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Trends in Incidence of Cancers of the Oral Cavity and Pharynx — United States 2007–2016

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Cancers of the oral cavity and pharynx account for 3% of cancers diagnosed in the United States* each year. Cancers at these sites can differ anatomically and histologically and might have different causal factors, such as tobacco use, alcohol use, and infection with human papillomavirus (HPV) (*1*). Incidence of combined oral cavity and pharyngeal cancers declined during the 1980s but began to increase around 1999 (*2*,*3*). Because tobacco use has declined in the United States, accompanied by a decrease in incidence of many tobacco-related cancers, researchers have suggested that the increase in oral cavity and pharynx cancers might be attributed to anatomic sites with specific cell types in which HPV DNA is often found (*4*,*5*). U.S. Cancer Statistics† data were analyzed to examine trends in incidence of cancers of the oral cavity and pharynx by anatomic site, sex, race/ethnicity, and age group. During 2007–2016, incidence rates increased for cancers of the oral cavity and pharynx combined, base of tongue, anterior tongue, gum, tonsil, oropharynx, and other oral cavity and pharynx. Incidence rates declined for cancers of the lip, floor of mouth, soft palate and uvula, hard palate, hypopharynx, and nasopharynx, and were stable for cancers of the cheek and other mouth and salivary gland. Ongoing implementation of proven population-based strategies to prevent tobacco use initiation, promote smoking cessation, reduce excessive alcohol use, and increase HPV vaccination rates might help prevent cancers of the oral cavity and pharynx.

Data on new cases of cancers of the oral cavity and pharynx (*International Classification of Diseases for Oncology, Third Edition:* C00–C14)§ reported during 2007–2016, the most recently available data, were obtained from U.S. Cancer Statistics. U.S. Cancer Statistics includes population-based cancer registry data from CDC's National Program of Cancer

* https://www.cdc.gov/cancer/dataviz.

† https://www.cdc.gov/uscs.

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

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Registries and the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) program. This report covers the entire U.S. population during the 10-year period. Only microscopically confirmed cases were included.

Annual incidence rates per 100,000 persons used modified annual population estimates in the denominator (as an approximation of person-years) and were age-adjusted by the direct method to the 2000 U.S. standard population¶ using SEERStat software (version 8.3.6; National Cancer Institute). Trends in rates were estimated using joinpoint regression, with a maximum of one joinpoint allowed (JoinPoint version 4.6.0; National Cancer Institute). Average annual percentage change (AAPC) for 2007–2016 was calculated using the average of the slope coefficients of the underlying joinpoint regression lines with the weights equal to the length of each segment over the interval. To determine whether AAPCs were significantly different from zero, a t-test was used for 0 joinpoints, and a z-test was used for 1 joinpoint. Rates were considered to increase or decrease if $p<0.05$. Rates were examined by anatomic site, sex, race/ethnicity (five mutually exclusive groups, including non-Hispanic white [white], non-Hispanic black [black], non-Hispanic American Indian/Alaska Native [AI/AN], non-Hispanic Asian/Pacific Islanders [A/PI], and Hispanic) and age group (20–39, 40–49, 50–59, 60–69, 70–79, and ≥80 years). Rates also were examined by association with HPV, based on studies that examined the presence of HPV DNA in a sample of cancer tissue specimens (*6*). HPV-associated cancers included squamous cell cancer types at the base of tongue, pharyngeal tonsils, anterior and posterior tonsillar pillars, glossotonsillar sulci, soft palate and uvula, and lateral and posterior pharyngeal walls. All other cancers were considered not HPV-associated.

During 2007–2016, incidence rates increased for cancers of the oral cavity and pharynx combined (0.6% per year on average), other oral cavity and pharynx (3.4%), base of tongue (1.8%), anterior tongue (1.8%), gum (1.9%), tonsil (2.4%), and oropharynx (1.9%) (Figure). Rates declined for cancers of the soft palate and uvula (-3.7%), hard palate (-0.9%), floor of mouth (-3.1%), lip (-2.7%), hypopharynx (-2.4%), and nasopharynx (-1.3%); and were stable for cancers of the cheek and other mouth and salivary gland. When cancers of the oral cavity and pharynx were grouped by association with HPV, HPV-associated cancers increased 2.1% per year on average, whereas cancers not associated with HPV decreased 0.4% per year on average.

Several anatomic sites are commonly grouped in the category "oral cavity and pharynx" (Table 1). Rates for all cancers of the oral cavity and pharynx combined increased among whites and A/PI, decreased among blacks and Hispanics, and were stable among AI/AN (Table 2). When the anatomic sites with increasing incidence trends were examined by race/ethnicity, rates increased only among whites with three exceptions: rates of cancers of the tonsil increased among AI/AN and of the anterior tongue and gum among A/PI. Rates of cancers

¶ https://seer.cancer.gov/popdata.

