population: Fresno, Kern, Kings, Madera, Merced, Monterey, San Joaquin, San Luis Obispo, Stanislaus, and Tulare counties), moderate incidence (2–9 cases per 100,000: Alameda, Calaveras, Contra Costa, Imperial, Los Angeles, Mariposa, Orange, Riverside, Santa Barbara, San Bernardino, Santa Cruz, San Diego, Solano, Tuolumne, and Ventura counties), and low incidence (<2 per 100,000: all other California counties). A first order Rao-Scott chi-squared test was used to compute p-values with <0.05 considered

statistically significant. All analyses were conducted using SAS (version 9.4; SAS Institute).

Among 3,485 Californians surveyed, 2,893 (83.0%) responded to at least one Valley fever question, and 592 (17.0%) were excluded for not responding to any Valley fever question. After exclusion for missing data and weighting adjustment, 2,851 respondents were included in the analyses, with varying numbers of respondents for each question (range = 99.1%–99.6%).

Statewide, 42.4% of 2,824 respondents to the question, "Have you heard of Valley fever?" answered affirmatively, including 66.3%, 35.1%, and 45.0% in the high-, moderate-, and low-incidence regions, respectively (Table 1). Awareness was highest among adults aged ≥65 years (61.1%) and lowest among those aged 18–44 years (32.9%), and Hispanic persons (26.4%).

Statewide, 6.1% of 2,837 participants responded affirmatively to the question, "Do you live in an area where the Valley fever fungus exists?" including 25.0% in the high-incidence region and 3.0% each in the moderate- and low-incidence regions (Table 2). In the high-incidence region, environmental awareness was highest among adults aged ≥65 years (48.6%), and non-Hispanic White persons (40.7%); and lowest among adults aged 18–44 years (10.5%) and Hispanic persons (11.3%). In the moderate-incidence region, <5% of all demographic groups responded affirmatively to the environmental risk question.

Among 2,841 respondents to the severe Valley fever risk question, 1,272 (44.7%) had one or more risk factors for severe Valley fever based on BRFSS data (Table 3). Of those with one or more risk factors for severe Valley fever, 50.8% reported general Valley fever awareness, but only 3.5% responded that they were at increased risk for severe Valley Fever. When stratified by risk factors, which were not mutually exclusive, Black persons had both the lowest general Valley fever awareness (37.1%) and the lowest awareness of being at increased risk for severe disease (1.3%). Filipino persons and adults aged ≥65 years had higher general awareness of Valley fever (61.6% and 61.1%, respectively) but not for being at increased risk for severe disease (5.9% and 3.4%, respectively).

Summary

What is already known about this topic?

Valley fever (coccidioidomycosis) incidence in California has increased significantly since 2014.

What is added by this report?

During 2016–2017, 42.4% of California Behavioral Risk Factor Surveillance System survey respondents reported general Valley fever awareness, but only 25.0% of persons living in a high-incidence region were aware that they lived where *Coccidioides* spp. exist. Among persons at increased risk for severe disease, only 3.5% knew that they were at increased risk.

What are the implications for public health practice?

Public awareness of Valley fever, particularly in high and moderate-incidence regions and among groups at risk for severe disease, can aid in earlier disease recognition and management. These survey results helped guide a statewide Valley fever awareness campaign in California and potentially might inform programs in other southwestern states where persons are at risk for severe disease.

Discussion

The 2016–2017 California BRFSS survey indicated that fewer than half of Californians had general Valley fever awareness, and awareness was lowest among persons living in moderate-incidence regions, adults aged <45 years, and non-White residents. In the high-incidence region, general Valley fever awareness (66.3%) was much higher than that in the moderate- and low-incidence region; suggesting that local Valley fever awareness efforts in the high-incidence region (e.g., by providers, public health, media, and support groups in Kern and neighboring counties) (*8*,*9*), have produced increased awareness. Despite that, only 25% persons living in the high-incidence region, and even fewer Hispanics (11.3%) and adults aged 18–44 years (10.5%) in this region, knew that *Coccidioides* spp. existed in this area. In the moderate-incidence region, which included southern California, accounting for >50% of the state's population, environmental risk awareness was even lower (<5%) among all groups.

Among persons at increased risk for severe disease, approximately half had general Valley fever awareness but only 3.5% knew of their increased risk for severe disease. Raising Valley fever awareness in these populations at risk for severe disease is critical to increasing knowledge that could help reduce exposure to dust in areas where *Coccidioides* spp. exists; in addition, if persons become infected, recognizing their illness as Valley fever and seeking earlier clinical care might lead to improved outcomes.

The findings in this report are subject to at least four limitations. First, the number of respondents was relatively small; therefore, results might not be generalizable to the entire state population. Second, analyses were based on the respondent's county of residence, which might differ from where *Coccidioides* spp. exposures might occur. Third, certain risk factors for severe disease could not be included because they were not available or prevalent in BRFSS, notably pregnancy and immunosuppression (e.g., treatment for cancer or human immunodeficiency virus infection). Finally, BRFSS weighting factors are based on the total California population and might not represent smaller geographic areas (*7*).

TABLE 1. Respondents* who had ever heard of Valley fever,† by selected region and characteristics — Behavioral Risk Factor Surveillance System survey, California, 2016–2017

Characteristic	No.§	% who said yes	% of weighted state population who said yes (95% CI)	p-value
Statewide totals	**2,824**	**44.0**	**42.4 (39.1–45.7)**	—
Sex				
Female	1,501	45.7	41.1 (36.3–45.9)	0.427
Male	1,323	42.1	43.7 (39.3–48.2)	
Age group (yrs)				
18–44	1,049	29.4	32.9 (27.7–38.1)	<0.001
45–64	1,068	47.9	48.7 (43.8–53.7)	
≥65	707	59.8	61.1 (56.1–66.1)	
Race/Ethnicity				
White, NH	1,420	57.6	57.7 (53.7–61.7)	<0.001
Hispanic	925	25.6	26.4 (20.7–32.0)	
Non-White, NH	479	39.2	34.1 (26.2–42.1)	
High-incidence region¶				
Region total	**399**	**71.7**	**66.3 (53.5–79.1)**	—
Sex				
Female	237	70.9	61.7 (43.6–79.8)	0.238
Male	162	72.8	74.1 (61.6–86.5)	
Age group (yrs)				
18–44	149	59.1	53.5 (34.6–72.3)	<0.001
45–64	153	76.5	83.5 (76.2–90.8)	
≥65	97	83.5	85.3 (77.3–93.3)	
Race/Ethnicity				
White, NH	190	83.7	85.4 (77.8–93.0)	0.0021
Hispanic	170	60.6	58.6 (43.0–74.2)	
Non-White, NH	39	61.5	38.3 (1.5–75.1)	
Moderate-incidence region**				
Region total	**1,727**	**37.6**	**35.1 (31.1–39.1)**	—
Sex				
Female	919	39.1	33.4 (28.2–38.6)	0.387
Male	808	35.9	36.9 (30.9–42.8)	
Age group (yrs)				
18–44	654	23.7	25.8 (19.9–31.8)	<0.001
45–64	665	41.2	42.5 (36.2–48.9)	
≥65	408	53.9	55.1 (48.1–62.1)	
Race/Ethnicity				
White, NH	791	54.5	54.4 (48.7–60.1)	<0.001
Hispanic	626	17.1	17.0 (11.5–22.5)	
Non-White, NH	310	35.8	30.4 (21.5–39.4)	
Low-incidence region††				
Region Total	**576**	**44.1**	**45.0 (38.0–52.0)**	—
Sex				
Female	274	46.7	43.8 (33.1–54.5)	0.786
Male	302	41.7	45.7 (37.0–54.4)	
Age group (yrs)				
18–44	213	27.2	37.6 (25.6–49.6)	0.092
45–64	205	50.7	47.4 (36.3–58.6)	
≥65	158	58.2	56.6 (46.1–67.1)	
Race/Ethnicity				
White, NH	346	52.0	51.7 (43.6–59.7)	0.035
Hispanic	114	21.1	25.7 (11.8–39.7)	
Non-White, NH	116	43.1	43.0 (27.1–58.9)	

Abbreviations: CI = confidence interval; NH = non-Hispanic.

* Based on the weighted California percentage of respondents.

† Based on response to question 1: "Have you heard about the fungal disease called Valley Fever, also known as coccidioidomycosis or cocci?"

§ Number represents adjusted survey counts, where responses missing either sex, age, or race and ethnicity values was removed from the analysis; respondents missing county information were removed from regional analysis.

¶ High-incidence region: = ≥10 cases per 100,000 population (Fresno, Kern, Kings, Madera, Merced, Monterey, San Joaquin, San Luis Obispo, Stanislaus, and Tulare counties).

** Moderate-incidence region: = 2–9 cases per 100,000 population (Alameda, Calaveras, Contra Costa, Imperial, Los Angeles, Mariposa, Orange, Riverside, Santa Barbara, San Bernardino, Santa Cruz, San Diego, Solano, Tuolumne, and Ventura counties).

†† Low-incidence region: = <2 cases per 100,000 population (all other California counties).

TABLE 2. Percentage of Behavioral Risk Factor Surveillance System survey respondents* who indicated they live in an area where the Valley fever fungus exists, by selected region and characteristics — California, 2016–2017

Characteristic	No.†	% who said yes	% of weighted state population who said yes (95% CI)	p-value
High-incidence region§				
Total	**401**	**33.2**	**25.0 (18.0–32.0)**	—
Sex				
Female	238	31.9	22.2 (13.3–31.1)	0.332
Male	163	35.0	28.7 (18.2–39.2)	
Age group (yrs)				
18–44	149	16.8	10.5 (4.3–16.6)	<0.001
45–64	153	39.9	42.0 (30.0–54.1)	
≥65	99	47.5	48.6 (35.6–61.5)	
Race/Ethnicity				
White, NH	192	43.2	40.7 (30.6–50.7)	0.003
Hispanic	170	22.9	11.3 (6.1–16.4)	
Non-White, NH	39	28.2	16.5 (0.0–36.0)	
Moderate-incidence region¶				
Total	**1,737**	**3.5**	**3.0 (2.0–4.0)**	—
Sex				
Female	928	2.6	2.5 (1.0–4.1)	0.650
Male	809	4.4	3.0 (1.6–4.5)	
Age group (yrs)				
18–44	654	2.6	2.6 (0.9–4.3)	0.800
45–64	666	4.7	2.8 (1.5–4.0)	
≥65	417	2.9	3.6 (0.9–6.2)	
Race/Ethnicity				
White, NH	798	4.5	4.1 (2.0–6.3)	0.104
Hispanic	627	2.7	2.2 (0.9–3.5)	
Non-White, NH	312	2.2	1.5 (0.0–3.1)	
Low-incidence region				
Total	**577**	**4.3**	**3.0 (1.2–4.0)**	—
Sex				
Female	273	3.3	2.1 (0.2–3.9)	0.499
Male	304	5.3	3.0 (0.9–5.1)	
Age group (yrs)				
18–44	214	2.3	1.6 (0.0–3.4)	0.387
45–64	204	5.4	2.9 (0.4–5.5)	
≥65	159	5.7	4.2 (0.7–7.7)	
Race/Ethnicity				
White, NH	348	4.9	3.4 (1.1–5.7)	0.116
Hispanic	114	6.1	3.1 (0.1–6.1)	
Non-White, NH	115	0.9	0.5 (0.0–1.5)	

Abbreviations: CI = confidence interval; NH = non-Hispanic.
* Based on weighted California percentage of respondents.
† Number represents adjusted survey counts, where responses missing either sex, age, or race and ethnicity values was removed from the analysis; respondents missing county information were removed from regional analysis.
§ High-incidence region = ≥10 cases per 100,000 population (Fresno, Kern, Kings, Madera, Merced, Monterey, San Joaquin, San Luis Obispo, Stanislaus, and Tulare counties).
¶ Moderate-incidence region = 2–9 cases per 100,000 population (Alameda, Calaveras, Contra Costa, Imperial, Los Angeles, Mariposa, Orange, Riverside, Santa Barbara, San Bernardino, Santa Cruz, San Diego, Solano, Tuolumne, and Ventura counties).
** Low-incidence region = <2 cases per 100,000 population (all other California counties).

California's population is projected to increase, particularly in areas where Valley fever incidence is high or increasing (*10*). Findings in this report indicated a need to raise Valley fever awareness statewide and helped guide the California Valley fever awareness campaign with outreach to persons living in high- and moderate-incidence regions and to persons at risk for severe disease.

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TABLE 3. Statewide respondents* with and without risk for severe Valley fever, by selected characteristics — California, 2016–2017

	Survey question					
	"Have you heard about the fungal disease called Valley fever, also known as coccidioidomycosis or cocci?"			"Some individuals are at increased risk for severe Valley fever if infected. Are you one of these individuals at risk for severe Valley fever?"		
Risk factor	No†	% who said yes	Weighted California population % who said yes (95% CI)	No*	% who said yes	Weighted California population % who said yes (95% CI)
At risk for severe Valley fever	**1,258**	**51.3**	**50.8 (45.5–56.1)**	**1,272**	**4.4**	**3.5 (2.1–5.0)**
Age ≥65 yrs	707	59.8	61.1 (56.1–66.1)	719	4.0	3.4 (1.9–4.9)
Diabetes and prediabetes	379	46.4	47.0 (38.1–55.8)	383	6.0	4.3 (1.9–6.6)
Current smoking	299	40.8	45.0 (32.9–57.1)	300	4.3	3.2 (0.6–5.8)
Black race	138	44.9	37.1 (26.6–47.7)	138	2.2	1.3 (0.0–2.8)
Filipino ethnicity	52	46.2	61.6 (38.1–85.0)	53	1.9	5.9 (0.0–17.1)
Not at risk for severe Valley fever	**1,566**	**38.1**	**37.1 (33.1–41.1)**	**1,569**	**2.8**	**2.0 (1.0–2.9)**

Abbreviation: CI = confidence interval.
* Based on weighted California percentage of respondents.
† Number represents adjusted survey counts, for which responses missing either sex, age, or race and ethnicity values (i.e., Filipinos and Black persons) were removed from the analysis; specific risk groups were not mutually exclusive.

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Race, Ethnicity, and Age Trends in Persons Who Died from COVID-19 — United States, May–August 2020

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During February 12–October 15, 2020, the coronavirus disease 2019 (COVID-19) pandemic resulted in approximately 7,900,000 aggregated reported cases and approximately 216,000 deaths in the United States.* Among COVID-19–associated deaths reported to national case surveillance during February 12–May 18, persons aged ≥65 years and members of racial and ethnic minority groups were disproportionately represented (*1*). This report describes demographic and geographic trends in COVID-19–associated deaths reported to the National Vital Statistics System† (NVSS) during May 1–August 31, 2020, by 50 states and the District of Columbia. During this period, 114,411 COVID-19–associated deaths were reported. Overall, 78.2% of decedents were aged ≥65 years, and 53.3% were male; 51.3% were non-Hispanic White (White), 24.2% were Hispanic or Latino (Hispanic), and 18.7% were non-Hispanic Black (Black). The number of COVID-19–associated deaths decreased from 37,940 in May to 17,718 in June; subsequently, counts increased to 30,401 in July and declined to 28,352 in August. From May to August, the percentage distribution of COVID-19–associated deaths by U.S. Census region increased from 23.4% to 62.7% in the South and from 10.6% to 21.4% in the West. Over the same period, the percentage distribution of decedents who were Hispanic increased from 16.3% to 26.4%. COVID-19 remains a major public health threat regardless of age or race and ethnicity. Deaths continued to occur disproportionately among older persons and certain racial and ethnic minorities, particularly among Hispanic persons. These results can inform public health messaging and mitigation efforts focused on prevention and early detection of infection among disproportionately affected groups.

In NVSS data, confirmed or presumed COVID-19–associated deaths are assigned the *International Classification of Diseases, Tenth Revision* code U07.1 as a contributing or underlying cause of death on the death certificate. The underlying cause of death is the condition that began the chain of events ultimately leading to the person's death. COVID-19 was the underlying cause for approximately 92% of COVID-19–associated deaths and was a contributing cause for approximately 8% during the investigation period (*2*). NVSS data in this report exclude deaths among residents of territories and foreign countries.

Using NVSS data from May 1 through August 31, 2020, CDC tabulated the numbers and percentages of COVID-19–associated deaths by age, sex, race and ethnicity (categorized as Hispanic, White, Black, non-Hispanic Asian [Asian], non-Hispanic American Indian or Alaska Native [AI/AN], non-Hispanic Native Hawaiian or other Pacific Islander [NHPI], non-Hispanic multiracial [multiracial], and unknown), U.S. Census region,§ and location of death (e.g., hospital, nursing home or long-term care facility, or residence). Because only 0.5% of COVID-19 decedents were either NHPI or multiracial, and counts <10 are suppressed in NVSS to maintain confidentiality, these groups were combined into one group for analyses. Age, race and ethnicity, and place of death were unknown for two (<0.01%), 465 (0.4%), and 46 (0.04%) deaths, respectively. To describe changes in demographic features over time, percentages of deaths among two age groups (≥65 years and <65 years), racial and ethnic groups, and U.S. Census region were calculated for each

* CDC official counts of cases and deaths, released daily at https://covid.cdc.gov/covid-data-tracker/, are aggregate counts from reporting jurisdictions. Throughout the COVID-19 pandemic, and separately from the NVSS, CDC has been tracking both aggregate and individual (i.e., line-listed) counts of cases and deaths. For aggregate counts, from January 22 to March 2, 2020, CDC provided laboratory confirmation for all U.S. confirmed cases. Starting March 3, jurisdiction partners validated aggregate counts each night for report released at 12 p.m. the following day by CDC. For individual counts, jurisdiction partners electronically submit standardized information for individual cases of COVID-19 to CDC. From April 14, aggregate and individual counts included confirmed and probable cases and deaths, according to the Council of State and Territorial Epidemiologists (CSTE) position statement Interim 20-ID-01 (https://cdn.ymaws.com/www.cste.org/resource/resmgr/2020ps/interim-20-id-01_covid-19.pdf; https://wwwn.cdc.gov/nndss/conditions/coronavirus-disease-2019-covid-19/case-definition/2020/). On August 5, CSTE published an updated position statement, Interim 20-ID-02, to clarify the interpretation of antigen detection tests and serologic test results within the case classification (https://wwwn.cdc.gov/nndss/conditions/coronavirus-disease-2019-covid-19/case-definition/2020/08/05/).

† https://www.cdc.gov/nchs/nvss/deaths.htm.

§ U.S. Census Bureau regions are Northeast, Midwest, South, and West. https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf.

month. R statistical software (version 3.6.3; The R Foundation) was used to tabulate death counts and generate histograms. This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.¶

During May 1–August 31, 2020, a total of 114,411 COVID-19–associated deaths were reported to NVSS (Table). The number of COVID-19–associated deaths decreased from 37,940 in May to 17,718 in June; subsequently, counts increased to 30,401 in July and declined to 28,352 in August. Among decedents, the majority were male (53.3%), White (51.3%), aged ≥65 years (78.2%), and died in an inpatient health care setting (64.3%). Overall, 24.2% of decedents were Hispanic, 18.7% were Black, 3.5% were Asian, 1.3% were AI/AN, and 0.5% were either NHPI or multiracial. During the period studied, the largest percentage of COVID-19–associated deaths occurred in the South Census region (45.7%), followed by the Northeast (20.5%), the West (18.3%), and the Midwest (15.5%). Twenty-two percent of decedents died in a nursing home or long-term care facility.

During May–August 2020, the percentage of COVID-19–associated deaths occurring in the South increased from 23.4% in May to 62.7% in August, and in the West from 10.6% to 21.4%; the percentages occurring in the Northeast decreased from 44.2% in May to 4.0% in August, and in the Midwest declined from 21.8% to 11.8% (Figure 1). The percentage of decedents aged ≥65 years decreased from 81.8% to 77.6%, and the percentage of deaths occurring in nursing homes or long-term care facilities decreased from 29.8% to 16.6% (Figure 1).

From May to August, the percentage of decedents who were White decreased from 56.9% to 51.5%, and the percentage who were Black decreased from 20.3% to 17.4%, whereas the percentage who were Hispanic increased from 16.3% to 26.4% (Figure 2). Hispanics were the only racial and ethnic group among whom the overall percentage of deaths increased. Among persons aged ≥65 years, the monthly percentage of Hispanic decedents increased in the South (from 10.3% to 21.7%) and West (from 29.6% to 35.4%) and decreased in the Northeast (from 11.3% to 9.3%) and Midwest (from 7.8% to 4.2%). The monthly percentage of Hispanic decedents aged <65 years increased in the South (from 29.2% to 38.1%) and West (from 51.8% to 62.3%) and decreased in the Northeast (from 34.9% to 30.7%) and Midwest (31.1% to 20.4%)(Supplementary Figure, https://stacks.cdc.gov/view/cdc/95229).