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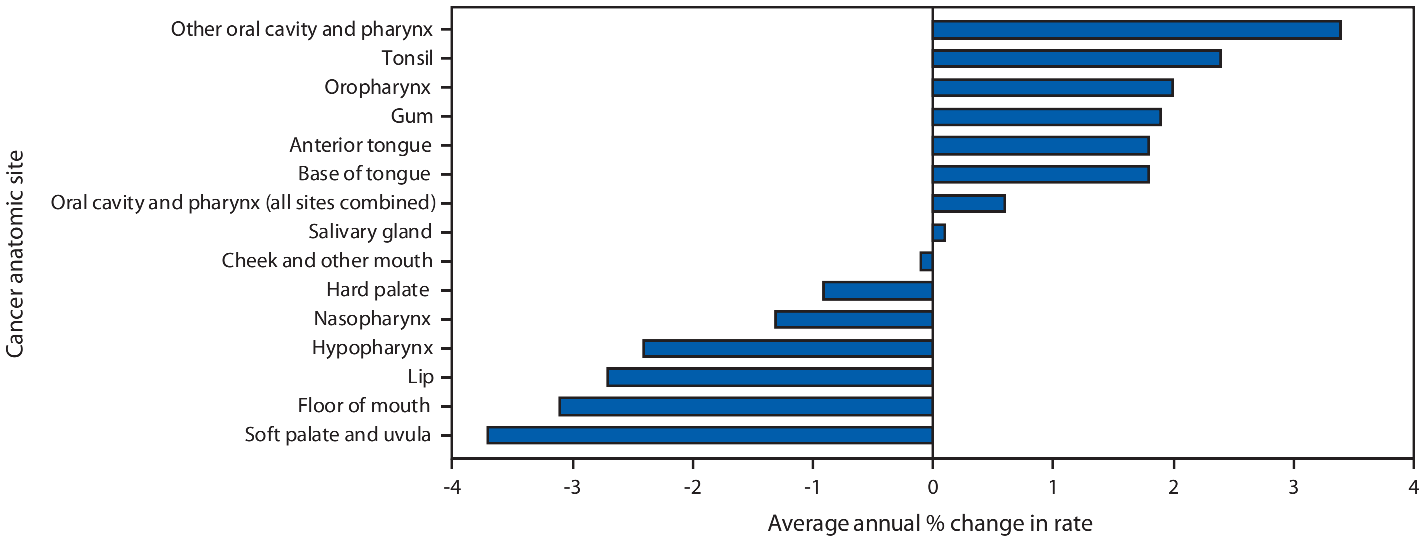
FIGURE. Trends in incidence of cancers of the oral cavity and pharynx,*,†,§ by cancer anatomic site, United States, 2007–2016



* Cancer incidence data were compiled from cancer registries that meet the data quality criteria for all invasive cancer sites combined, representing 100% of the U.S. population.

† Annual percentage changes were statistically significant (at $p<0.05$) for all sites except "Salivary gland" and "Cheek and other mouth," which had rates considered stable.

§ "Other oral cavity and pharynx" cancers included *International Classification of Diseases for Oncology, Third Edition* (ICD-O-3) codes C14.0 (Pharynx NOS), C14.2 (Waldeyers ring), and C14.8 (Overlapping lesion of lip, oral cavity, and pharynx).

TABLE 1. Cancers of oral cavity and pharynx with ICD-O-3 code by anatomic site and HPV association status,* — United States, 2007 and 2016

			No. of cases (%)	
Anatomic site	**ICD-O-3 code**	**HPV-associated**	**2007**	**2016**
Oral cavity and pharynx (all sites)	**C00-C14**	**No**	**35,076 (100)**	**44,419 (100)**
Lip	C00.0-C00.9	No	2,048 (6)	1,847 (4)
Base of tongue	C01.9, C02.4, C02.8	Yes	5,661 (16)	8,164 (18)
Anterior tongue	C02.0-C02.3, C02.9	No	4,422 (13)	6,155 (14)
Floor of mouth	C04.0-C04.9	No	2,073 (6)	1,978 (4)
Gum	C03.0, C03.1, C03.9	No	1,215 (3)	1,727 (4)
Soft palate and uvula	C05.1, C05.2	Yes	870 (2)	743 (2)
Hard palate	C05.0, C05.8, C05.9	No	767 (2)	859 (2)
Cheek and other mouth	C06.0-C06.9	No	2,057 (6)	2,463 (6)
Salivary gland	C07.9-C08.9	No	3,862 (11)	4,433 (10)
Tonsil	C09.0-C09.9	Yes	5,791 (17)	8,792 (20)
Oropharynx	C10.0-C10.9	Yes	1,507 (4)	2,165 (5)
Nasopharynx	C11.0-C11.9	No	1,779 (5)	1,788 (4)
Hypopharynx	C12.9-C13.9	No	2,307 (7)	2,211 (5)
Other oral cavity and pharynx	C14.0-C14.8	Yes	717 (2)	1,094 (2)

Abbreviations: HPV = human papilloma virus; ICD-O-3 = *International Classification of Diseases for Oncology, Third Edition*.