TABLE. Demographic characteristics of persons who died because of COVID-19* (N = 114,411) — National Vital Statistics System (NVSS), United States, May 1–August 31, 2020†

Characteristic	Deaths,§ %
Age group, yrs	
<1	<0.1
1–4	<0.1
5–17	<0.1
18–29	0.5
30–39	1.4
40–49	3.5
50–64	16.4
65–74	21.7
75–84	26.0
≥85	30.4
Unknown	<0.1
Sex	
Male	53.3
Female	46.7
Other	0.0
Race/Ethnicity	
White, non-Hispanic	51.3
Hispanic or Latino	24.2
Black, non-Hispanic	18.7
Asian, non-Hispanic	3.5
American Indian or Alaska Native, non-Hispanic	1.3
Other, non-Hispanic¶	0.5
Unknown race/ethnicity	0.4
U.S. Census region of residence	
South	45.7
Northeast	20.5
West	18.3
Midwest	15.5
Place of death	
Health care setting, inpatient	64.3
Nursing home or long-term care facility	21.5
Decedent's home	5.2
Hospice facility	3.7
Health care setting, outpatient or emergency department	3.1
Other	2.0
Health care setting, dead on arrival	0.1
Unknown	<0.1

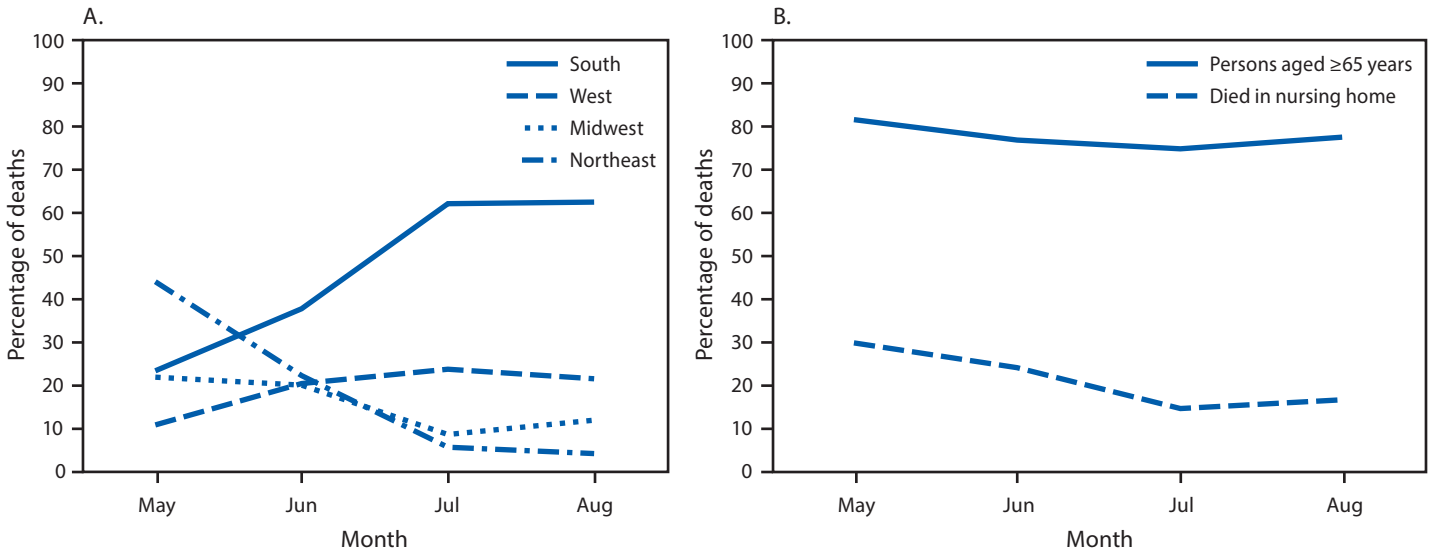
Abbreviation: COVID-19 = coronavirus disease 2019.
* Deaths with confirmed or presumed COVID-19, coded to *International Classification of Diseases, Tenth Revision* code U07.1. These data exclude deaths among foreign residents and territories.
† NVSS data from August are incomplete given reporting lags.
§ Percentages may not sum to 100 because of rounding. For two (<0.01%) COVID-19 deaths, age was unknown. Sex and region were known for all decedents. For 465 (0.4%) deaths, race or ethnicity were unknown. For 46 (0.04%) deaths, place of death was unknown.
¶ Other race/ethnicity includes persons who were non-Hispanic Native Hawaiian or other Pacific Islander or were non-Hispanic multiracial.

Discussion

Based on NVSS data on 114,411 persons who died from COVID-19 in the United States during May–August 2020, the predominant U.S. Census regions shifted from the Northeast to the South and West. The majority of COVID-19–associated deaths occurred among White persons (51.3%), but Black and Hispanic persons were disproportionately represented. Although a small decrease (2.9 percentage points between May and August) in decedents who were Black was observed, Black persons still accounted for 18.7% of overall deaths despite representing just 12.5% of the U.S. population (*3*). Similarly,

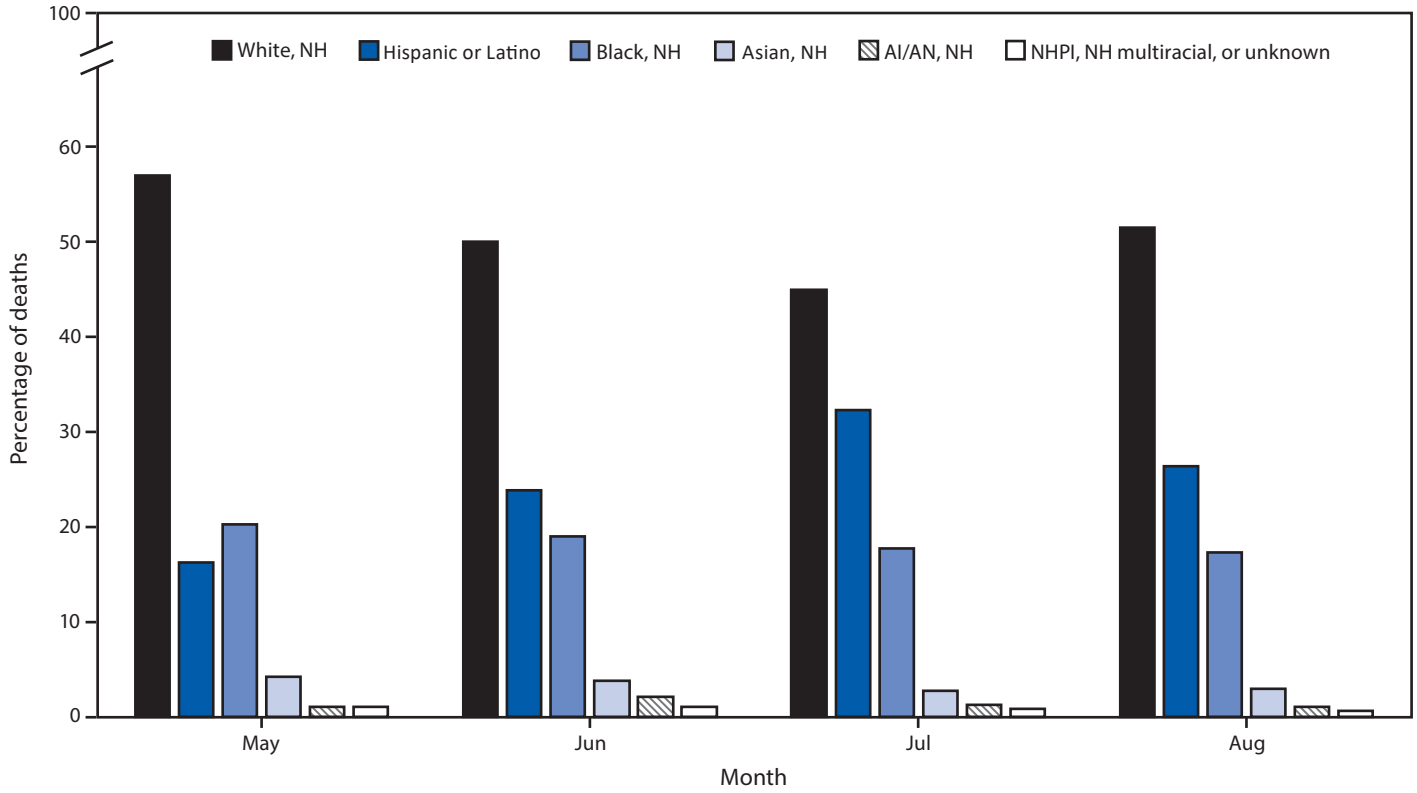
¶ See e.g., 45 C.F.R. part 46.102(l)(2), 21 C.F.R. part 56; 42 U.S.C. §241(d); 5 U.S.C. §552a; 44 U.S.C. §3501 et seq.

FIGURE 1. Monthly COVID-19–associated deaths* as a percentage of all deaths, by U.S. Census region, all ages (A), and for persons aged ≥65 years or persons of any age who died in a nursing home or long-term care facility (B) (N = 114,411) — National Vital Statistics System, United States, May 1–August 31, 2020



Abbreviation: COVID-19 = coronavirus disease 2019.
* Age data were missing for two (<0.01%) COVID-19 deaths, and place of death data were missing for 46 (0.04%) deaths. Total numbers of deaths might vary because of suppression of counts with <10 deaths.

FIGURE 2. Monthly deaths, by race/ethnicity* as a percentage of all COVID-19–associated deaths (N = 114,411) — National Vital Statistics System, United States, May 1–August 31, 2020



Abbreviations: AI/AN = American Indian or Alaska Native; COVID-19 = coronavirus disease 2019; NH = non-Hispanic; NHPI = Native Hawaiian or other Pacific Islander.
* Race or ethnicity data were unknown for 465 (0.4%) deaths. Total numbers of deaths might vary because of suppression of counts with <10 deaths.

Summary

What is already known about this topic?

Persons aged ≥65 years and members of minority racial and ethnic groups are disproportionately represented among COVID-19–associated deaths.

What is added by this report?

Analysis of 114,411 COVID-19–associated deaths reported to National Vital Statistics System during May–August 2020, found that 51.3% of decedents were non-Hispanic White, 24.2% were Hispanic or Latino (Hispanic), and 18.7% were non-Hispanic Black. The percentage of Hispanic decedents increased from 16.3% in May to 26.4% in August.

What are the implications for public health practice?

These results can inform public health messaging and mitigation efforts focused on prevention and early detection of infection among disproportionately affected groups so as to minimize subsequent mortality.

Hispanic persons were disproportionately represented among decedents: 24.2% of decedents were Hispanic compared with 18.5% of the U.S. population. In addition, the percentage of decedents who were Hispanic increased 10.1 percentage points from May through August. Whereas Hispanic persons accounted for 14% of COVID-19–associated deaths in the United States during February 12–May 18, 2020 (*1*), that percentage increased to approximately 25% in August. Although there has been a geographic shift in COVID-19–associated deaths from the Northeast to the West and South, where Hispanic persons account for a higher percentage of the population, this analysis found that ethnic disparities among decedents in the West and South increased during May–August, 2020, suggesting that the geographic shift alone does not entirely account for the increase in percentage of Hispanic decedents nationwide. Disparities in COVID-19 incidence and deaths among Hispanic persons and other underrepresented racial and ethnic groups are well documented (*4–6*) and might be related to increased risk for exposure to SARS-CoV-2, the virus that causes COVID-19. Inequities in the social determinants of health can lead to increased risk for SARS-CoV-2 exposure among some racial and ethnic groups. For example, persons from underrepresented racial and ethnic groups might be more likely to live in multigenerational and multifamily households, reside in congregate living environments, hold jobs requiring in-person work (e.g., meatpacking, agriculture, service, and health care), have limited access to health care, or experience discrimination (*5,6*). Differences in the prevalence of underlying conditions (e.g., diabetes and obesity) among racial and ethnic groups might also be associated with increased susceptibility to COVID-19–associated complications and death (*4*).

The shift in COVID-19–associated deaths during May–August 2020 from the Northeast (where 17.1% of the U.S. population resides) into the South and West (where 38.3% and 23.9% of the U.S. population resides, respectively)** is consistent with recent findings documenting the emergence of COVID-19 hotspots†† in these regions during June–July 2020 (*7*). The decreasing percentage of deaths occurring among persons aged ≥65 years and persons in nursing homes, which were important sites of COVID-19–associated deaths early in the pandemic, suggests a continued shift toward noninstitutionalized and younger populations. The observed geographic shifts in COVID-19–associated deaths might be related to differential implementation of community mitigation efforts throughout the nation, including earlier reopening efforts in selected jurisdictions. To prevent the spread of COVID-19, CDC continues to recommend the use of masks, frequent handwashing, and maintenance of social distancing, including avoidance of large gatherings (*8*).

The findings in this report are subject to at least two limitations. First, NVSS provisional death data are continually updated and subject to delays. Therefore, this report likely underestimates the number of deaths that occurred, particularly during August 2020, for which data are less complete than previous months. Furthermore, in focusing only on COVID-19–associated deaths captured by NVSS, this report did not address long-term morbidity faced by some persons who survive COVID-19 infections, nor does it account for deaths and morbidity related to the indirect effects of interrupted health care and socioeconomic disruption caused by the pandemic (*9*). For example, one report indicated that by June 30, 2020, an estimated 41% of U.S. adults had delayed or avoided medical care because of concerns about the pandemic, including 12% who reported having avoided urgent or emergency care (*10*).

Despite these limitations, this report provides information on how demographic and geographic factors have changed among COVID-19–associated deaths during May–August 2020. Racial and ethnic disparities among COVID-19 decedents have persisted over the course of the pandemic and continue to increase among Hispanic persons. These results can inform public health messaging and mitigation efforts focused on prevention and early detection of infection among disproportionately affected groups so as to minimize subsequent mortality.

** https://www.census.gov/popclock/print.php?component=growth&image=//www.census.gov/popclock/share/images/growth_1561939200.png.

†† Counties defined as hotspot counties met all four of the following criteria, relative to the date assessed: 1) >100 new COVID-19 cases in the most recent 7 days, 2) an increase in the most recent 7-day COVID-19 incidence over the preceding 7-day incidence, 3) a decrease of <60% or an increase in the most recent 3-day COVID-19 incidence over the preceding 3-day incidence, and 4) the ratio of 7-day incidence/30-day incidence exceeds 0.31. In addition, hotspots must have met at least one of the following criteria: 1) >60% change in the most recent 3-day COVID-19 incidence or 2) >60% change in the most recent 7-day incidence.

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Excess Deaths Associated with COVID-19, by Age and Race and Ethnicity — United States, January 26–October 3, 2020

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On October 20, 2020, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

As of October 15, 216,025 deaths from coronavirus disease 2019 (COVID-19) have been reported in the United States*; however, this number might underestimate the total impact of the pandemic on mortality. Measures of excess deaths have been used to estimate the impact of public health pandemics or disasters, particularly when there are questions about underascertainment of deaths directly attributable to a given event or cause (*1*–*6*).† Excess deaths are defined as the number of persons who have died from all causes, in excess of the expected number of deaths for a given place and time. This report describes trends and demographic patterns in excess deaths during January 26–October 3, 2020. Expected numbers of deaths were estimated using overdispersed Poisson regression models with spline terms to account for seasonal patterns, using provisional mortality data from CDC's National Vital Statistics System (NVSS) (*7*). Weekly numbers of deaths by age group and race/ethnicity were assessed to examine the difference between the weekly number of deaths occurring in 2020 and the average number occurring in the same week during 2015–2019 and the percentage change in 2020. Overall, an estimated 299,028 excess deaths have occurred in the United States from late January through October 3, 2020, with two thirds of these attributed to COVID-19. The largest percentage increases were seen among adults aged 25–44 years and among Hispanic or Latino (Hispanic) persons. These results provide information about the degree to which COVID-19 deaths might be underascertained and inform efforts to prevent mortality directly or indirectly associated with the COVID-19 pandemic, such as efforts to minimize disruptions to health care.

Estimates of excess deaths can provide a comprehensive account of mortality related to the COVID-19 pandemic, including deaths that are directly or indirectly attributable to COVID-19. Estimates of the numbers of deaths directly attributable to COVID-19 might be limited by factors such as the availability and use of diagnostic testing (including postmortem testing) and the accurate and complete reporting of cause of death information on the death certificate. Excess death analyses are not subject to these limitations because they examine historical trends in all-cause mortality to determine the degree to which observed numbers of deaths differ from historical norms. In April 2020, CDC's National Center for Health Statistics (NCHS) began publishing data on excess deaths associated with the COVID-19 pandemic (*7*,*8*). This report describes trends and demographic patterns in the number of excess deaths occurring in the United States from January 26, 2020, through October 3, 2020, and differences by age and race/ethnicity using provisional mortality data from the NVSS.§

Excess deaths are typically defined as the number of persons who have died from all causes, in excess of the expected number of deaths for a given place and time. A detailed description of the methodology for estimating excess deaths has been described previously (*7*). Briefly, expected numbers of deaths are estimated using overdispersed Poisson regression models with spline terms to account for seasonal patterns. The average expected number, as well as the upper bound of the 95% prediction interval (the range of values likely to contain the value of a single new observation), are used as thresholds to determine the number of excess deaths (i.e., observed numbers above each threshold) and percentage excess (excess deaths divided by average expected number of deaths). Estimates described here refer to the number or percentage above the average; estimates above the upper bound threshold have been published elsewhere (*7*). Observed numbers of deaths are weighted to account for incomplete reporting by jurisdictions (50 states and the District of Columbia [DC]) in the most recent weeks, where the weights were estimated based on completeness of provisional data in the past year (*7*).

Weekly NVSS data on excess deaths occurring from January 26 (the week ending February 1), 2020, through October 3, 2020, were used to quantify the number of excess deaths and the percentage excess for deaths from all causes and deaths from all causes excluding COVID-19.¶ Deaths attributed to COVID-19 have the *International Classification of Diseases, Tenth Revision* code U07.1 as an underlying or contributing cause of death.

Weekly numbers of deaths by age group (0–24, 25–44, 45–64, 65–74, 75–84, and ≥85 years) and race/ethnicity (Hispanic or Latino [Hispanic], non-Hispanic White [White], non-Hispanic Black or African American [Black], non-Hispanic Asian [Asian],

* CDC official counts of cases and deaths are released daily at https://covid.cdc.gov/covid-data-tracker/.

† https://www.medrxiv.org/content/10.1101/2020.06.06.20120857v1.full.pdf.

§ https://www.cdc.gov/nchs/nvss/deaths.htm.

¶ Deaths from all causes excluding COVID-19 are calculated by subtracting the number of confirmed or presumed COVID-19 deaths from the total number of deaths. Deaths with confirmed or presumed COVID-19 are assigned the *International Classification of Diseases, Tenth Revision* code U07.1 as a contributing or underlying cause of death on the death certificate.

non-Hispanic American Indian or Alaska Native [AI/AN], and other/unknown race/ethnicity, which included non-Hispanic Native Hawaiian or other Pacific Islander, non-Hispanic multiracial, and unknown) were used to examine the difference between the weekly number of deaths occurring in 2020 and the average number occurring in the same week during 2015–2019. These values were used to calculate an average percentage change in 2020 (i.e., above or below average compared with past years), over the period of analysis, by age group and race and Hispanic ethnicity. NVSS data in this report include all deaths occurring in the 50 states and DC and are not limited to U.S. residents. Approximately 0.2% of decedents overall are foreign residents. R statistical software (version 3.5.0; The R Foundation) was used to conduct all analyses.

From January 26, 2020, through October 3, 2020, an estimated 299,028 more persons than expected have died in the United States.** Excess deaths reached their highest points to date during the weeks ending April 11 (40.4% excess) and August 8, 2020 (23.5% excess) (Figure 1). Two thirds of excess deaths during the analysis period (66.2%; 198,081) were attributed to COVID-19 and the remaining third to other causes†† (Figure 1).

The total number of excess deaths (deaths above average levels) from January 26 through October 3 ranged from a low of approximately 841 in the youngest age group (<25 years) to a high of 94,646 among adults aged 75–84 years.§§ However, the average percentage change in deaths over this period compared with previous years was largest for adults aged 25–44 years (26.5%) (Figure 2). Overall, numbers of deaths among persons aged <25 years were 2.0% below average,¶¶ and among adults aged 45–64, 65–74 years, 75–84, and ≥85 years were 14.4%, 24.1%, 21.5%, and 14.7% above average, respectively.

When examined by race and ethnicity, the total numbers of excess deaths during the analysis period ranged from a low of approximately 3,412 among AI/AN persons to a high of 171,491 among White persons. For White persons, deaths were 11.9% higher when compared to average numbers during 2015–2019. However, some racial and ethnic subgroups experienced disproportionately higher percentage increases in deaths (Figure 3). Specifically, the average percentage increase over this period was largest for Hispanic persons (53.6%). Deaths were 28.9% above average for AI/AN persons, 32.9% above average for Black persons, 34.6% above average for those of other or unknown race or ethnicity, and 36.6% above average for Asian persons.

Discussion

Based on NVSS data, excess deaths have occurred every week in the United States since March 2020. An estimated 299,028 more persons than expected have died since January 26, 2020; approximately two thirds of these deaths were attributed to COVID-19. A recent analysis of excess deaths from March through July reported very similar findings, but that study did not include more recent data through September (*5*).

Although more excess deaths have occurred among older age groups, relative to past years, adults aged 25–44 years have experienced the largest average percentage increase in the number of deaths from all causes from late January through October 3, 2020. The age distribution of COVID-19 deaths shifted toward younger age groups from May through August (*9*); however, these disproportionate increases might also be related to underlying trends in other causes of death. Future analyses might shed light on the extent to which increases among younger age groups are driven by COVID-19 or by other causes of death. Among racial and ethnic groups, the smallest average percentage increase in numbers of deaths compared with previous years occurred among White persons (11.9%) and the largest for Hispanic persons (53.6%), with intermediate increases (28.9%–36.6%) among AI/AN, Black, and Asian persons. These disproportionate increases among certain racial and ethnic groups are consistent with noted disparities in COVID-19 mortality.***

The findings in this report are subject to at least five limitations. First, the weighting of provisional NVSS mortality data might not fully account for reporting lags, particularly in recent weeks. Estimated numbers of deaths in the most recent weeks are likely underestimated and will increase as more data become available. Second, there is uncertainty associated with

** Excess deaths over this period ranged from 224,173 to 299,028. The lower end of this range corresponds to the total number above the upper bound of the 95% prediction intervals, and the upper end of the range corresponds to the total number above the average expected counts. Deaths above the upper bound threshold are significantly higher than expected. https://www.cdc.gov/nchs/nvss/vsrr/covid19/excess_deaths.htm.

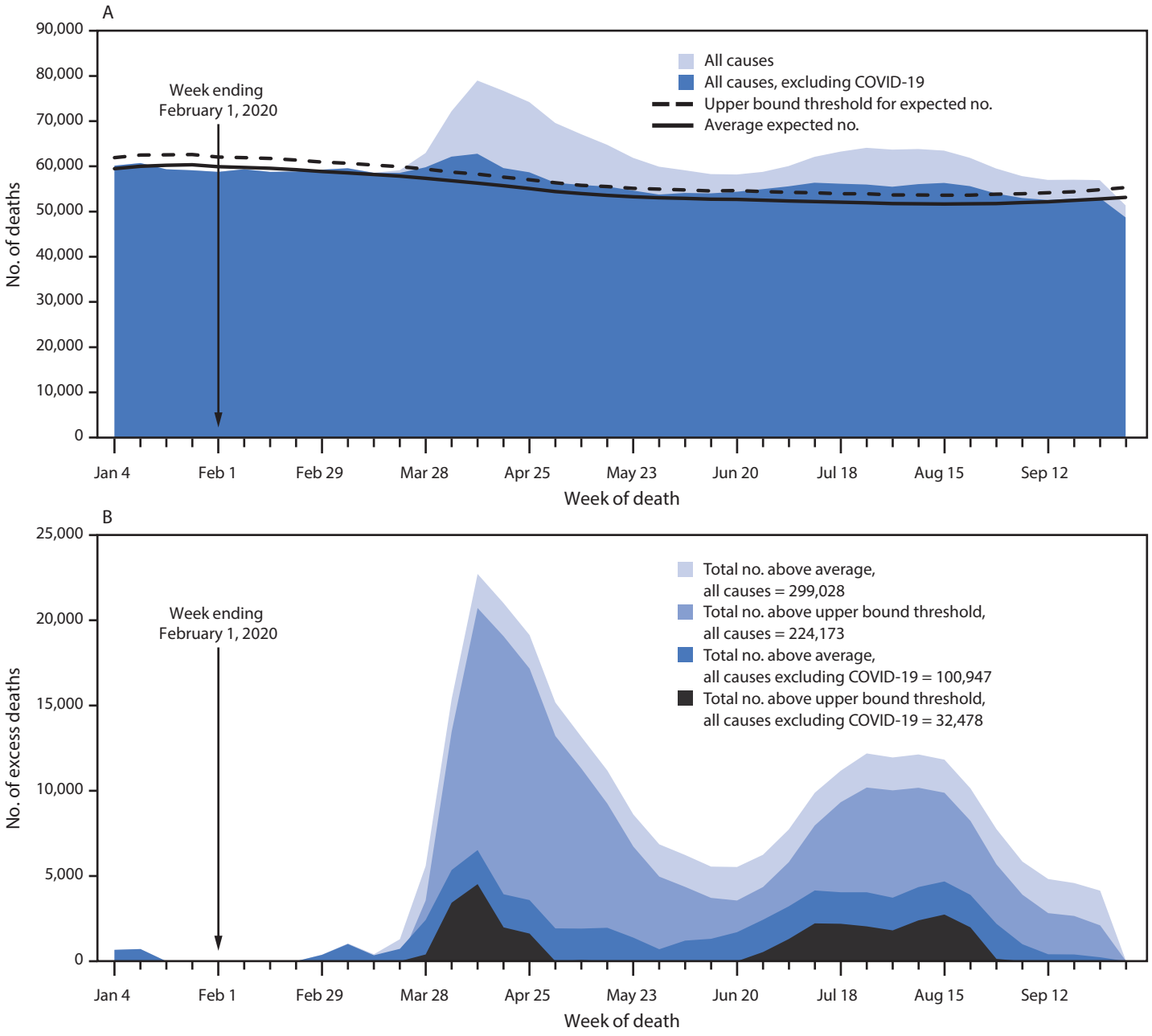
†† Excess deaths attributed to COVID-19 were calculated by subtracting the number of excess deaths from all causes excluding COVID-19 from the total number of excess deaths from all causes. These excess death estimates were based on the numbers of deaths above the average expected number. Using the upper bound of the 95% prediction interval for the expected numbers (the upper bound threshold), an estimated 224,173 excess deaths occurred during this period, 85.5% of which were attributed to COVID-19.

§§ Weeks when the observed numbers of deaths were below the average numbers from 2015 to 2019 were excluded from the total numbers of excess deaths above average levels (i.e., negative values were treated as 0 excess deaths).

¶¶ The total average percentage change in the number of deaths occurring from the week ending February 1, 2020, through October 3, 2020, included weeks where the percentage difference was negative (i.e., deaths were fewer than expected). This mainly affected the youngest age group, among whom, overall, deaths during this period were 2.0% below average. Excluding weeks with negative numbers of excess deaths results in overall percentage increases of 4.2% for decedents aged <25 years. Increases for other age groups were similar when excluding weeks with negative numbers of excess deaths, with the exception of those aged ≥85 years, among whom the percentage increase was larger (18.1%) when weeks with negative values were excluded.

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

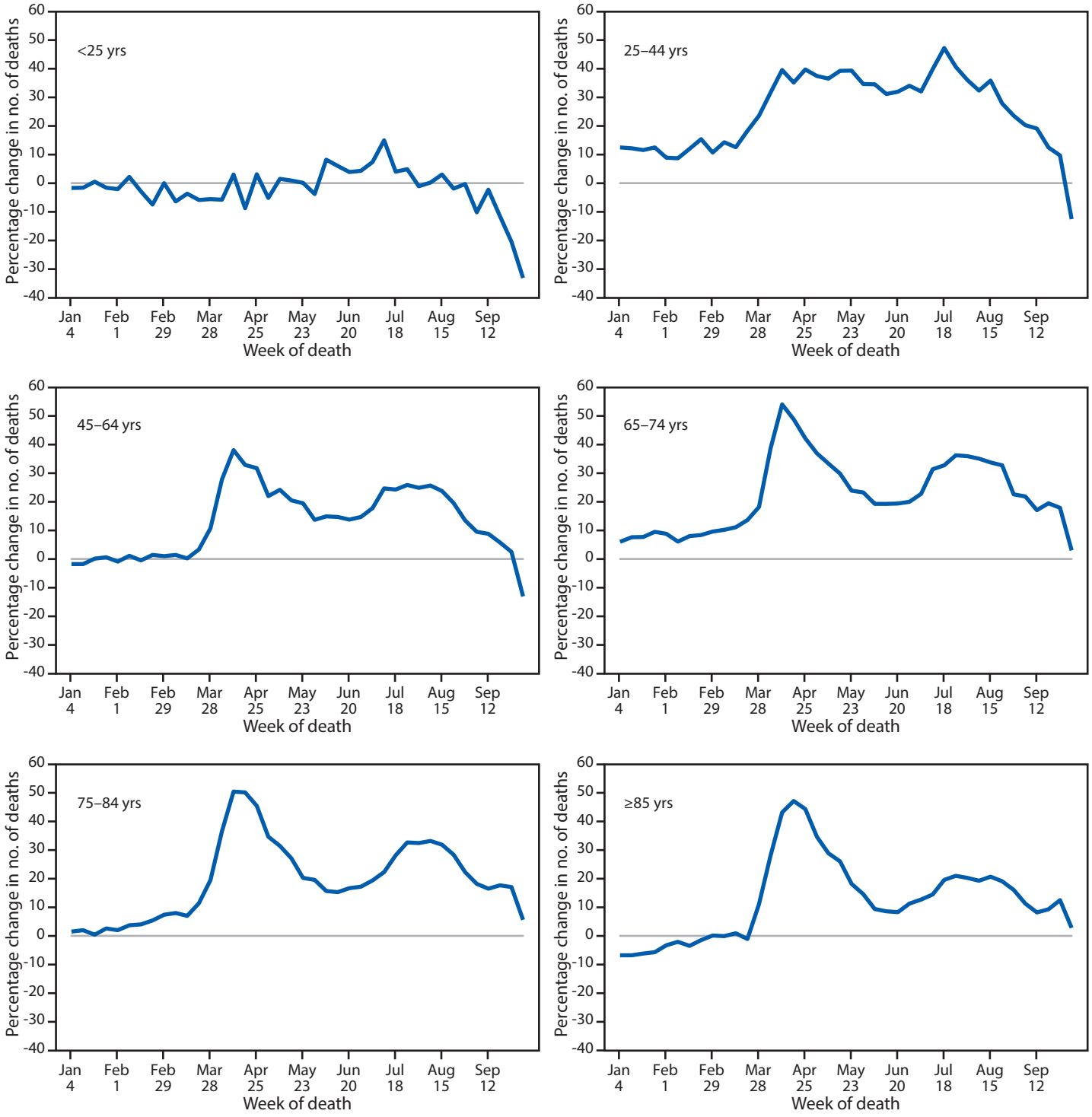
FIGURE 1. Weekly numbers of deaths from all causes and from all causes excluding COVID-19 relative to the average expected number and the upper bound of the 95% prediction interval (A), and the weekly and total numbers of deaths from all causes and from all causes excluding COVID-19 above the average expected number and the upper bound of the 95% prediction interval (B) — National Vital Statistics System, United States, January–September 2020



Abbreviation: COVID-19 = coronavirus disease 2019.

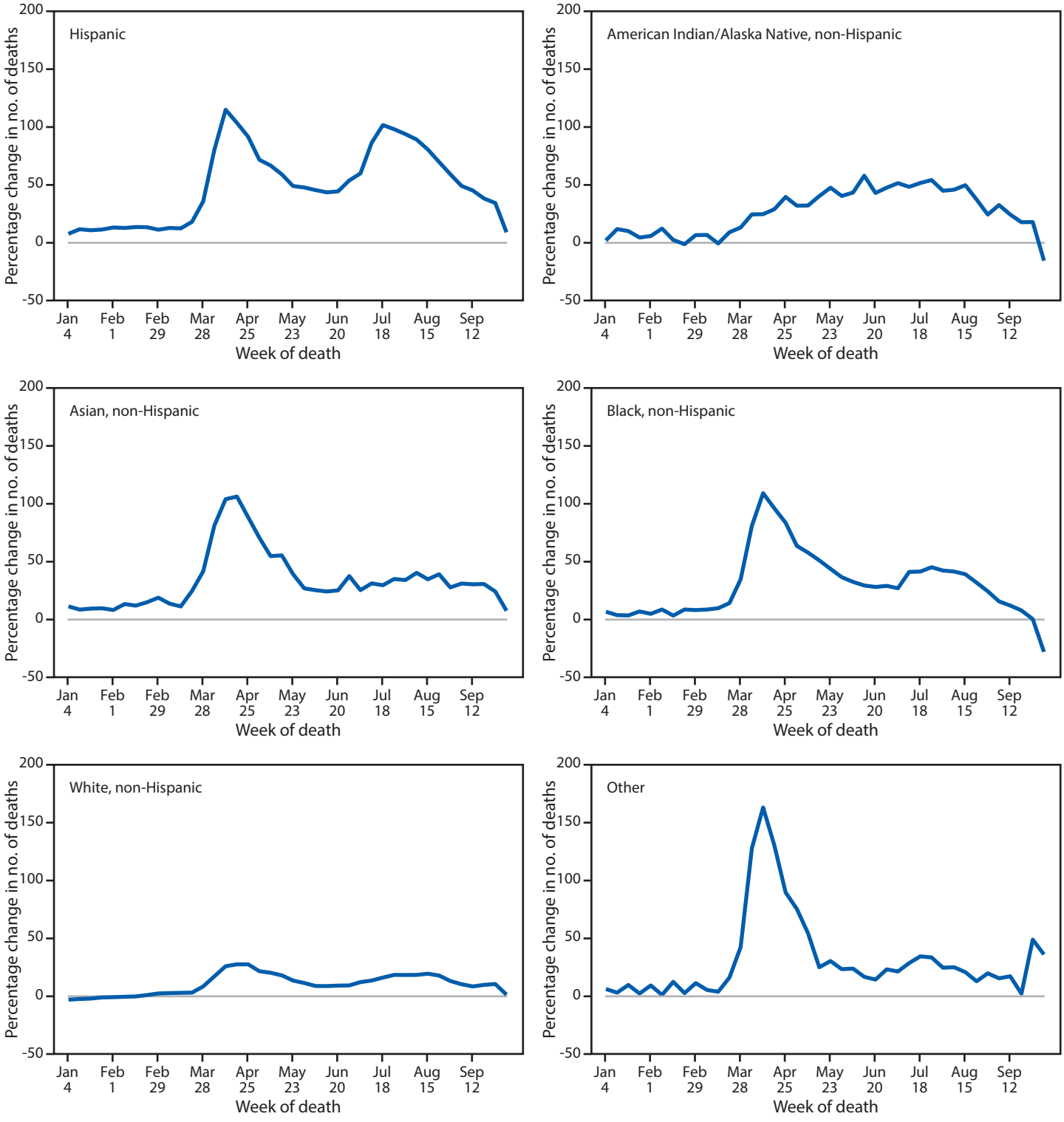
the models used to generate the expected numbers of deaths in a given week. A range of values for excess death estimates is provided elsewhere (*7*), but these ranges might not reflect all of the sources of uncertainty, such as the completeness of provisional data. Third, different methods or models for estimating the expected numbers of deaths might lead to different results. Estimates of the number or percentage of deaths above average levels by race/ethnicity and age reported here might not sum to the total numbers of excess deaths reported elsewhere, which might have been estimated using different methodologies. Fourth, using the average numbers of deaths from past years might underestimate the total expected numbers because of population growth or aging, or because of increasing trends in certain causes such as drug overdose mortality. Finally, estimates

FIGURE 2. Percentage change in the weekly number of deaths in 2020 relative to average numbers in the same weeks during 2015–2019, by age group — United States, 2015–2019 and 2020



of excess deaths attributed to COVID-19 might underestimate the actual number directly attributable to COVID-19, because deaths from other causes might represent misclassified COVID-19–related deaths or deaths indirectly caused by the pandemic. Specifically, deaths from circulatory diseases, Alzheimer disease and dementia, and respiratory diseases have increased in 2020 relative to past years (*7*), and it is unclear to what extent these represent misclassified COVID-19 deaths

FIGURE 3. Percentage change in the weekly number of deaths in 2020 relative to average numbers in the same weeks during 2015–2019, by race and Hispanic ethnicity — United States, 2015–2019 and 2020



or deaths indirectly related to the pandemic (e.g., because of disruptions in health care access or utilization).

Despite these limitations, however, this report demonstrates important trends and demographic patterns in excess deaths that occurred during the COVID-19 pandemic. These results provide more information about deaths during the COVID-19 pandemic and inform public health messaging and mitigation efforts focused on the prevention of infection and mortality

Summary

What is already known about this topic?

As of October 15, 216,025 deaths from COVID-19 have been reported in the United States; however, this might underestimate the total impact of the pandemic on mortality.

What is added by this report?

Overall, an estimated 299,028 excess deaths occurred from late January through October 3, 2020, with 198,081 (66%) excess deaths attributed to COVID-19. The largest percentage increases were seen among adults aged 25–44 years and among Hispanic or Latino persons.

What are the implications for public health practice?

These results inform efforts to prevent mortality directly or indirectly associated with the COVID-19 pandemic, such as efforts to minimize disruptions to health care.

directly or indirectly associated with the COVID-19 pandemic and the elimination of health inequities. CDC continues to recommend the use of masks, frequent handwashing, and maintenance of social distancing to prevent COVID-19.[†††]

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

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Risk for In-Hospital Complications Associated with COVID-19 and Influenza — Veterans Health Administration, United States, October 1, 2018–May 31, 2020

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On October 20, 2020, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

Coronavirus disease 2019 (COVID-19) is primarily a respiratory illness, although increasing evidence indicates that infection with SARS-CoV-2, the virus that causes COVID-19, can affect multiple organ systems (*1*). Data that examine all in-hospital complications of COVID-19 and that compare these complications with those associated with other viral respiratory pathogens, such as influenza, are lacking. To assess complications of COVID-19 and influenza, electronic health records (EHRs) from 3,948 hospitalized patients with COVID-19 (March 1–May 31, 2020) and 5,453 hospitalized patients with influenza (October 1, 2018–February 1, 2020) from the national Veterans Health Administration (VHA), the largest integrated health care system in the United States,* were analyzed. Using *International Classification of Diseases, Tenth Revision, Clinical Modification* (ICD-10-CM) codes, complications in patients with laboratory-confirmed COVID-19 were compared with those in patients with influenza. Risk ratios were calculated and adjusted for age, sex, race/ethnicity, and underlying medical conditions; proportions of complications were stratified among patients with COVID-19 by race/ethnicity. Patients with COVID-19 had almost 19 times the risk for acute respiratory distress syndrome (ARDS) than did patients with influenza, (adjusted risk ratio [aRR] = 18.60; 95% confidence interval [CI] = 12.40–28.00), and more than twice the risk for myocarditis (2.56; 1.17–5.59), deep vein thrombosis (2.81; 2.04–3.87), pulmonary embolism (2.10; 1.53–2.89), intracranial hemorrhage (2.85; 1.35–6.03), acute hepatitis/liver failure (3.13; 1.92–5.10), bacteremia (2.46; 1.91–3.18), and pressure ulcers (2.65; 2.14–3.27). The risks for exacerbations of asthma (0.27; 0.16–0.44) and chronic obstructive pulmonary disease (COPD) (0.37; 0.32–0.42) were lower among patients with COVID-19 than among those with influenza. The percentage of COVID-19 patients who died while hospitalized (21.0%) was more than five times that of influenza patients (3.8%), and the duration of hospitalization was almost three times longer for COVID-19 patients. Among patients with COVID-19, the risk for respiratory, neurologic, and renal complications, and sepsis was higher among non-Hispanic Black or African American (Black) patients, patients of other races, and Hispanic or Latino (Hispanic) patients compared with those in non-Hispanic White (White) patients, even after adjusting for age and underlying medical conditions. These findings highlight the higher risk for most complications associated with COVID-19 compared with influenza and might aid clinicians and researchers in recognizing, monitoring, and managing the spectrum of COVID-19 manifestations. The higher risk for certain complications among racial and ethnic minority patients provides further evidence that certain racial and ethnic minority groups are disproportionally affected by COVID-19 and that this disparity is not solely accounted for by age and underlying medical conditions.

The study population comprised two cohorts of hospitalized adult (aged ≥18 years) VHA patients: 1) those with nasopharyngeal (90%) or other specimens that had tested positive for SARS-CoV-2 by real-time reverse transcription–polymerase chain reaction (RT-PCR) during March 1–May 31, 2020, and 2) those with laboratory-confirmed influenza A or B by rapid antigen assay, real-time RT-PCR, direct or indirect fluorescent staining, or viral culture, during October 1, 2018–February 1, 2020. Patients who received an influenza diagnosis after February 1, 2020, were excluded to minimize the possible inclusion of patients co-infected with SARS-CoV-2. Patients were restricted to those with a COVID-19 or influenza test during hospitalization or in the 30 days preceding hospitalization (including inpatient care at a nursing home). Patients who were still hospitalized as of July 31, 2020, or who were admitted >14 days before receiving testing were excluded from the analysis.