* HPV-associated cancers are defined as cancers at specific anatomic sites with specific cell types in which HPV DNA frequently is found. These include ICD-O-3 site codes C01.9, C02.4, C02.8, C05.1, C05.2, C09.0, C09.8, C09.9, C10.0, C10.1, C10.2, C10.3, C10.4, C10.8, C10.9, C14.0, C14.2, and C14.8, with squamous cell carcinomas (histology codes: 8050–8084 and 8120–8131).

of the base of the tongue, tonsil, and oropharynx decreased among blacks.

Rates for all cancers of the oral cavity and pharynx combined increased among males but were stable among females. Among females, rates increased for cancers of the anterior tongue, gum, and tonsil but decreased for cancers of the floor of mouth, soft palate and uvula, nasopharynx, and hypopharynx, and were stable for other sites. A similar pattern was observed among males except that rates also decreased for cancer of the lip, increased for cancers of the base of tongue, oropharynx, and other oral cavity and pharynx, and were stable only for hard palate, cheek and other mouth, and salivary gland.

By age group, rates for all cancers of the oral cavity and pharynx combined increased among persons aged 50–79 years, decreased among those aged 40–49 years, and were stable among those aged 20–39 and ≥80 years. Among sites with increasing rate trends, the increases were mainly driven by increases among persons aged 50–79 years; those rates were generally stable or decreased among persons aged 20–49 years and increased or were stable among those aged ≥80 years. All other rates were stable or could not be calculated because of small number of cases.

Discussion

During 2007–2016, the incidence of cancers of the oral cavity and pharynx combined increased, despite decreases in several anatomic sites, including the nasopharynx, hypopharynx, lip, and floor of mouth. The overall increase appears to be driven by increases in cancers of the tonsil, base of tongue, oropharynx, and other cancers of the oral cavity and pharynx, which are HPV-associated, as well as by those of gum and anterior tongue.

Declines in tobacco use might have contributed to the decreases observed in some sites (*7*). Population-based tobacco control measures (including high-impact antitobacco mass media campaigns, tobacco price increases, and comprehensive smoke-free laws) are proven to prevent tobacco use initiation and promote smoking cessation,** but they are not implemented equally in all U.S. states and communities.†† Similarly, state alcohol control policies and alcohol screening are effective in reducing excessive alcohol use but are underutilized (*8*). Tobacco and alcohol use are still common in the United States; in 2018, 14% of the adult population reported current cigarette smoking, and 27% reported binge drinking.§§ To reduce the risk for cancers of the oral cavity and pharynx, communities might benefit from broader application of evidence-based interventions and targeted efforts among groups with high prevalence of tobacco and alcohol use or high cancer rates.¶¶

The overall increasing trend in oral cancer rates was the result of a combination of increasing rates among whites and A/PI, stable rates in AI/AN, and decreasing rates among blacks and Hispanics. A previous study found rates of oropharyngeal squamous cell cancers increased the most among white men compared with other racial/ethnic groups (*4*). Differences in sexual behavior might account for the higher rate; compared with other racial/ethnic groups, white men report an earlier age at oral sex initiation and have a higher number of oral sex partners which have been shown to be risk factors for exposure to HPV infection (*9*).

** https://www.cdc.gov/tobacco/stateandcommunity/best_practices/index.htm?source = govdelivery.
†† https://www.cdc.gov/statesystem/.
§§ https://www.healthypeople.gov/2020/topics-objectives.
¶¶ https://www.thecommunityguide.org/topic/excessive-alcohol-consumption; https://www.thecommunityguide.org/topic/tobacco.

Summary

What is already known about this topic?

Oral cavity and pharynx cancers account for 3% of cancers diagnosed annually in the United States; risk factors include tobacco use, excessive alcohol consumption, and human papilloma virus (HPV) infection.

What is added by this report?

During 2007–2016, incidence of cancers of the oral cavity and pharynx combined increased, despite decreases in those at multiple anatomic sites. The overall increase was driven by increases in HPV-associated cancers of the tonsil, base of tongue, oropharynx, other oral cavity and pharynx, and the gum and anterior tongue.

What are the implications for public health practice?

Broader application of proven strategies to prevent tobacco use initiation, promote smoking cessation, reduce excessive alcohol consumption, and increase HPV vaccination rates can help reduce the incidence of these cancers.