Data from EHRs were extracted from VHA Praedico Surveillance System, a biosurveillance application used for early detection, monitoring, and forecasting of infectious disease outbreaks† and Corporate Data Warehouse. Data included age, sex, race/ethnicity, ICD-10-CM diagnosis codes, hospital admission and discharge date, and, if applicable, date of intensive care unit (ICU) admission and date of death. Thirty-three acute complications (not mutually exclusive) were identified using ICD-10-CM codes from the hospitalization EHR (*2*). Underlying medical conditions were identified using ICD-10-CM codes from inpatient, outpatient, and problem list records from at least 14 days before the specimen collection date (*3*).

* https://www.va.gov/vetdata/docs/pocketcards/fy20q2.pdf.

† https://www.oit.va.gov/Services/TRM/ToolPage.aspx?tid=8712.

Categorical variables were compared using Chi-squared or Fisher's exact test and continuous variables with Wilcoxon rank sum test. Two-sided p-values <0.05 were considered statistically significant. Among patients with COVID-19, the risk for complications was compared among racial/ethnic groups using log-binomial models, adjusting for age and underlying medical conditions, with White patients as the reference group. Relative risk for complications in patients with COVID-19 compared with those with influenza were estimated using log-binomial models, adjusting for age, sex, race/ethnicity, and underlying medical conditions. To assess bias from seasonality in complications unrelated to influenza or COVID-19, a sensitivity analysis restricted to cases diagnosed during March–May of 2019 (influenza) and March–May of 2020 (COVID-19) was conducted. All analyses were performed using SAS (version 9.4; SAS Institute). The data used in this analysis were obtained for the purpose of public health operations in VHA.[§] Because no additional analyses were performed outside public health operational activities, the activity was determined to meet the requirements of public health surveillance as defined in 45 CFR 46.102(l)(2), and Institutional Review Board review was not required.

During October 1, 2018–February 1, 2020, 5,746 hospitalized patients received a positive influenza test result and during March 1–May 31, 2020, 4,305 hospitalized patients received a positive SARS-CoV-2 test result. For both groups, testing occurred during the 30 days preceding hospitalization or while hospitalized. A total of 132 patients admitted >14 days before testing were excluded, as were 518 patients who were still hospitalized as of July 31, 2020, leaving 5,453 influenza patients and 3,948 COVID-19 patients for analysis.

Patients with COVID-19 were slightly older than were those with influenza (median = 70 years; interquartile range [IQR] = 61–77 years versus 69 years; IQR = 61–75 years) (p = 0.001), but patients with influenza had higher prevalences of most underlying medical conditions than did those with COVID-19 (Table 1). Black patients accounted for 48.3% of COVID-19 patients and 24.7% of influenza patients; the proportion of Hispanic patients was similar in both groups. The percentage of COVID-19 patients admitted to an ICU (36.5%) was more than twice that of influenza patients (17.6%); the percentage of COVID-19 patients who died while hospitalized (21.0%) was more than five times that of influenza patients (3.8%); and the duration of hospitalization was almost three times longer for COVID-19 patients (median 8.6 days; IQR = 3.9–18.6 days) than that for influenza patients (3.0 days; 1.8–6.5 days) (p<0.001 for all).

[§] Access to data for public health activities is covered under the Privacy Act of 1974, System of Records entitled National Patient Databases-VA (121VA10P2) as set forth in 79 FR 8245.

Among patients with COVID-19, 76.8% had respiratory complications, including pneumonia (70.1%), respiratory failure (46.5%), and ARDS (9.3%). Nonrespiratory complications were frequent, including renal (39.6%), cardiovascular (13.1%), hematologic (6.2%), and neurologic complications (4.1%), as well as sepsis (24.9%) and bacteremia (4.7%); 24.1% of COVID-19 patients had complications involving three or more organ systems. Among COVID-19 patients, nine complications were more prevalent among racial and ethnic minority patients, including respiratory, neurologic, and renal complications, even after adjustment for age and underlying medical conditions (Table 2).

Compared with patients with influenza, patients with COVID-19 had two times the risk for pneumonia; 1.7 times the risk for respiratory failure; 19 times the risk for ARDS; 3.5 times the risk for pneumothorax; and statistically significantly increased risks for cardiogenic shock, myocarditis, deep vein thrombosis, pulmonary embolism, disseminated intravascular coagulation, cerebral ischemia or infarction, intracranial hemorrhage, acute kidney failure, dialysis initiation, acute hepatitis or liver failure, sepsis, bacteremia, and pressure ulcers (Figure). Patients with COVID-19 had a lower risk for five complications (asthma exacerbation, COPD exacerbation, acute myocardial infarction (MI) or unstable angina, acute congestive heart failure (CHF), and hypertensive crisis), although acute MI or unstable angina, acute CHF, and hypertensive crisis were not statistically significant when restricting to patients diagnosed during the same seasonal months.

Discussion

Findings from a large, national cohort of patients hospitalized within the VHA illustrate the increased risk for complications involving multiple organ systems among patients with COVID-19 compared with those with influenza, as well as racial/ethnic disparities in COVID-19–associated complications. Compared with patients with influenza, those with COVID-19 had a more than five times higher risk for in-hospital death and approximately double the ICU admission risk and hospital length of stay, and were at higher risk for 17 acute respiratory, cardiovascular, hematologic, neurologic, renal and other complications. Racial and ethnic disparities in the percentage of complications among patients with COVID-19 was found for respiratory, neurologic, and renal complications, as well as for sepsis.

Persons from racial and ethnic minority groups are increasingly recognized as having higher rates of COVID-19, associated hospitalizations, and increased risk for severe in-hospital outcomes (*4*,*5*). Although previous analysis of VHA data found no differences in COVID-19 mortality by race/ethnicity (*4*), in this analysis, Black, Hispanic, and non-Hispanic patients

TABLE 1. Demographics, underlying medical conditions, acute complications, and hospital outcomes among hospitalized patients with COVID-19 (March 1–May 31, 2020) and among historically hospitalized patients with influenza (October 1, 2018–February 1, 2020)* — Veterans Health Administration, United States

Characteristic or condition	No. (%)		P-value
	COVID-19	Influenza	
Baseline characteristics			
No. of patients	3,948	5,453	—
Median age at test date, yrs (IQR)	70 (61–77)	69 (61–75)	0.001
Male	3,710 (94.0)	5,116 (93.8)	0.76
Race/Ethnicity			
White, non-Hispanic	1,515 (40.4)	3,389 (64.0)	<0.001
Black, non-Hispanic	1,811 (48.3)	1,305 (24.7)	
Other race, non-Hispanic†	87 (2.3)	150 (2.8)	
Hispanic or Latino	336 (9.0)	449 (8.5)	
Underlying medical conditions§			
Asthma	260 (6.9)	565 (10.5)	<0.001
COPD	903 (23.9)	2,261 (42.0)	<0.001
Other lung conditions	534 (14.1)	1,078 (20.0)	<0.001
Blood disorders	123 (3.2)	257 (4.8)	<0.001
Cerebrovascular diseases	468 (12.4)	558 (10.4)	<0.001
Heart disease	1,909 (50.4)	3,068 (57.0)	<0.001
Heart failure	707 (18.7)	1,320 (24.5)	<0.001
Hypertension	2,893 (76.4)	4,082 (75.9)	0.77
Diabetes mellitus	1,873 (49.5)	2,416 (44.9)	<0.001
Renal conditions	1,111 (29.4)	1,468 (27.3)	0.03
Liver diseases	528 (13.9)	687 (12.8)	0.10
Immunosuppression	537 (14.2)	1,033 (19.2)	<0.001
Long-term medication use	451 (11.9)	776 (14.4)	<0.001
Cancer	696 (18.4)	1,341 (24.9)	<0.001
Neurologic/Musculoskeletal	1,602 (42.3)	2,091 (38.9)	<0.001
Endocrine disorders	620 (16.4)	996 (18.5)	0.01
Metabolic conditions	2,525 (66.7)	3,628 (67.5)	0.45
Extreme obesity	333 (8.8)	518 (9.6)	0.18
Any underlying medical condition¶	3,541 (93.6)	5,117 (95.1)	0.001
In-hospital complications**			
Respiratory	3,030 (76.8)	5,167 (94.8)	<0.001
Pneumonia	2,766 (70.1)	1,916 (35.1)	<0.001
Respiratory failure	1,834 (46.5)	1,556 (28.5)	<0.001
ARDS	369 (9.3)	29 (0.5)	<0.001
Asthma exacerbation, no./No. (%)††	17/260 (6.5)	127/565 (22.5)	<0.001
COPD exacerbation, no./No. (%)††	160/903 (17.7)	1,154/2,261 (51.0)	<0.001
Pneumothorax	24 (0.6)	9 (0.2)	<0.001
Cardiovascular	516 (13.1)	911 (16.7)	<0.001
Acute MI/Unstable angina	300 (7.6)	499 (9.2)	0.01
Acute CHF	216 (5.5)	467 (8.6)	<0.001
Cardiogenic shock	36 (0.9)	28 (0.5)	0.02
Hypertensive crisis	53 (1.3)	90 (1.7)	0.23
Acute myocarditis	23 (0.6)	11 (0.2)	0.002
Hematologic	244 (6.2)	135 (2.5)	<0.001
Deep vein thrombosis	131 (3.3)	62 (1.1)	<0.001
Pulmonary embolism	112 (2.8)	72 (1.3)	<0.001
DIC	18 (0.5)	6 (0.1)	0.001
Neurologic	161 (4.1)	116 (2.1)	<0.001
Cerebral ischemia/infarction	125 (3.2)	92 (1.7)	<0.001
Intracranial hemorrhage	27 (0.7)	10 (0.2)	<0.001
Endocrine	79 (2.0)	80 (1.5)	0.05
Diabetic ketoacidosis, no./No. (%)††	42/1,873 (2.2)	42/2,416 (1.7)	0.24
Gastrointestinal	77 (2.0)	200 (3.7)	<0.001
Acute hepatitis/liver failure	63 (1.6)	26 (0.5)	<0.001
Renal	1,562 (39.6)	1,434 (26.3)	<0.001
Acute kidney failure	1,541 (39.0)	1,413 (25.9)	<0.001
Dialysis initiation§§	120 (3.0)	39 (0.7)	<0.001
Other¶¶	1,249 (31.6)	1,258 (23.1)	<0.001
Sepsis	984 (24.9)	1,012 (18.6)	<0.001
Bacteremia	186 (4.7)	100 (1.8)	<0.001
Pressure ulcer	289 (7.3)	144 (2.6)	<0.001

See table footnotes on the next page.

TABLE 1. (*Continued*) Demographics, underlying medical conditions, acute complications, and hospital outcomes among hospitalized patients with COVID-19 (March 1–May 31, 2020) and among historically hospitalized patients with influenza (October 1, 2018–February 1, 2020)* — Veterans Health Administration, United States

Characteristic or condition	No. (%)		P-value
	COVID-19	Influenza	
Hospital outcomes			
Length of stay, days (IQR)	8.6 (3.9–18.6)	3.0 (1.8–6.5)	<0.001
ICU admission	1,421 (36.5)	961 (17.6)	<0.001
In-hospital mortality	828 (21.0)	190 (3.8)	<0.001

Abbreviations: ARDS = acute respiratory distress syndrome; CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; COVID-19 = coronavirus disease 2019; DIC = disseminated intravascular coagulation; ICU = intensive care unit; IQR = interquartile range; MI = myocardial infarction.

* Data on race or ethnicity were missing for 199 (5.0%) patients with COVID-19 and 160 (2.9%) patients with influenza; data on underlying medical conditions were missing for 163 (4.1%) patients with COVID-19 and 75 (1.4%) patients with influenza; and data on ICU admission was missing for 49 (1.2%) patients with COVID-19. P-values were calculated from Chi-squared or Fisher's exact test for categorical variables and Wilcoxon rank sum test for continuous variables.

† Among patients with COVID-19, non-Hispanic Other included 22 patients with multiple races documented, 22 American Indians or Alaska Natives, 29 Asians, and 14 Native Hawaiians or other Pacific Islanders. Among patients with influenza, non-Hispanic Other included 47 patients with multiple races documented, 34 American Indians or Alaska Natives, 29 Asians, and 40 Native Hawaiians or other Pacific Islanders.

§ Coding of underlying medical conditions was based on *International Classification of Diseases, Tenth Revision, Clinical Modification,* (ICD-10-CM) codes and grouping into categories was based primarily on established categorizations from the CDC Hospitalized Adult Influenza Vaccine Effectiveness Network.

¶ Excluding hypertension only.

** Complications are not mutually exclusive. Acute complications primarily identified using a list of ICD-10-CM codes published by Chow EJ, Rolfes MA, O'Halloran A, et al. (https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2762991). Complications assessed but not included in Chow et al. include pressure ulcers (ICD-10-CM code L89*) and dialysis initiation (ICD-10-CM codes Z49, Z99.2, Z95.3, and Z91.15 and Current Procedural Terminology codes 90935, 90937, 90940, 90945, 90947, 90999, 0505F, 4045F, 36800, 36810, and 36816).

†† Denominator restricted to patients with the underlying medical condition related to the complication (asthma, COPD, or diabetes mellitus).

§§ Indication of dialysis during hospitalization without indication of dialysis within the past year.

¶¶ Other rare complications reported in <1% of patients with COVID-19 included acute pericarditis (seven, 0.2%), immune thrombocytopenic purpura (seven, 0.2%), Guillain-Barre Syndrome (six, 0.2%), encephalitis (seven, 0.2%), acute disseminated encephalomyelitis and encephalomyelitis (one, <0.1%), thyrotoxicosis (19, 0.5%), hyperglycemic hyperosmolar syndrome (14, 0.4%), acute pancreatitis (16, 0.4%), rhabdomyolysis (83, 2.1%), and autoimmune hemolytic anemia (one, <0.1%).

TABLE 2. Proportions and adjusted relative risk of selected COVID-19 respiratory and nonrespiratory complications,* by race/ethnicity† — Veterans Health Administration, United States, March 1–May 31, 2020

Complication	White, non-Hispanic (N = 1,515)	Black or African American, non-Hispanic (N = 1,811)		Other race, non-Hispanic§ (N = 87)		Hispanic or Latino (N = 336)		P-value**
	No. (%)	No. (%)	aRR (95% CI)¶	No. (%)	aRR (95% CI)¶	No. (%)	aRR (95% CI)¶	
Pneumonia	967 (63.8)	1,322 (73.0)	1.15 (1.10–1.21)	64 (73.6)	1.15 (1.01–1.31)	257 (76.5)	1.21 (1.13–1.31)	<0.001
Respiratory failure	656 (43.3)	860 (47.5)	1.14 (1.06–1.23)	48 (55.2)	1.30 (1.08–1.58)	158 (47.0)	1.13 (0.99–1.28)	0.03
ARDS	118 (7.8)	177 (9.8)	1.25 (1.00–1.57)	15 (17.2)	2.06 (1.24–3.43)	38 (11.3)	1.32 (0.92–1.91)	0.01
Hypertensive crisis	11 (0.7)	33 (1.8)	2.27 (1.13–4.54)	3 (3.4)	4.03 (1.14–14.21)	2 (0.6)	0.87 (0.19–3.90)	0.01
Cerebral ischemia/infarction	29 (1.9)	69 (3.8)	2.42 (1.57–3.74)	2 (2.3)	1.34 (0.33–5.50)	17 (5.1)	3.44 (1.92–6.18)	<0.01
Intracranial hemorrhage	6 (0.4)	15 (0.8)	2.45 (0.88–6.80)	3 (3.4)	10.36 (2.54–42.31)	3 (0.9)	2.69 (0.64–11.25)	0.02
Acute kidney failure	483 (31.9)	845 (46.7)	1.40 (1.28–1.53)	36 (41.4)	1.29 (1.01–1.66)	108 (32.1)	1.06 (0.89–1.26)	<0.001
Dialysis initiation	21 (1.4)	83 (4.7)	2.92 (1.81–4.71)	2 (2.4)	1.47 (0.35–6.16)	9 (2.9)	2.09 (0.97–4.52)	<0.001
Sepsis	306 (20.2)	496 (27.4)	1.42 (1.25–1.61)	29 (33.3)	1.71 (1.25–2.34)	91 (27.1)	1.40 (1.14–1.73)	<0.001

Abbreviations: ARDS = acute respiratory distress syndrome; aRR = adjusted risk ratio; CI = confidence interval; COVID-19 = coronavirus disease 2019.

* Complications are not mutually exclusive. Other complications assessed but not statistically different (p-value >0.05) across strata of race/ethnicity included pneumothorax, asthma and chronic obstructive pulmonary disease exacerbation, acute myocardial infarction/unstable angina, acute congestive heart failure, acute myocarditis, cardiogenic shock, deep vein thrombosis, pulmonary embolism, disseminated intravascular coagulation, diabetic ketoacidosis, acute hepatitis/liver failure, bacteremia, and pressure ulcers.

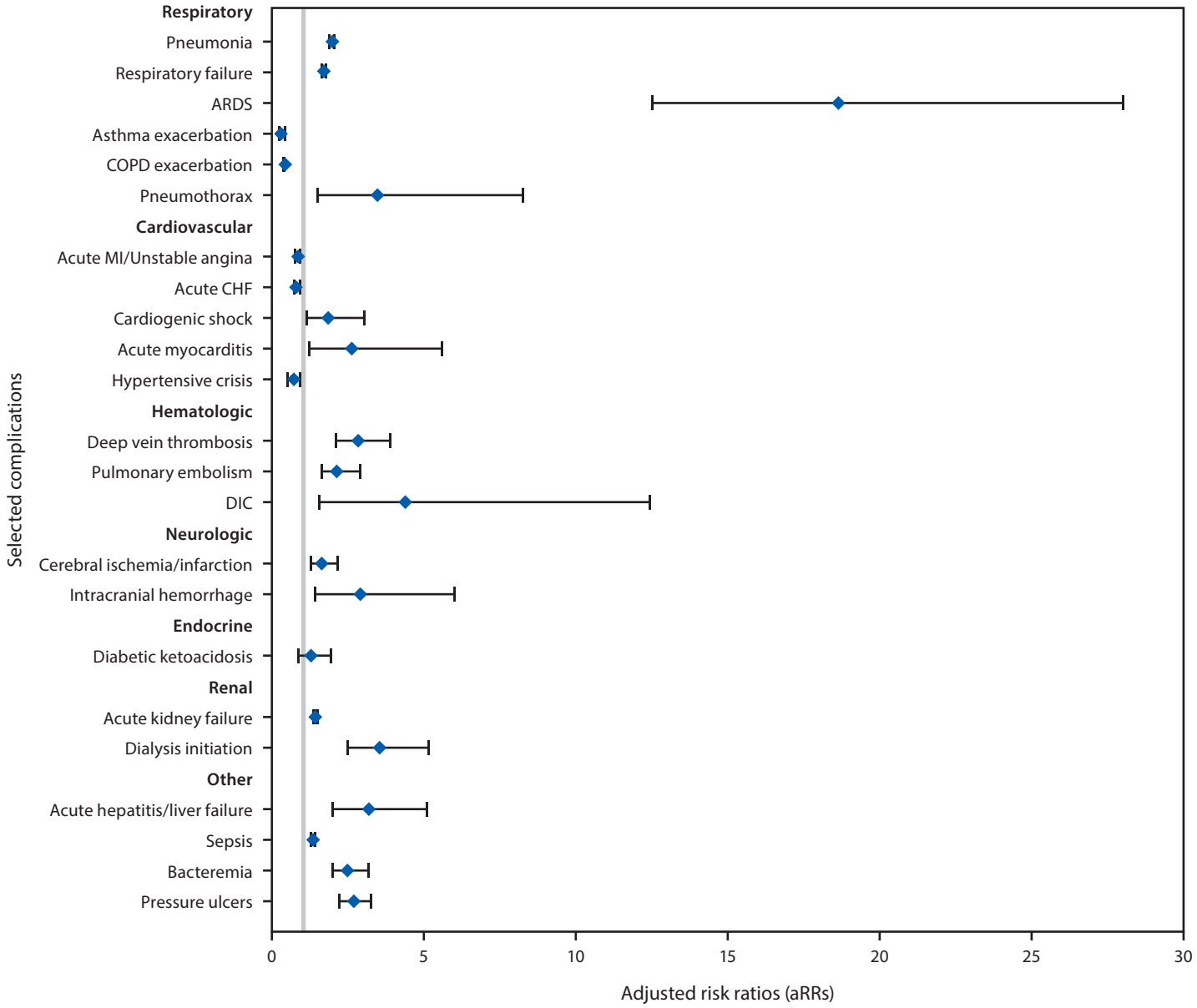
† Data on race/ethnicity were missing for 199 (5.0%) of COVID-19 patients and were excluded from the race/ethnicity stratification.

§ Other, non-Hispanic category included 22 patients with multiple races documented, 22 American Indians or Alaska Natives, 29 Asians, and 14 Native Hawaiians or other Pacific Islanders.

¶ Separate log-binomial models were run to estimate aRRs for each complication. Pneumonia, respiratory failure, and ARDS models adjusted for age, COPD, asthma, and other lung diseases; hypertensive crisis model adjusted for age, hypertension, heart disease, and heart failure; cerebral ischemia/infarction and intracranial hemorrhage models controlled for age, underlying cerebrovascular diseases, neurologic/musculoskeletal conditions, heart disease, and heart failure; acute kidney failure and dialysis models controlled for age, underlying renal disease, diabetes mellitus, and hypertension.

** P-values calculated from Chi-squared or Fisher's exact test to compare frequencies of complications among strata of race/ethnicity.

FIGURE. Adjusted relative risk* for selected acute respiratory and nonrespiratory complications in hospitalized patients with COVID-19 (March 1–May 31, 2020), compared with historically hospitalized patients with influenza (October 1, 2018–February 1, 2020) — Veterans Health Administration, United States†,§,¶



Abbreviations: ARDS = acute respiratory distress syndrome; CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; DIC = disseminated intravascular coagulation; MI = myocardial infarction.

* 95% confidence intervals (CIs) indicated with error bars.

† When restricted to patients with influenza during the same seasonal months (March–May), aRRs and 95% CIs for acute MI or unstable angina, acute CHF, and hypertensive crisis were 0.90 (0.74–1.11), 1.03 (0.82–1.28), and 0.75 (0.44–1.29), respectively.

§ Dialysis during hospitalization was identified using *International Classification of Diseases, Tenth Revision, Clinical Modification* and current procedural terminology codes, and new initiation of dialysis was determined by excluding patients with indication of dialysis within the past year.

¶ Separate crude and adjusted log-binomial models were run for each complication (which were not mutually exclusive). All adjusted models adjusted for age, sex, race/ethnicity, and outcome-specific underlying conditions. Specifically, respiratory complication models controlled for COPD, asthma, and other lung diseases; neurologic complication models controlled for underlying cerebrovascular diseases, neurological/musculoskeletal conditions, heart disease, and heart failure; cardiovascular and hematologic condition models controlled for heart disease, heart failure, renal conditions, diabetes mellitus, and extreme obesity; the acute kidney failure model controlled for underlying renal disease, diabetes mellitus, and hypertension. Complications related to the worsening of a chronic medical condition were restricted to those patients with that underlying medical condition.

of other races had higher risks for sepsis and respiratory, neurologic, and renal complications than did White patients. The disparities in acute complications among racial and ethnic minority groups could not solely be accounted for by differences in underlying medical conditions or age and might be affected by social, environmental, economic, and structural inequities.¶ Elucidation of the reasons for these disparities is urgently needed to advance health equity for all persons.

The risk for respiratory complications was high, consistent with current knowledge of SARS-CoV-2 and influenza pathogenesis (*1*,*6*). Notably, compared with patients with influenza, patients with COVID-19 had two times the risk for pneumonia, 1.7 times the risk for respiratory failure, 19 times the risk for ARDS, and 3.5 times the risk for pneumothorax, underscoring the severity of COVID-19 respiratory illness relative to that of influenza. Conversely, the risk for asthma and COPD exacerbations was approximately three times lower among patients with COVID-19 than among those with influenza.

The risk for certain acute nonrespiratory complications was also high, including the risk for sepsis and renal and cardiovascular complications. Patients with COVID-19 were at increased risk for acute kidney failure requiring dialysis than were patients with influenza, consistent with previous evidence of influenza- (*2*) and COVID-19–associated (*7*) acute kidney failure. The frequent occurrence and increased risk for sepsis among patients with COVID-19 is consistent with reports of dysregulated immune response in these patients (*8*). The distribution of cardiovascular complications differed between patients with influenza and those with COVID-19; patients with COVID-19 experienced lower risk for acute MI, unstable angina, and acute CHF but higher risk for acute myocarditis and cardiogenic shock. There were no significant differences in occurrence of acute MI, unstable angina, and CHF among patients with COVID-19 or influenza diagnosed during the same months, suggesting potential confounding by seasonal variations in cardiovascular disease.

Other less common (<10%), but often severe complications included hematologic and neurologic complications, bacteremia, and pressure ulcers. Whereas other viruses, like influenza, might cause proinflammatory cytokines and clot formation (*6*), the findings from this study suggest that hematologic complications are a much more frequent complication of COVID-19, consistent with previous reports of COVID-19–related thromboembolic events (*1*,*9*). A New York City study reported that the odds of stroke were 7.6 times higher among COVID-19 patients than among those with influenza (*10*), which is consistent with the present findings of a twofold increase in the risk for cerebral ischemia or infarction. Patients with COVID-19 might be at increased risk for pressure ulcers related to prolonged hospitalizations, prone positioning, or both.

Summary

What is already known about this topic?

Patients hospitalized with COVID-19 are reported to be at risk for respiratory and nonrespiratory complications.

What is added by this report?

Hospitalized patients with COVID-19 in the Veterans Health Administration had a more than five times higher risk for in-hospital death and increased risk for 17 respiratory and nonrespiratory complications than did hospitalized patients with influenza. The risks for sepsis and respiratory, neurologic, and renal complications of COVID-19 were higher among non-Hispanic Black or African American and Hispanic patients than among non-Hispanic White patients.

What are the implications for public health practice?

Compared with influenza, COVID-19 is associated with increased risk for most respiratory and nonrespiratory complications. Certain racial and ethnic minority groups are disproportionally affected by COVID-19.

The findings in this report are subject to at least six limitations. First, administrative codes might have limited sensitivity and specificity for capturing conditions and might misclassify chronic conditions as acute. Extreme obesity was defined based solely on ICD-10-CM codes and not body mass index, resulting in potential misclassification and residual confounding. Second, clinician-ordered testing could potentially underestimate some complications in patients with less typical respiratory symptoms. Third, the analysis of racial differences was limited by the small sample size within the non-Hispanic Other race group. Fourth, the generalizability of results might be limited by the diversity and moderate severity among adults of the predominant circulating influenza type/subtype during the period of this analysis (A H3N2 in 2018–2019 and A H1N1 and B in 2019–2020).** Fifth, influenza vaccination or treatments for COVID-19 or influenza that might affect these outcomes were not examined. Finally, this analysis did not adjust for region or facility size or type, and further research is warranted to assess the impact of these factors on the risk for COVID-19 complications.

Hospitalized adult VHA patients with COVID-19 experienced a higher risk for respiratory and nonrespiratory complications and death than did hospitalized patients with influenza. Disparities by race/ethnicity in experiencing sepsis and respiratory, neurologic, and renal complications, even

¶ https://www.healthypeople.gov/2020/topics-objectives/topic/social-determinants-of-health.

** https://www.cdc.gov/mmwr/volumes/68/wr/mm6824a3.htm?s_cid; https://www.cdc.gov/mmwr/volumes/69/wr/mm6907a1.htm?s_cid.

after adjustment for age and underlying medical conditions, provide further evidence that racial and ethnic minority groups are disproportionally affected by COVID-19. Clinicians should be vigilant for symptoms and signs of a spectrum of complications among hospitalized patients with COVID-19 so that interventions can be instituted to improve outcomes and reduce long-term disability.

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Association Between Social Vulnerability and a County's Risk for Becoming a COVID-19 Hotspot — United States, June 1–July 25, 2020

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Poverty, crowded housing, and other community attributes associated with social vulnerability increase a community's risk for adverse health outcomes during and following a public health event (*1*). CDC uses standard criteria to identify U.S. counties with rapidly increasing coronavirus disease 2019 (COVID-19) incidence (hotspot counties) to support health departments in coordinating public health responses (*2*). County-level data on COVID-19 cases during June 1–July 25, 2020 and from the 2018 CDC social vulnerability index (SVI) were analyzed to examine associations between social vulnerability and hotspot detection and to describe incidence after hotspot detection. Areas with greater social vulnerabilities, particularly those related to higher representation of racial and ethnic minority residents (risk ratio [RR] = 5.3; 95% confidence interval [CI] = 4.4–6.4), density of housing units per structure (RR = 3.1; 95% CI = 2.7–3.6), and crowded housing units (i.e., more persons than rooms) (RR = 2.0; 95% CI = 1.8–2.3), were more likely to become hotspots, especially in less urban areas. Among hotspot counties, those with greater social vulnerability had higher COVID-19 incidence during the 14 days after detection (212–234 cases per 100,000 persons for highest SVI quartile versus 35–131 cases per 100,000 persons for other quartiles). Focused public health action at the federal, state, and local levels is needed not only to prevent communities with greater social vulnerability from becoming hotspots but also to decrease persistently high incidence among hotspot counties that are socially vulnerable.

Daily county-level COVID-19 case counts were obtained through USAFacts (https://usafacts.org/), which compiles data reported by state and local health departments.* Beginning on March 8, 2020, hotspot counties were identified daily using standard criteria† (*2*). County-level social vulnerability data were obtained from the 2018 CDC SVI, which was developed to identify communities with the most needs during and following public health events. Scores for overall SVI, along with four vulnerability subcomponents pertaining to 1) socioeconomic status, 2) household composition and disability, 3) representation of racial and ethnic minority groups and English proficiency, and 4) housing type and transportation, were generated using 15 population-based measures.§ Scores for the overall and subcomponent measures were presented as percentile rankings by county, with higher scores indicating greater vulnerability. SVI scores were categorized as quartiles based on their distribution among all U.S. counties. Urbanicity of counties was based on the National Center for Health Statistics 2013 urban-rural classification scheme¶ (*3*).

Counties meeting hotspot criteria at least once during March 8–July 25 were described by urbanicity and social vulnerability based on the first date of hotspot detection. All other analyses were limited to hotspots identified during June 1–July 25. Among all 3,142 U.S. counties, RRs with 95% CIs were calculated using bivariate log-binomial models to assess differences in the probability of being identified as a hotspot during June 1–July 25 by SVI quartile, overall and for the four SVI subcomponents; analyses were also stratified by urbanicity.** Based on these results, the probability of hotspot identification was further examined by specific measures of social vulnerability related to the representation of the

* https://usafacts.org/issues/coronavirus.

† Areas defined as hotspot counties met all four of the following criteria, relative to the date assessed: 1) >100 new COVID-19 cases in the most recent 7 days, 2) higher COVID-19 incidence in the most recent 7 days incidence compared with the preceding 7 days, 3) a decrease of <60% or an increase in the most recent 3-day COVID-19 incidence over the preceding 3-day incidence, and 4) the ratio of 7-day incidence to 30-day incidence exceeds 0.31. In addition, hotspots must have met at least one of the following criteria: 1) >60% change in the most recent 3-day COVID-19 incidence or 2) >60% change in the most recent 7-day incidence. CDC and other federal agencies that are monitoring trends in COVID-19 are collaborating to refine approaches to define and monitor hotspots. As a result, terminology or definitions used in future reports might differ from the terminology used in this report.

§ The 15 population-based social factors incorporated into the SVI measures were four domains: 1) socioeconomic status, which was based on poverty, employment, income, and educational attainment; 2) household composition and disability, which was based on age (pediatric and elderly populations), civilians aged >5 years with a disability, and single-parent households; 3) racial and ethnic minority residents (i.e., do not identify as White, non-Hispanic/Latino) and English proficiency, which was based on representation of racial and ethnic minority residents and English proficiency; and 4) housing type and transportation, which was based on multiunit structures, mobile homes, crowding, no household vehicle access, and institutionalized group quarters. https://www.atsdr.cdc.gov/placeandhealth/svi/index.html.

¶ According to the 2013 National Center for Health Statistics Urban-Rural Classification Scheme for counties, counties can be categorized into one of six categories based on population size, including large central metropolitan, large fringe metropolitan, medium metropolitan, small metropolitan, micropolitan, and noncore areas. For this analysis, results were presented in three categories: large central metropolitan and large fringe metropolitan (large metropolitan); medium and small metropolitan; and micropolitan and noncore areas (nonmetropolitan).

** P-values for Fisher's exact tests were used to determine statistical significance.

following groups in each county: racial and ethnic minority residents, English proficiency, housing type, and transportation; counties were categorized as at or above or below the national median values.

Among the 747 counties meeting hotspot criteria during June 1–July 25, 689 (92%) were classified as new hotspots.[††] Among these 689 counties, the median COVID-19 incidence[§§] was calculated over the 14 days after hotspot identification and compared with incidence during the same period among 689 randomly selected non-hotspot counties matched by three urbanicity categories. Among new hotspot counties, incidence was also compared by SVI quartile.[¶¶] All analyses were conducted using SAS (version 9.4; SAS Institute) and R (version 4.0.2; The R Foundation). P-values <0.05 were considered statistically significant.

The percentage of hotspots in nonmetropolitan areas increased from 11% during March–April to 40% during June–July (Figure 1). The percentage of hotspots in the highest SVI quartile increased from 22% during March–April to 42% during June–July (Figure 1).

During June 1–July 25, 747 (24%) U.S. counties (representing 60% of the U.S. population) were identified as hotspots (Table). Counties with higher social vulnerability, particularly vulnerabilities related to the representation of racial and ethnic minority residents, English proficiency, housing type, and transportation, had a higher probability of being identified as a hotspot. For example, the risk for becoming a hotspot was 37.3 (95% CI = 20.1–69.3) times as high among areas in the highest quartile of vulnerability related to representation of racial and ethnic minority residents and English proficiency and 3.4 (95% CI = 2.7–4.2) times as high among areas in the highest quartile of vulnerability related to housing type and transportation, compared with areas in the lowest quartile for these vulnerabilities. These vulnerability subcomponents were more strongly associated with hotspot identification in less urban areas. Counties with median percentage or higher of racial and ethnic minority residents (RR = 5.3; 95% CI = 4.4–6.4), housing structures with ≥10 units (RR = 3.1 [2.7–3.6]), and crowded housing units (i.e., more persons than rooms) (RR = 2.0; 95% CI = 1.8–2.3) were more likely to become hotspots.

At the time of identification, incidence among new hotspot counties was 97 cases per 100,000 persons; in contrast, incidence in non-hotspot counties was 27 cases per 100,000 persons (p<0.001). Fourteen days later, hotspot county incidence was 140 cases per 100,000, and incidence in non-hotspot counties was 40 cases per 100,000 persons (p<0.001) (Figure 2). During the 14 days after hotspot detection, the absolute change in incidence in hotspot counties was higher than that in non-hotspot counties (p<0.001). Among hotspot counties, incidence was higher for counties with higher social vulnerability and particularly high in the highest quartile of social vulnerability on the day identified as a hotspot (212 cases versus 35–56 per 100,000 for other quartiles; p<0.001) and 14 days after being identified as a hotspot (234 cases versus 82–131 per 100,000; p<0.001) (Figure 2).

Discussion

In this analysis, counties with more social vulnerabilities, particularly those with a higher percentage of racial and ethnic minority residents, high-density housing structures, and crowded housing units, were at higher risk for becoming a COVID-19 hotspot, especially in less urban areas. Among hotspot counties, areas with more social vulnerability had significantly higher incidence than did other counties. These findings have implications for efforts to prevent counties with social vulnerability from becoming COVID-19 hotspots, including prioritizing vaccination access,[***] and for implementing public health action in counties that become hotspots.

Consistent with previous findings (*4*–*6*), these results show that COVID-19 disproportionately affects racial and ethnic minority groups, who might also experience more socioeconomic challenges.[†††] Communities with higher social vulnerability have a higher percentage of racial and ethnic minority residents, who might be more likely to have essential jobs requiring in-person work and live in potentially crowded conditions (*7*,*8*). These circumstances could put racial and ethnic minority residents at risk for COVID-19 through close contact with others. Incorporating the needs of populations that are socially vulnerable into community mitigation plans is essential for limiting COVID-19 transmission. Specifically, implementing recommended prevention efforts at facilities requiring in-person work (e.g., meat processing facilities and grocery stores), including temperature or symptom screening, mask mandates, social distancing practices, and paid sick leave policies encouraging ill workers to remain home, might reduce transmission risk among populations that are vulnerable at workplaces (*9*). In addition, plain-language and culturally sensitive and relevant public health messaging should be tailored

[††] New hotspot counties met hotspot criteria after ≥21 days of not meeting hotspot criteria. This component of the analysis was limited to new hotspot counties to understand trends after initial hotspot identification.

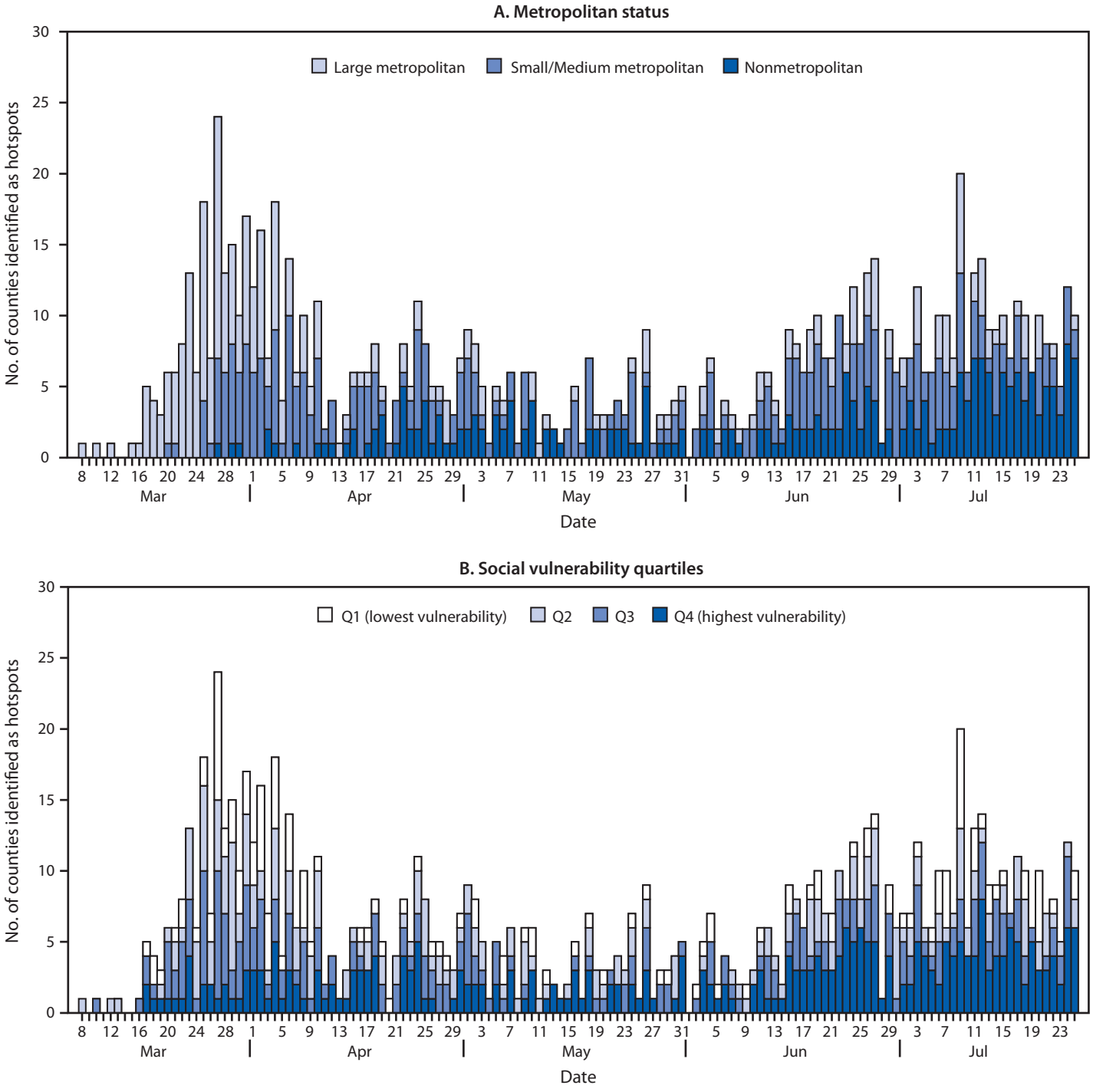
[§§] Incidence was calculated based on 7-day moving window during the 14 days after hotspot identification to smooth expected variation in daily case counts.

[¶¶] For incidence comparisons, statistically significant differences were evaluated using the Wilcoxon rank-sum test.

[***] https://www.nap.edu/catalog/25917/framework-for-equitable-allocation-of-covid-19-vaccine#resources.

[†††] https://www.cdc.gov/coronavirus/2019-ncov/community/health-equity/race-ethnicity.html#fn19.

FIGURE 1. Daily number of counties identified as hotspots, by urbanicity (A)* and by quartiles of overall social vulnerability index score (B), based on first date of hotspot identification (N = 905 counties)†,§ — United States, March 8–July 25, 2020



* According to the 2013 National Center for Health Statistics Urban-Rural Classification Scheme for counties, counties can be grouped into one of six categories based on population size, including large central metropolitan, large fringe metropolitan, medium metropolitan, small metropolitan, micropolitan, and noncore areas. For this analysis, results were presented in three categories: large central metropolitan and large fringe metropolitan (large metropolitan), medium and small metropolitan, and micropolitan and noncore areas (nonmetropolitan).

† Overall social vulnerability scores were percentile rankings ranging from 0–1, with higher values indicating greater social vulnerability. Scores were categorized into quartiles based on distribution among all U.S. counties.

§ Each county only appears once and is represented based on the first date of hotspot identification during March 8–July 25, 2020.

TABLE. Associations between social vulnerability measures* and hotspot identification, overall and by urbanicity† (N = 3,142 total counties) — United States, June 1–July 25, 2020

Social vulnerability	All counties			Large metropolitan counties			Medium and small metropolitan counties			Nonmetropolitan counties		
	Overall	Hotspots		Overall	Hotspots		Overall	Hotspots		Overall	Hotspots	
	No.	No. (row %)	RR (95% CI)¶	No.	No. (row %)	RR (95% CI)¶	No.	No. (row %)	RR (95% CI)¶	No.	No. (row %)	RR (95% CI)¶
Overall (row %)	**3,142**	**747 (24)**	—	**436**	**227 (52)**	—	**372**	**190 (51)**	—	**1,976**	**195 (10)**	—
Overall social vulnerability												
Q1 (lowest vulnerability)	786	109 (14)	Reference	171	68 (40)	Reference	152	34 (22)	Reference	463	7 (2)	Reference
Q2	784	176 (22)	1.6 (1.3–2.0)	122	68 (56)	1.4 (1.1–1.8)	205	96 (47)	2.1 (1.5–2.9)	457	12 (3)	1.7 (0.7–4.4)
Q3	785	198 (25)	1.8 (1.5–2.2)	99	59 (60)	1.5 (1.2–1.9)	212	98 (46)	2.1 (1.5–2.9)	474	41 (9)	5.7 (2.6–12.6)
Q4 (highest vulnerability)	786	263 (33)	2.4 (2.0–2.9)	44	32 (73)	1.8 (1.4–2.4)	161	97 (60)	2.7 (2.0–3.7)	581	134 (23)	15.3 (7.2–32.3)
Social vulnerability related to socioeconomic status												
Q1 (lowest vulnerability)	785	167 (21)	Reference	180	95 (53)	Reference	176	62 (35)	Reference	429	10 (2)	Reference
Q2	786	197 (25)	1.2 (1.0–1.4)	144	72 (50)	0.9 (0.8–1.2)	218	107 (49)	1.4 (1.1–1.8)	424	18 (4)	1.8 (0.9–3.9)
Q3	784	188 (24)	1.1 (0.9–1.4)	81	47 (58)	1.1 (0.9–1.4)	201	97 (48)	1.4 (1.1–1.8)	502	44 (9)	3.8 (1.9–7.4)
Q4 (highest vulnerability)	786	194 (25)	1.2 (1.0–1.4)	31	13 (42)	0.8 (0.5–1.2)	135	59 (44)	1.2 (0.9–1.6)	620	122 (20)	8.4 (4.5–15.9)
Social vulnerability related to household composition and disability												
Q1 (lowest vulnerability)	786	240 (31)	Reference	228	115 (50)	Reference	215	103 (48)	Reference	343	22 (6)	Reference
Q2	786	163 (21)	0.7 (0.6–0.8)	122	70 (57)	1.1 (0.9–1.4)	181	66 (36)	0.8 (0.6–1.0)	483	27 (6)	0.9 (0.5–1.5)
Q3	784	181 (23)	0.8 (0.6–0.9)	58	33 (57)	1.1 (0.9–1.5)	190	98 (52)	1.1 (0.9–1.3)	536	50 (9)	1.5 (0.9–2.4)
Q4 (highest vulnerability)	786	163 (21)	0.7 (0.6–0.8)	28	9 (32)	0.6 (0.4–1.1)	144	58 (40)	0.8 (0.7–1.1)	614	96 (16)	2.4 (1.6–3.8)
Social vulnerability related to racial and ethnic minority residents and English proficiency												
Q1 (lowest vulnerability)	788	10 (1)	Reference	55	5 (9)	Reference	111	3 (3)	Reference	622	2 (0)	Reference
Q2	783	86 (11)	8.7 (4.5–16.5)	91	22 (24)	2.7 (1.1–6.6)	179	37 (21)	7.6 (2.4–24.2)	513	27 (5)	16.4 (3.9–68.5)
Q3	785	279 (36)	28.0 (15.0–52.2)	104	63 (61)	6.7 (2.8–15.6)	242	142 (59)	21.7 (7.1–66.6)	439	74 (17)	52.4 (12.9–212.4)
Q4 (highest vulnerability)	786	372 (47)	37.3 (20.1–69.3)	186	137 (74)	8.1 (3.5–18.8)	198	143 (72)	26.7 (8.7–81.9)	402	92 (23)	71.2 (17.6–287.3)
Social vulnerability related to housing type and transportation												
Q1 (lowest vulnerability)	786	87 (11)	Reference	159	70 (44)	Reference	139	14 (10)	Reference	488	3 (1)	Reference
Q2	786	149 (19)	1.7 (1.3–2.2)	112	57 (51)	1.2 (0.9–1.5)	158	60 (38)	3.8 (2.2–6.4)	516	32 (6)	10.1 (3.1–32.7)
Q3	785	218 (28)	2.5 (2.0–3.2)	87	52 (60)	1.4 (1.1–1.7)	219	117 (53)	5.3 (3.2–8.9)	479	49 (10)	16.6 (5.2–53.0)
Q4 (highest vulnerability)	785	293 (37)	3.4 (2.7–4.2)	78	48 (62)	1.4 (1.1–1.8)	214	134 (63)	6.2 (3.7–10.3)	493	111 (23)	36.6 (11.7–114.5)
Individual components of social vulnerability related to racial and ethnic minority residents and English proficiency§												
Percentage of racial and ethnic minority residents (median = 16.1%)												
Less than median	1,569	118 (8)	Reference	149	37 (25)	Reference	301	54 (18)	Reference	1,119	27 (2)	Reference
At or above median	1,567	629 (40)	5.3 (4.4–6.4)	287	190 (66)	2.7 (2.0–3.6)	429	271 (63)	3.5 (2.7–4.5)	857	168 (20)	8.1 (5.5–12.1)
Percentage who speak English less than well (median = 0.7%)												
Less than median	1,458	130 (9)	Reference	129	23 (18)	Reference	273	47 (17)	Reference	1,056	60 (6)	Reference
At or above median	1,684	617 (37)	4.1 (3.4–4.9)	307	204 (66)	3.7 (2.6–5.4)	457	278 (61)	3.5 (2.7–4.6)	920	135 (15)	2.6 (1.9–3.5)

See table footnotes on the next page.

based on community needs, communicated by local leaders, and translated into other languages in areas with many non-native English speakers (*9*).

Additional support from federal, state, and local partners is needed for communities with social vulnerabilities and at risk for COVID-19, particularly for persons living in crowded or high-density housing conditions. Initiatives to provide temporary housing, food, and medication for COVID-19 patients living in crowded housing units could be considered to permit separation from household members during infectious periods.§§§

As expected, hotspot counties had significantly higher COVID-19 incidence at the time of detection than did non-hotspot counties. Hotspot counties also had a higher absolute

§§§ https://covid19.ca.gov/housing-for-agricultural-workers/.

TABLE. (*Continued*) Associations between social vulnerability measures* and hotspot identification, overall and by urbanicity† (N = 3,142 total counties) —United States, June 1–July 25, 2020

Social vulnerability	All counties			Large metropolitan counties			Medium and small metropolitan counties			Nonmetropolitan counties		
	Overall	Hotspots		Overall	Hotspots		Overall	Hotspots		Overall	Hotspots	
	No.	No. (row %)	RR (95% CI)¶	No.	No. (row %)	RR (95% CI)¶	No.	No. (row %)	RR (95% CI)¶	No.	No. (row %)	RR (95% CI)¶
Individual components of social vulnerability related to housing type and transportation§												
Percentage of housing structures with ≥10 units (median = 2.9%)												
Less than median	1,554	179 (12)	Reference	111	29 (26)	Reference	234	39 (17)	Reference	1,209	111 (9)	Reference
At or above median	1,588	568 (36)	3.1 (2.7–3.6)	325	198 (61)	2.3 (1.7–3.2)	496	286 (58)	3.5 (2.6–4.7)	767	84 (11)	1.2 (0.9–1.6)
Percentage of housing units that are mobile home units (median = 10.9%)												
Less than median	1,559	440 (28)	Reference	328	186 (57)	Reference	424	210 (50)	Reference	807	44 (5)	Reference
At or above median	1,583	307 (19)	0.7 (0.6–0.8)	108	41 (38)	0.7 (0.5–0.9)	306	115 (38)	0.8 (0.6–0.9)	1,169	151 (13)	2.4 (1.7–3.3)
Percentage of households with more persons than rooms (median = 1.9%)												
Less than median	1,513	235 (16)	Reference	213	88 (41)	Reference	350	112 (32)	Reference	950	35 (4)	Reference
At or above median	1,629	512 (31)	2.0 (1.8–2.3)	223	139 (62)	1.5 (1.2–1.8)	380	213 (56)	1.8 (1.5–2.1)	1,026	160 (16)	4.2 (3.0–6.0)
Percentage of households without vehicle access (median = 5.7%)												
Less than median	1,571	333 (21)	Reference	271	138 (51)	Reference	346	130 (38)	Reference	954	65 (7)	Reference
At or above median	1,571	414 (26)	1.2 (1.1–1.4)	165	89 (54)	1.1 (0.9–1.3)	384	195 (51)	1.4 (1.1–1.6)	1,022	130 (13)	1.9 (1.4–2.5)
Percentage of persons living in institutionalized group quarters (median = 2%)												
Less than median	1,569	348 (22)	Reference	273	149 (55)	Reference	334	122 (37)	Reference	962	77 (8)	Reference
At or above median	1,573	399 (25)	1.1 (1.0–1.3)	163	78 (48)	0.9 (0.7–1.1)	396	203 (51)	1.4 (1.2–1.7)	1,014	118 (12)	1.5 (1.1–1.9)

Abbreviations: CI = confidence interval; RR = risk ratio.

* Scores for all social vulnerability measures represented percentile rankings by county, ranging from 0–1, with higher scores indicating greater vulnerability. Scores were categorized into quartiles based on distribution among all U.S. counties.

† Because of limited sample size, the National Center for Health Statistics urban/rural categories were collapsed into large metropolitan (which includes large central metropolitan and large fringe areas), medium and small metropolitan, and nonmetropolitan (micropolitan and noncore) areas.

§ Cutoffs for individual components of social vulnerability related to housing type and transportation were based on median values.

¶ P-values for Fisher's exact tests yielded statistically significant findings (p<0.05) for all 95% CIs excluding the null value.

change in incidence during the 14 days after identification, demonstrating real and meaningful increases in incidence in these counties and underscoring the importance of implementing robust public health responses in these counties. Among hotspot counties, areas with the highest social vulnerability had significantly higher incidence, indicating an urgent need to prioritize public health action in these counties to curb COVID-19 transmission. Hotspot data informed deployment of multiagency response teams from CDC, the Federal Emergency Management Agency, the Office of the Assistant Secretary for Preparedness and Response, and the Office of the Associate Secretary for Health, to 33 locations in 21 states during June 29–July 24. These COVID-19 Response Assistance Field Teams (CRAFTs) learned from state and local leaders about local response efforts and assessed how federal assistance could augment local efforts to reduce the impact of the COVID-19 pandemic. Areas with high social vulnerability need continued support in developing and implementing mitigation strategies and strengthening contact tracing

Summary

What is already known about this topic?

Communities with higher social vulnerabilities, including poverty and crowded housing units, have more adverse outcomes during and following a public health event.

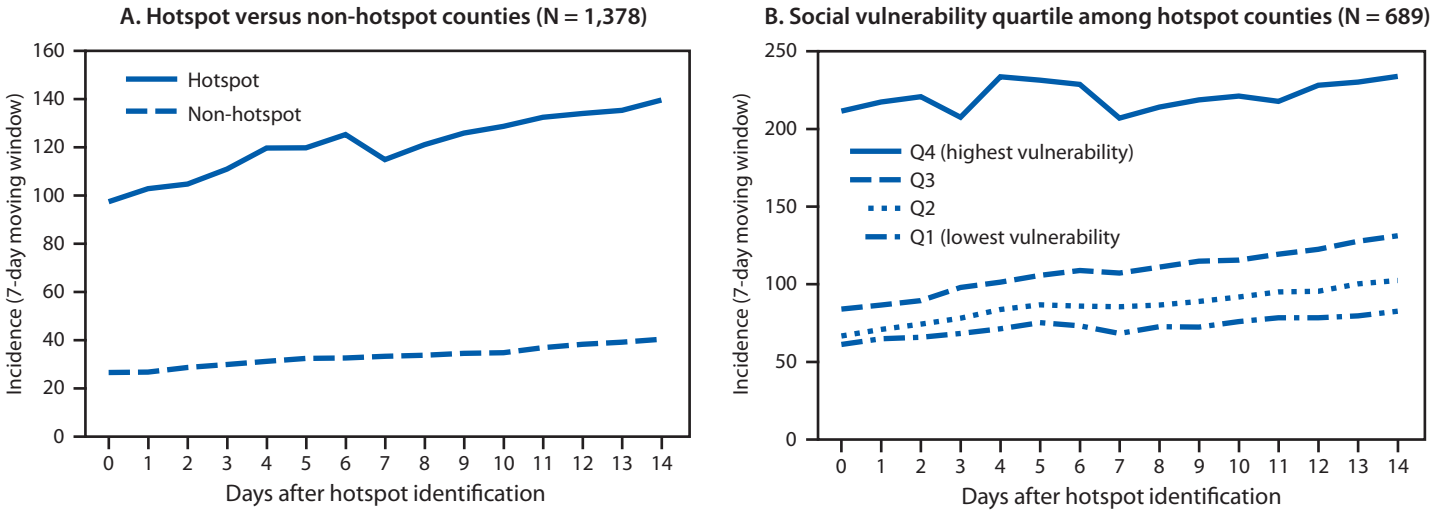
What is added by this report?

Counties with greater social vulnerability were more likely to become areas with rapidly increasing COVID-19 incidence (hotspot counties), especially counties with higher percentages of racial and ethnic minority residents and people living in crowded housing conditions, and in less urban areas. Hotspot counties with higher social vulnerability had high and increasing incidence after identification.

What are the implications for public health practice?

Focused public health action is urgently needed to prevent communities that are socially vulnerable from becoming COVID-19 hotspots and address persistently high COVID-19 incidence among hotspot areas that are socially vulnerable.

FIGURE 2. COVID-19 incidence* during the 14 days after identification as a hotspot, compared with counties not identified as hotspots† (A) (N = 1,378 counties), and COVID-19 incidence, by quartile of social vulnerability index among hotspot counties§ (B) (N = 689 counties) — United States, June 1–July 25, 2020



* Cases per 100,000 persons; calculated based on 7-day moving window (total number of cases over the last 7 days per 100,000 population) during the 14 days after hotspot identification to smooth expected variation in daily case counts.

† To compare incidence in hotspot and non-hotspot counties, a random sample of non-hotspot counties (1:1 ratio) was matched to hotspot counties by urbanicity and assigned the same date of reference.

§ Overall social vulnerability scores were percentile rankings ranging from 0–1, with higher values indicating more social vulnerability. Scores were categorized into quartiles based on distribution among all U.S. counties.

programs to quickly identify and isolate COVID-19 cases and limit transmission.

The findings in this report are subject to at least three limitations. First, associations between social vulnerability and risk for COVID-19 infection using person-level data could not be assessed; it was also not possible to assess confounding by factors such as employment. Second, changes in testing availability and laboratory reporting might have affected COVID-19 incidence estimates and hotspot detection. Finally, the hotspot criteria might have limited the ability to detect hotspots in counties with smaller populations.

Building on previous work (*10*), these findings underscore the need for federal, state, and local partners to work with community leaders to support areas with high social vulnerability and prevent them from becoming COVID-19 hotspots. These findings also demonstrate the need to reevaluate factors related to high incidence for earlier detection of hotspot counties, particularly in areas with high social vulnerabilities; among hotspot counties, these results demonstrate the need to prioritize immediate public health action in counties with the highest social vulnerability, especially in less urban areas.

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Mitigating a COVID-19 Outbreak Among Major League Baseball Players — United States, 2020

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Mass gatherings have been implicated in higher rates of transmission of SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19), and many sporting events have been restricted or canceled to limit disease spread (*1*). Based on current CDC COVID-19 mitigation recommendations related to events and gatherings (*2*), Major League Baseball (MLB) developed new health and safety protocols before the July 24 start of the 2020 season. In addition, MLB made the decision that games would be played without spectators. Before a three-game series between teams A and B, the Philadelphia Department of Public Health was notified of a team A player with laboratory-confirmed COVID-19; the player was isolated as recommended (*2*). During the series and the week after, laboratory-confirmed COVID-19 was diagnosed among 19 additional team A players and staff members and one team B staff member. Throughout their potentially infectious periods, some asymptomatic team A players and coaches, who subsequently received positive SARS-CoV-2 test results, engaged in on-field play with teams B and C. No on-field team B or team C players or staff members subsequently received a clinical diagnosis of COVID-19. Certain MLB health and safety protocols, which include frequent diagnostic testing for rapid case identification, isolation of persons with positive test results, quarantine for close contacts, mask wearing, and social distancing, might have limited COVID-19 transmission between teams.

Investigation and Results

On June 23, before the July 24 start of the 2020 season, MLB implemented health and safety protocols, which included COVID-19 mitigation strategies (Table). The health and safety protocols established tiered, risk-based testing for MLB teams, which called for persons who received a positive SARS-CoV-2 test result to be placed in isolation and for close contacts to be quarantined separately. Tier 1 included players and persons with high interpersonal contacts with players (e.g., coaches, umpires, and medical staff members). Tier 2 included persons who were able to wear face masks, maintain social distance, or both during their regular interactions with tier 1 persons (e.g., travel and home clubhouse staff members). Tier 3 included persons with minimal contact with other staff members (e.g., cleaning service and stadium security staff members).

On day 1, team A traveled from location A to location C and played two games with team C (Figure).* On day 2, team A traveled from location C to location B for a three-game series with team B commencing on day 4. Before game play on day 4, the index team A player (an asymptomatic tier 1 risk group member who received every other day testing, per protocol) received a positive SARS-CoV-2 real-time reverse transcription–polymerase chain reaction (RT-PCR) test result from collection on day 2. The player was isolated at location B, and the Philadelphia Department of Public Health was notified, who led the outbreak investigation. After identification of the first confirmed COVID-19 patient on team A, all tier 1 and tier 2 players and staff members with known close contact with persons with COVID-19 on teams A and B were tested for SARS-CoV-2. Tier 2 staff members without known contact with a person with confirmed COVID-19, and staff members at facilities providing services for team A were offered voluntary diagnostic testing. Teams A, B, and C players and staff members received a diagnosis of outbreak-related COVID-19 if they had a positive SARS-CoV-2 RT-PCR test result during days 2–11 of the outbreak. Saliva specimens were collected by trained personnel. SARS-CoV-2 RT-PCR testing was conducted at the Sports Medicine Research and Testing Laboratory (Utah) or the Rutgers Clinical Genomic Laboratory (New Jersey). Translational Genomics Research Institute (Arizona) completed whole genome sequencing on residual diagnostic samples using standard methods (*3*). Sequence reads were aligned and compared with a Wuhan reference strain; all variants were identified and compared with the global GISAID SARS-CoV-2 database (>80,000 genomes). Investigators received from MLB a deidentified line list of team members with diagnosed COVID-19, a timeline of the outbreak response, the duration of on-field play by potentially infectious persons (within 24 hours before the date of collection of the test-positive specimen), contact tracing procedures, and the MLB health and safety protocols.

* The Figure shows the day of testing, whereas the results presented in the text provide the day of receipt of a positive test result.

TABLE. Selected mitigation strategies implemented by Major League Baseball at the opening of the 2020 season — United States, 2020

Mitigation strategy	Description
Minimize contact between players and staff members (tiers)	To manage within team contacts, relevant players and staff members were divided into three tiers to minimize contact needed on-site for games: • Tier 1: players and persons with high interpersonal contacts with players, e.g., coaches and medical staff members • Tier 2: nonplaying staff members who work with tier 1 but are able to wear face masks, maintain social distancing recommendations, or both, e.g., traveling and home clubhouse staff members • Tier 3: essential staff members who do not require close contact with tier 1, e.g., cleaning service providers and stadium security personnel Umpires were not permitted to visit either team's clubhouse and were limited to umpire room, field, and areas necessary for travel between Opposing team players and staff members were not permitted to visit each other's clubhouse facilities Team clubhouse attendants and staff members were required to remain at their assigned location during games and movement between team clubhouse facilities was not permitted
Symptom screening and testing	Tier 1, asymptomatic: temperature and symptoms screened* at least twice per day, diagnostic testing† every other day Tier 2, asymptomatic: home symptom screening, facility health screening upon entry to stadium or club facility, diagnostic testing at least two times per week Tier 3, asymptomatic: home symptom screening, facility health screening upon entry to stadium or club facility, no routine diagnostic testing Symptomatic or close contact of known COVID-19 case: clinical assessment, person is isolated, expedited diagnostic testing within 24 hours
Isolation of persons testing positive and quarantine of close contacts	Persons testing positive may be released from isolation provided the following criteria are met: • Two negative diagnostic test results, taken ≥24 hours apart • Afebrile ≥72 hours without the use of a fever suppressant and respiratory symptoms have improved (as documented by a clinician) • Completion of at least one antibody test after the positive diagnostic test result • Team medical staff members conclude person is no longer at risk for transmission • Local regulations are satisfied Close contacts may be released from quarantine provided the following criteria are met: • Negative diagnostic test results • Asymptomatic • Agreeing to participate in enhanced monitoring (e.g., more frequent temperature checks) by the team's medical staff members for ≥10 days and daily diagnostic testing for 7 days after the exposure
Face masks	All persons must wear masks when in club facilities except when engaged in strenuous physical activity such as: • On the field, in the bullpen, or in the dugout • During games or practices
Social distancing	All players and staff members were required to maintain social distancing in club facilities Teams were advised to interact with one another only during gameplay, to avoid unnecessary physical interactions (e.g., high fives) and to avoid large group activities outside practices and games All players and staff members were encouraged to maintain social distancing outside of club facilities and to avoid activities that involved large groups or were primarily indoors
Environmental cleaning and disinfection	Routine cleaning of club facilities in accordance with CDC guidelines§ Immediate cleaning and disinfection of club-controlled areas accessed by person with symptoms or diagnostic testing indicative of COVID-19

Abbreviation: COVID-19 = coronavirus disease 2019.

* Signs and symptoms screened included fever, shortness of breath or difficulty breathing, cough (new onset or worsening), headache, chills, sore or scratchy throat, new loss of taste or smell, muscle pain, nasal congestion, runny nose, nausea or vomiting, diarrhea, gastrointestinal distress or upset stomach, fatigue or weakness, swelling of the toes or lower extremities, chest tightness or pain, swollen lymph nodes or glands, abdominal pain, and rash or discolored and swollen toes ("COVID toes").

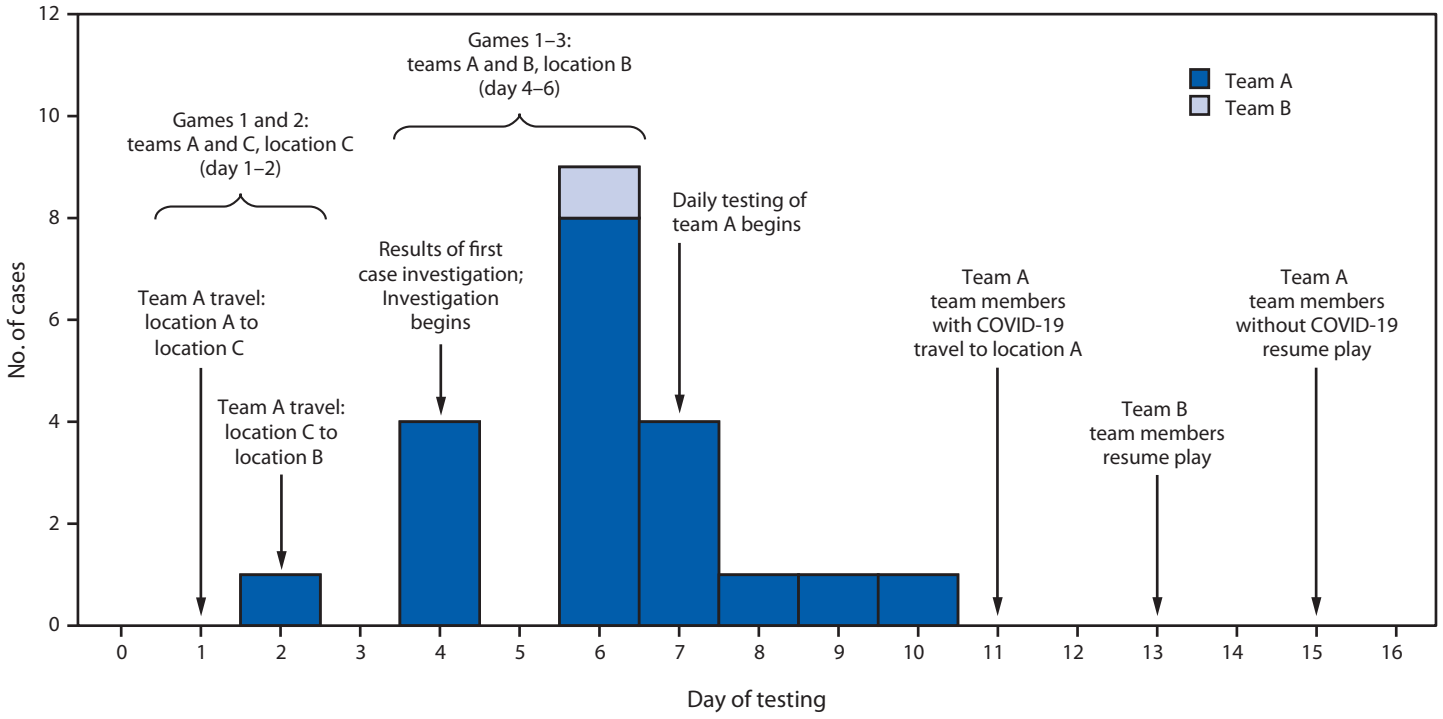
† Saliva or nasopharyngeal specimens were tested for SARS-CoV-2 using a reverse transcription–polymerase chain reaction test at the Sports Medicine Research and Testing Laboratory, Utah and the Rutgers Clinical Genomic Laboratory, New Jersey.

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

After game 2 (day 5) of the three-game series at location B, three additional asymptomatic team A players received positive SARS-CoV-2 test results and were isolated. Immediately after game 3 (day 6), an additional eight team A players and staff members received positive test results, for a total of 12 team A players and staff members. MLB initiated daily testing for all team A and team B tier 1 and 2 employees for the outbreak duration. During days 7–11, eight more team A employees received positive test results. Overall, 20 COVID-19 cases were diagnosed among team A tier 1 players and staff members and one team B tier 2 employee; that employee's official duties required indoor interaction with team A. Umpires and team C tier 1 employees continued with every other day testing and no further positive tests were recorded during the outbreak. Testing was available for non-MLB staff members(e.g., hotel staff members) who had possible interaction with team A. None of the 56 non-MLB staff members who were tested received positive SARS-CoV-2 test results.

Among 20 residual samples, 18 were suitable for whole genome sequencing. Among these, 17 had identical consensus sequences, and one showed a single nucleotide variant. These data were consistent with a single introduction resulting in a

FIGURE. Dates of testing and events during a COVID-19 outbreak among professional baseball players and staff members (N = 21) — Major League Baseball, United States, 2020



Abbreviation: COVID-19 = coronavirus disease 2019.

super-spreading event (*4*). Phylogenetic comparisons placed these 18 genomes in a large clade dominated by genomes sequenced from the southeastern United States.

In total, 146 MLB employees were exposed to SARS-CoV-2, including 68 associated with team A, 31 with team B, 38 with team C, and nine umpires; among these, 21 persons received positive SARS-CoV-2 test results. On average, testing results were available within 24 hours of collection (range = 12–48 hours). The overall attack rate was 14.4% (21 of 146), with team A, B, and C attack rates of 29.4% (20 of 68), 3.2% (one of 31), and 0% (zero of 38), respectively. Twenty of the 21 persons with diagnosed COVID-19 were tier 1 team A employees, and one was a tier 2 team B employee. Among the 19 of 21 persons with COVID-19 who were symptomatic, symptoms developed an average of 2.3 days after collection of the test-positive sample (range = 0–7 days). Potentially infectious persons had a total game time (e.g., bullpen, dugout, and on-field) of 40 hours 23 minutes and a total on-field play time of 11 hours 8 minutes at locations B and C; one on-field practice for team A occurred on day 3. Games scheduled with teams A and B were postponed on days 8–14. Team A persons with COVID-19 returned home on day 11 via private charter buses. Remaining team A employees traveled to location D on day 13. No additional cases were identified after day 11. Team A resumed play on day 15. Team B resumed practices on day 13 and play on day 14.

Public Health Response

MLB isolated all players and staff members with COVID-19 at a separate location from those under quarantine. MLB coordinated with Philadelphia Department of Public Health to ensure rapid identification of cases and testing of contacts and to implement mitigation efforts. The lack of evidence for on-field transmission, as demonstrated by the absence of infections among opposing on-field team players and staff members, pointed to indoor exposures as the likely means of SARS-CoV-2 spread. Limitations identified in infection prevention practices led to MLB health and safety protocol revisions on day 16. Amendments included increasing cloth face mask use among players and staff members (i.e., at all times except on the field of play), limiting travel to essential staff members, and prohibiting visits to gatherings of large groups of persons (e.g., at bars and lounges).

Discussion

COVID-19 outbreaks have been predominantly attributed to indoor settings with few investigations evaluating the spread of SARS-CoV-2 outdoors (*5*). Throughout five professional baseball games, asymptomatic, unknowingly infected players

and coaches spent more than a cumulative 11 hours on the field. Although disease transmission were possible on the field, no opposing team players or coaches or umpires became ill during the outbreak. Interactions outside of on-field play were likely the source of spread, and SARS-CoV-2 transmission risk between baseball teams while on the playing field appeared low. Enforced health and safety protocols reduced interteam contacts and limited opposing team close contacts to brief interactions outdoors, potentially reducing the risk for transmission (*6*). Though one outbreak might not be representative of all scenarios faced by MLB, by mid October 2020, only 91 of 169,143 samples (0.05%) from 21 different teams returned positive test results; 57 (63%) of the 91 persons with positive test results have been players and 34 have been staff members. All patients recovered. No other COVID-19 outbreaks have spread to opposing MLB team members (*7*,*8*).

Social distancing policies likely limited the transmission of SARS-CoV-2 among staff members. Most persons with COVID-19 were tier 1 players and staff members, who had high likelihood of interpersonal contact in their roles within MLB. The one team B tier 2 employee who contracted COVID-19 closely interacted indoors with team A tier 1 employees who subsequently tested positive, likely increasing infection risk. Social distancing measures have been effective in a variety of settings (*9*), and this outbreak provides additional support for their use during sporting events, such as baseball games. When used, universal mask-wearing policies (*2*) provided additional protection for teammates. Consistent adherence to these policies off-field also might have contributed to protecting the communities hosting the games.

Mitigation strategies in the MLB health and safety protocols appear to have limited spread of COVID-19 beyond team A. However, even these multiple layers of protection are not infallible and containing the disease with isolation and quarantine is important in limiting the spread of COVID-19. The potential for presymptomatic transmission evidenced by MLB players and staff members reporting symptoms an average of 2.3 days after a positive test result highlights the importance of testing asymptomatic persons. The observed transmission within team A and evidence of a super-spreading event, led to updates in the health and safety protocols after the outbreak. Even with comprehensive COVID-19 mitigation efforts for sporting events, persons' actions on and off the field are equally important in acquiring infection in the community and preventing transmission during games. This MLB outbreak investigation highlights the importance of employing multiple mitigation strategies to decrease risk for the person, the team, and the venue staff members.

Summary

What is already known about this topic?

Mitigation strategies decrease the spread of communicable diseases. Data on their effectiveness to prevent and mitigate SARS-CoV-2 transmission during outdoor sporting events are limited.

What is added by this report?

During the 2020 season, Major League Baseball instituted a multilayered COVID-19 prevention and mitigation strategy. In an outbreak among 20 baseball players and staff members on a single team, no secondary transmission during field play between two opposing teams occurred. Interactions outside of game play were the likely source of transmission within the team.

What are the implications for public health practice?

Adherence to COVID-19 mitigation measures on and off the field has important implications for infection prevention in comparable sports teams, including professional, amateur collegiate, high school, and club baseball and softball teams.

Other professional sports leagues have adopted "bubble" strategies, (i.e., tightly controlled campus environments), to limit the exposures of players and staff members (*10*), whereas MLB and the players chose to play within their communities, enabling them to interact with persons outside of MLB including family members and the general public. Limited information on activities and exposures of players and staff members while off-field and in the community were available for this investigation. Some of the strategies employed, including frequent testing and dedicated contact tracing might not be realistic options for most nonprofessional teams. However, the multilayered strategy of mitigation measures used by MLB may have limited the spread to, within, and across teams.

Implementation of CDC COVID-19 mitigation strategies, particularly mask wearing and social distancing, as included in the MLB health and safety protocols, might provide nonprofessional baseball teams a means to play while reducing SARS-CoV-2 transmission between teams. However, in order to limit the spread of COVID-19 transmission both within and across teams, mitigation actions outside of game activities are also important. Willingness to adapt play based on knowledge of community transmission, and adherence to community mitigation strategies might allow sporting activities to resume. Persons engaged in similar sports might be able to implement some of these policies, e.g., within high schools and club teams, to provide a safer environment for all participants.

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First 100 Persons with COVID-19 — Zambia, March 18–April 28, 2020

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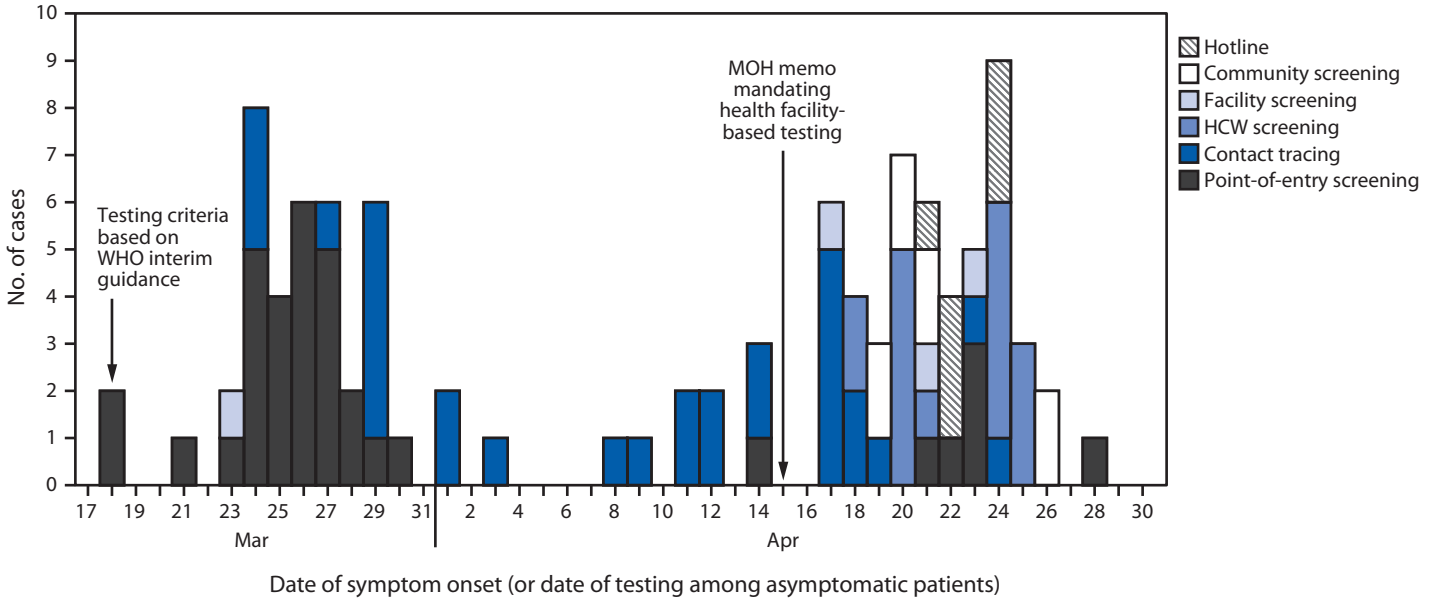
Zambia is a landlocked, lower-middle income country in southern Africa, with a population of 17 million (*1*). The first known cases of coronavirus disease 2019 (COVID-19) in Zambia occurred in a married couple who had traveled to France and were subject to port-of-entry surveillance and subsequent remote monitoring of travelers with a history of international travel for 14 days after arrival. They were identified as having suspected cases on March 18, 2020, and tested for COVID-19 after developing respiratory symptoms during the 14-day monitoring period. In March 2020, the Zambia National Public Health Institute (ZNPHI) defined a suspected case of COVID-19 as 1) an acute respiratory illness in a person with a history of international travel during the 14 days preceding symptom onset; or 2) acute respiratory illness in a person with a history of contact with a person with laboratory-confirmed COVID-19 in the 14 days preceding symptom onset; or 3) severe acute respiratory illness requiring hospitalization; or 4) being a household or close contact of a patient with laboratory-confirmed COVID-19. This definition was adapted from World Health Organization (WHO) interim guidance issued March 20, 2020, on global surveillance for COVID-19 (*2*) to also include asymptomatic contacts of persons with confirmed COVID-19. Persons with suspected COVID-19 were identified through various mechanisms, including port-of-entry surveillance, contact tracing, health care worker (HCW) testing, facility-based inpatient screening, community-based screening, and calls from the public into a national hotline administered by the Disaster Management and Mitigation Unit and ZNPHI. Port-of-entry surveillance included an arrival screen consisting of a temperature scan, report of symptoms during the preceding 14 days, and collection of a history of travel and contact with persons with confirmed COVID-19 in the 14 days before arrival in Zambia, followed by daily remote telephone monitoring for 14 days. Travelers were tested for SARS-CoV-2, the virus that causes COVID-19, if they were symptomatic upon arrival or developed symptoms during the 14-day monitoring period. Persons with suspected COVID-19 were tested as soon as possible after evaluation for respiratory symptoms or within 7 days of last known exposure (i.e., travel or contact with a confirmed case). All COVID-19 diagnoses were confirmed using real-time reverse transcription–polymerase chain reaction (RT-PCR) testing (SARS-CoV-2 Nucleic Acid Detection Kit, Maccura) of nasopharyngeal specimens; all patients with confirmed COVID-19 were admitted into institutional isolation at the time of laboratory confirmation, which was generally within 36 hours. COVID-19 patients were deemed recovered and released from isolation after two consecutive PCR-negative test results ≥24 hours apart. A Ministry of Health memorandum was released on April 13, 2020, mandating testing in public facilities of 1) all persons admitted to medical and pediatric wards regardless of symptoms; 2) all patients being admitted to surgical and obstetric wards, regardless of symptoms; 3) any outpatient with fever, cough, or shortness of breath; and 4) any facility or community death in a person with respiratory symptoms, and 5) biweekly screening of all HCWs in isolation centers and health facilities where persons with COVID-19 had been evaluated. This report describes the first 100 COVID-19 cases reported in Zambia, during March 18–April 28, 2020.

These 100 positive test results were reported from 6,165 tests conducted during this time (1.6% positive); most (77%) of the 100 persons with COVID-19 were identified in the capital of Lusaka. Most cases occurred in men (61%) and in adults aged 30–44 years (32%) and were identified through point-of-entry surveillance (35%) and contact tracing (30%). Thirty-five persons with COVID-19 had traveled internationally in the 14 days before testing; 65 persons with locally acquired COVID-19 included 30 non-HCW contacts of a person with known COVID-19. Fever, cough, sore throat, headache, and fatigue were the most commonly reported signs and symptoms; 79% of cases were asymptomatic at the time of testing. Median recovery time was 12 days (interquartile range = 1–42 days) from date of symptom onset (or date of testing for asymptomatic patients). Underlying health conditions were reported by 20% of patients; among patients with underlying conditions, human immunodeficiency virus infection (35%) and hypertension (35%) were those most commonly reported. Three deaths were recorded; two of the patients who died received critical or intensive care before death, and all three had at least one underlying health condition.

During the first 28 days after confirmation of Zambia's first COVID-19 case, 65% of cases were identified via point-of-entry surveillance and contact tracing (Figure). However, testing asymptomatic persons, including HCWs, in hospital

FIGURE. Mode of detection*,† of first 100 confirmed COVID-19 cases — Zambia, March 18–April 28, 2020



Abbreviations: COVID-19 = coronavirus disease 2019; HCW = health care worker; MOH = Ministry of Health; WHO = World Health Organization.

* WHO Interim Guidance: Global Surveillance for COVID-19 Caused by Human Infection with COVID-19 Virus. March 20, 2020. https://apps.who.int/iris/rest/bitstreams/1272502/retrieve. Zambia suspected case definition: 1) an acute respiratory illness in a person with a history of international travel during the 14 days preceding symptom onset; 2) acute respiratory illness in a person with a history of contact with a person with laboratory-confirmed COVID-19 in the 14 days preceding symptom onset; 3) severe acute respiratory illness requiring hospitalization; or 4) being a household or close contact of a patient with laboratory-confirmed COVID-19.

† MOH memo released on April 13, 2020, mandated testing of 1) all persons admitted to medical and pediatric wards regardless of symptoms; 2) all patients before admission to surgical and obstetric wards, regardless of symptoms; 3) any outpatient with fever, cough, or shortness of breath; and 4) any facility or community death in a person with respiratory symptoms, and facility-based screening of HCWs.

settings where persons with confirmed COVID-19 were being cared for was helpful in identifying COVID-19 among 16 HCWs and four admitted patients and might have reduced nosocomial transmission.

After the first persons with COVID-19 with no apparent epidemiologic links to other reported persons with COVID-19 were confirmed in early April, the number of cases identified through community-based screenings in residential areas and nearby markets where the unlinked cases had been identified increased. Expansion of the national testing strategy to include asymptomatic persons with possible COVID-19 exposures and those with no international travel history facilitated detection and isolation of cases that would have been otherwise missed. Other countries in the region or with similar demographic profiles might find these strategies useful for detection, containment, or mitigation of COVID-19.

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Rapid Adaptation of HIV Treatment Programs in Response to COVID-19 — Namibia, 2020

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Namibia is an upper-middle income country in southern Africa, with a population of approximately 2.5 million (*1*). On March 13, 2020, the first two cases of coronavirus disease 2019 (COVID-19) in Namibia were identified among recently arrived international travelers. On March 17, Namibia's president declared a state of emergency, which introduced measures such as closing of all international borders, enactment of regional travel restrictions, closing of schools, suspension of gatherings, and implementation of physical distancing measures across the country. As of October 19, 2020, Namibia had reported 12,326 laboratory-confirmed COVID-19 cases and 131 COVID-19–associated deaths. CDC, through its Namibia country office, as part of ongoing assistance from the U.S. President's Emergency Plan for AIDS Relief (PEPFAR) provided technical assistance to the Ministry of Health and Social Services (MoHSS) for rapid coordination of the national human immunodeficiency virus (HIV) treatment program with the national COVID-19 response.

With support from PEPFAR since 2004, Namibia is on the verge of HIV epidemic control: 95% of persons with HIV infection know their status; 95% of these persons are receiving antiretroviral therapy (ART); and among these, 92% have achieved viral load suppression (≤1,000 copies of viral RNA/mL) (*2*). Because the COVID-19 pandemic has the potential to compromise Namibia's ART program efforts, MoHSS prioritized providing life-saving ART while reducing patient volume in ART facilities to reduce the risk for COVID-19 exposure in advance of a possible broader COVID-19 outbreak in Namibia.

Regional MoHSS ART clinical mentors, who are experienced ART physicians supporting healthcare workers in each of the 14 regions, served as points of contact to implement rapid adjustments to the ART program. New national guidance, coordination, and feedback were communicated through the Project Extension for Community Healthcare Outcomes (ECHO) virtual mentoring platform (*3*); Namibia was among the first African countries to adopt Project ECHO in 2015. During March 17–April 21, MoHSS conducted seven communication sessions using the Project ECHO platform with 760 sites and 2,068 health care providers. Because all major district hospitals and high-volume health care centers in the country use the ECHO platform, rapid communication and telementoring across all regions was possible, despite travel restrictions.

MoHSS, with CDC support and in alignment with forthcoming PEPFAR guidance (*4*), quickly developed a plan to minimize the frequency of patient contact with the health care system and reduce burden on facilities. The plan consisted of facility readiness, multimonth dispensing (MMD) of ART, and the expansion of community ART dispensing.

Facility readiness included plans for screening and triaging patients. ART patients were first screened for COVID-19–compatible signs and symptoms* upon arrival at the health facility. Those with symptoms were isolated and tested for SARS-CoV-2, the virus that causes COVID-19, by polymerase chain reaction (PCR) testing of specimens obtained with a nasopharyngeal swab and, if hospitalization was not required, were asked to self-isolate while waiting for results. In an effort to avoid overcrowded waiting areas, and thereby possible SARS-CoV-2-transmission, asymptomatic patients were triaged to receive fast-track refills without entering the facility or quick, small group clinical consultations for dispensing MMD. Patients aged ≥50 years and those with underlying medical conditions (*5*) received expedited services. MoHSS provided recommended personal protective equipment (*6*) to clinic staff members and symptomatic patients.

Four-month MMD of ART was implemented by assessing the national stock and adjusting ART guidance to maximize available stock and ensure optimal regimens. To ensure treatment continuity, the National Central Medical Store distributed 4–6 months' supply of stock for 166,237 (97%) of 171,830 total patients receiving ART to health care facilities in all regions. Emergency procurement was activated to ensure that a 12-month supply of ART stock would be available in the country.

Community ART dispensing was expanded through 1) newly established community-based ART points, 2) primary health care outreach points, 3) community adherence groups, 4) mobile vans, and 5) home delivery. Outreach points placed

* Fever or temperature ≥100.4°F (38.0°C), cough, shortness of breath, weakness, muscle aches, chills, vomiting or diarrhea, headache, chest pain, new loss of taste or smell.

at the borders were especially important for Angolan patients seeking ART refills in Namibia despite border closures. A national ART hotline was established to assist patients who experienced difficulty accessing services.

Other HIV treatment services were also adjusted to prevent transmission of SARS-CoV-2 (Table). Programs minimized patient contact with health care facilities to limit possible exposure. Community programming supported physical distancing and used alternative methods of communication, including virtual platforms such as Zoom or Skype, phone calls, social media, and WhatsApp Messenger, a mobile application for smartphones. Group activities were limited in size according to Namibia national regulations.

Namibia has rapidly implemented public health measures to mitigate SARS-CoV-2 transmission, which allows additional time to adequately prepare the health care system for a potential surge in COVID-19 cases. The ART program has adapted to ensure the continuity of essential HIV services

TABLE. Adaptations of the national human immunodeficiency virus (HIV) testing and treatment program during the COVID-19 outbreak — Namibia, 2020

Program area	Program adaptations
Clinic readiness	Screening and triaging clients for COVID-19 symptoms Adjusting clinic flow to limit overcrowding and exposure risk for patients and health care workers Limiting clinic appointments to avoid crowding (prioritizing patients failing ART or clinical complaints) Providing ART refills without entering the facility Providing expedited services for patients at higher risk for COVID-19 morbidity and mortality Using Project ECHO platform for regular communication, coordination and telementoring for all regions Providing virtual COVID-19 trainings for staff members Providing PPE
MMD of ART (adults, children, and pregnant and breastfeeding women)	Assessing national stock situation and adjusting ART guidance to ensure adequate medication stock for MMD Issuing and widely sharing interim ART guidance through ECHO and clinical mentorship network Distributing stock to regions to ensure adequate supplies for MMD
Community dispensing	Using community-based ART outreach points Adapting and expanding community adherence groups with groups <10 at one time Expanding primary health care outreach points Using mobile vans (especially for persons at high risk and for those unable to get MMD) Establishing home delivery (through community health care workers)
Patient tracing	Shifting physical tracing of patients missing appointments to phone tracing exclusively
Strengthening border services	Liaising with regional governments, immigration authorities, and police to allow patients to access medicines Creating outreach points for patients to access ART at the Angola-Namibia border Tracing patients who miss appointments via telephone to link them back into care Establishing ART hotline to assist patients having difficulty accessing services and answer questions about COVID-19 and HIV
Facility HIV testing	Prioritizing facility-based testing (antenatal care, admitted patients, early infant diagnosis, persons with tuberculosis and sexually transmitted infections, passive index testing) Standardizing safe HIV testing services provision using physical distancing and PPE measures Maximizing use of self-testing kits* outside of clinic settings for clients and their partners
Community index testing	Discontinuing community index testing until safe processes were established Providing guidance for proper PPE use to implement community index testing once deemed safe
HIV recency testing	Pausing recency testing to decrease time spent in clinics and decrease burden on laboratory staff members
Community adolescent treatment supporters and teen clubs	Providing community adolescent treatment supporters with mobile phones and airtime to continue to engage beneficiaries from home Limiting teen clubs to continue meeting in only places where they could practice recommended physical distancing with no more than 10 teens at a time
Cervical cancer screening and treatment	Continuing limited screening at health facilities that have program-specific staff members Postponing all outreach and campaigns
Tuberculosis preventive therapy	Dispensing tuberculosis preventive therapy for the full duration of treatment for those initiating or already receiving tuberculosis preventive therapy Delivering tuberculosis preventive therapy medications to eligible clients through community health care workers with recommended PPE and physical distancing
Prevention of mother-to-child transmission of HIV	Continuing routine testing of pregnant and breastfeeding women and HIV-exposed infants Providing MMD for pregnant and breastfeeding women Prioritizing safe labor and delivery access in health care facilities with adjustments in clinic flow to minimize the risk for COVID-19 exposure Providing pregnant and breastfeeding women adherence and retention support through telephone calls

Abbreviations: ART = antiretroviral therapy; COVID-19 = coronavirus disease 2019; MMD = multimonth dispensing; PPE = personal protective equipment; Project ECHO = Extension for Community Healthcare Outcomes.
* OraSure Technologies. http://www.oraquick.com.

while maintaining a safe health care environment for clients and staff members during the COVID-19 pandemic. Efforts are underway to evaluate the implementation of these initiatives across sites and the impact on programs. These public health strategies could be implemented in other settings where COVID-19 might threaten the HIV treatment program when the public health providers and governments are willing to use new technologies and novel strategies to maintain patient care.

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Notes from the Field

Characteristics of E-cigarette, or Vaping, Products Confiscated in Public High Schools in California and North Carolina — March and May 2019

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E-cigarette, or vaping, products are electronic devices that produce an inhalable aerosol by heating an e-liquid that typically contains nicotine and other additives (*1*). Nicotine is highly addictive, can harm adolescent brain development, and can prime the brain for addiction to other drugs (*1*). In 2019, 27.5% of U.S. high school students currently used e-cigarettes (*2*), and 73.4% of high school students had observed e-cigarette use on school grounds (*3*). E-cigarette use among U.S. youths increased considerably during 2017–2019 (*2*). This rise coincided with the increased popularity of "pod mods," which are products with a prefilled or refillable pod cartridge (pod) and a modifiable (mod) system. Pod mods typically use nicotine salts rather than the freebase nicotine used in most other e-cigarette, or vaping, products and conventional tobacco products (e.g., cigarettes).* Nicotine salts, which have a lower pH than freebase nicotine, allow particularly high levels of nicotine to be inhaled more easily and with less irritation to the throat than freebase nicotine.† The most commonly sold pod mod brand is JUUL, which accounted for 75% of all U.S. e-cigarettes sales by the end of 2018.§ A majority (59.1%) of U.S. high school student e-cigarette users report JUUL is their usual brand (*2*).

To understand the types of e-cigarette, or vaping, products used on school grounds, CDC conducted an environmental assessment in California and North Carolina public high schools in March and May 2019, respectively. An e-mail request from the California Department of Public Health and Department of Education and North Carolina Division of Public Health was sent to a convenience sample of 1,456 California high schools and a state-representative sample of 25 North Carolina high schools to request available products confiscated from students or found on school grounds during the 2018–19 academic year. Sixteen (1%) California and nine (36%) North Carolina high schools responded and provided products, which were characterized by device type, e-liquid cartridge type, and brand.

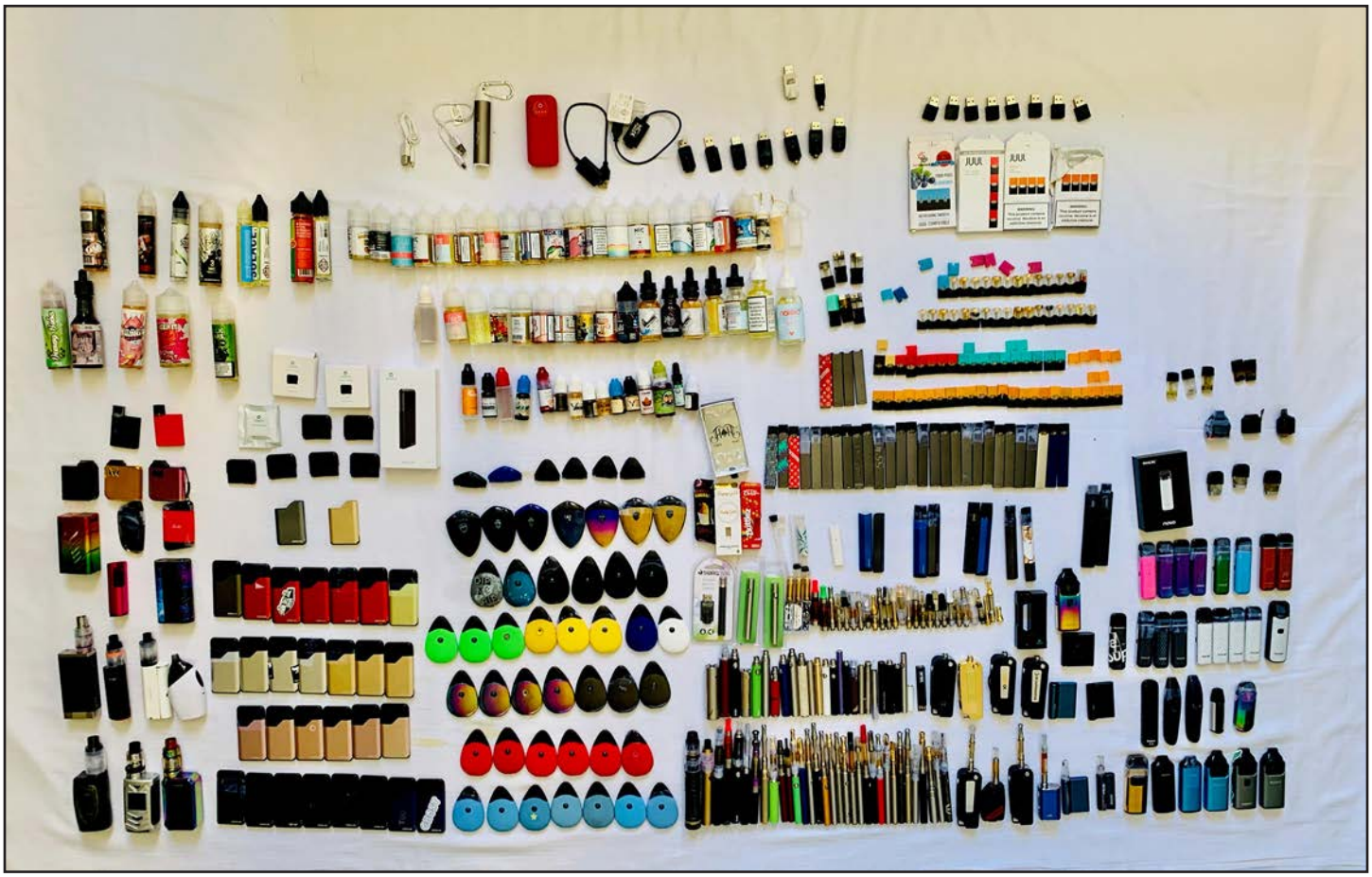
Overall, 233 devices and 343 e-liquid cartridges were collected in California (Figure), and 176 devices and 267 e-liquid cartridges were collected in North Carolina. Pod mods were the most commonly collected devices in California (64%) and North Carolina (74%), and pod mod cartridges were the most commonly collected e-liquid cartridge type in California (80%) and North Carolina (81%). Among these devices and e-liquid cartridges, the three most commonly collected brands were Suorin (29%), SMOK (15%), and JUUL (14%) in California, and JUUL (48%), SMOK (16%), and Suorin (9%) in North Carolina.

Approximately 1,000 e-cigarette, or vaping, products were collected from 25 high schools in California and North Carolina during the 2018–19 academic year. Pod mods, including JUUL, Suorin, and SMOK, were the three most commonly collected products, but variations in prevalence of collected device types and brands were observed between the two states. These differences could be attributed to brand popularity, affordability, or differing legal status of marijuana sales between states. For example, during the time of this study and currently, recreational and medicinal marijuana could be legally sold to persons aged ≥21 years in California and were thus present in society for potential indirect access by youths; in contrast, marijuana sales are currently illegal in North Carolina. Some types and brands of pod mod products are intended to be refilled by the user (e.g., Suorin and SMOK), which could include e-liquids containing nonnicotine substances such as marijuana; one third of current U.S. high school e-cigarette users report using marijuana in an e-cigarette (*4*).

The findings in this report are subject to at least three limitations. First, the response rates were low; thus, these findings might not be representative of all California and North Carolina schools. Second, not all schools retained confiscated e-cigarettes and other products, and some were discarded before the assessment. Moreover, school staff members had varying ability to accurately identify easily concealable products or those that resemble common objects like flash drives. Thus, the devices and products examined by investigators, as well as those confiscated and collected, might not be representative of all devices used by students. Finally, the contents of the confiscated products were not assessed.

* https://www.cdc.gov/tobacco/basic_information/e-cigarettes/surgeon-general-advisory/index.html.
† https://www.cdc.gov/tobacco/basic_information/e-cigarettes/pdfs/ecigarette-or-vaping-products-visual-dictionary-508.pdf.
§ https://truthinitiative.org/sites/default/files/media/files/2019/03/Behind-the-explosive-growth-of-JUUL.pdf.

FIGURE. E-cigarette products confiscated from students by staff members or found on school grounds — 16 high schools, California, 2018–19 academic year



Photo/California Department of Health and Department of Education

School-based efforts to reduce and prevent tobacco product use are most effective when they are part of a comprehensive approach along with other evidence-based population-level strategies (*5*). School-level efforts could include adopting tobacco-free policies (including e-cigarettes) with enforcement measures that include access to resources and treatment for students, rather than punishment; implementing evidence-based curricula not sponsored by tobacco companies; and educating school staff members and parents about the changing product marketplace and known health risks of youth tobacco product use, including e-cigarettes (*5*).

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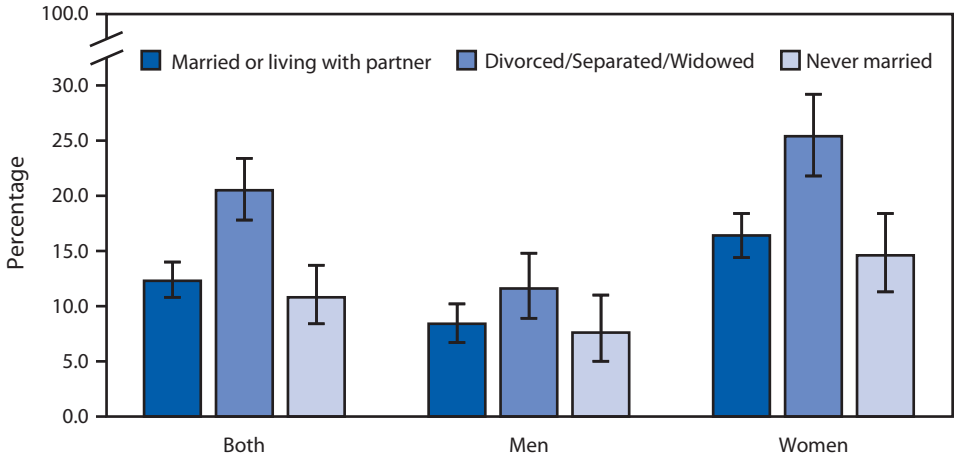
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Percentage of Adults Aged ≥20 Years Who Used Antidepressant Medications* in the Past 30 Days, by Sex and Marital Status — National Health and Nutrition Examination Survey, United States, 2015–2018



* The names of prescription medications taken in the last 30 days were obtained from containers reviewed during the household interview. Antidepressants were identified using a database from the medical information provider, Cerner Multum, Inc.

During 2015–2018, 13.6% of adults aged ≥20 years used prescription antidepressant medications in the past 30 days. Antidepressant use was higher among divorced, separated, or widowed (20.5%) adults than among either married or living with partner (12.3%) or never married (10.8%) adults. There was no difference in use between married and never married adults. These same patterns were observed for both men and women. Within every marital status category, a higher percentage of women compared with men took antidepressants.

Source: Brody DJ, Gu Q. Antidepressant use among adults: United States, 2015–2018. NCHS Data Brief, no 377. Hyattsville, MD: National Center for Health Statistics. 2020.

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