Public health efforts that focus on increasing HPV vaccination*** are an essential component of cancer prevention. Routine HPV vaccination is recommended for all persons at age 11 or 12 years, with catch-up vaccination through age 26 years.††† CDC's National Comprehensive Cancer Control Program supports cancer prevention efforts in all 50 states, the District of Columbia, tribal organizations, and U.S. territories; and, in collaboration with CDC's National Center for Immunization and Respiratory Diseases (NCIRD), supports activities to promote and provide access to HPV vaccine. CDC's Division of Cancer Prevention and NCIRD currently fund the American Cancer Society to convene partners at the National HPV Vaccination Roundtable to support activities that increase HPV vaccination coverage.§§§ There are no data on efficacy of vaccination on oral cavity and pharyngeal cancers from clinical trials, but these cancers are caused by HPV types that are targeted by available vaccines (*10*).

The findings in this report are subject to at least three limitations. First, delays in cancer reporting might result in an underestimate of incidence. Second, cancer registries do not routinely collect or report information about risk factors such as HPV infection, tobacco use, or alcohol use, so it was not possible to determine whether cancers occurred in persons exposed to these risk factors. Finally, because of the complexity of this anatomic region and potential difficulty in determining precisely where cancer originated, the anatomic site for some cases might have been incorrectly classified.

*** https://www.cdc.gov/vaccines/vpd/hpv/hcp/recommendations.html.
††† https://www.cdc.gov/cancer/ncccp/index.htm; https://www.cdc.gov/hpv/partners/index.html; https://www.thecommunityguide.org/topic/vaccination.
§§§ https://hpvroundtable.org/

TABLE 2. Annual rate*,† and average annual percentage change (AAPC) in rates of cancers of the oral cavity and pharynx, by trends, anatomic site, sex, race/ethnicity, and age group at diagnosis — United States, 2007–2016

Cancer type	Total cases 2007–2016	Year	Rate/ AAPC	Sex		Race/ethnicity[§]					Age group (yrs)					
				Men	Women	NH White	NH Black	NH AI/AN	NH A/PI	Hispanic	20–39	40–49	50–59	60–69	70–79	≥80
Cancer types with increasing trends																
Oral cavity and	**400,291**	2007	10.89	16.5	6.06	11.6	9.93	8.7	7.16	7.07	1.67	9.35	24.16	35.89	39.85	37.89
pharynx		2016	11.7	17.3	6.2	12.7	8.61	9.94	7.82	6.56	1.69	8.65	25.32	39.6	43.28	38.49
(all sites)		(AAPC)	0.6[¶]	0.7[¶]	0.3	1.1[¶]	−1.5[¶]	1.7	0.9[¶]	−0.9[¶]	−0.5	−1.0[¶]	0.7[¶]	1.3[¶]	1.1[¶]	0.4
Base of tongue	**69,460**	2007	1.72	2.94	0.65	1.93	1.42	1.61	0.47	0.86	0.16	1.45	4.7	6.66	5.57	3.58
		2016	2.03	3.58	0.65	2.42	1.24	2.13	0.48	0.87	0.11	1.29	4.89	8.7	8.08	4.34
		(AAPC)	1.8[¶]	2.3[¶]	−0.5	2.5[¶]	−1.8[¶]	3.7	−0.3	−0.5	−4.4[¶]	−1.3[¶]	0.6	2.9[¶]	3.7[¶]	2.3[¶]
Anterior tongue	**52,839**	2007	1.39	1.76	1.05	1.55	0.66	—**	1.14	1.01	0.36	1.22	2.72	4.4	5.02	5.29
		2016	1.62	1.96	1.31	1.87	0.64	0.81	1.51	0.98	0.42	1.37	3.22	4.99	6.29	5.7
		(AAPC)	1.8[¶]	1.5[¶]	2.2[¶]	2.1[¶]	−0.4	—	2.9[¶]	0.3	0.8	0.8	2.1[¶]	1.9[¶]	2.8[¶]	0.9
Gum	**14,583**	2007	0.39	0.44	0.34	0.41	0.25	—	0.29	0.3	0.03	0.13	0.44	0.98	2.23	3.27
		2016	0.45	0.51	0.39	0.48	0.26	—	0.52	0.25	0.04	0.17	0.5	1.36	2.25	3.68
		(AAPC)	1.9[¶]	2.0[¶]	1.6[¶]	2.1[¶]	1.4	—	6.2[¶]	0.3	—	2.6	3.1[¶]	2.3[¶]	1.3	1.8[¶]
Tonsil	**74,239**	2007	1.76	2.98	0.64	1.96	1.6	1.15	0.43	0.98	0.17	2.31	5.92	5.55	3.88	1.79
		2016	2.22	3.88	0.7	2.62	1.53	1.88	0.58	1.23	0.14	2.26	7.12	8.33	5.83	2.62
		(AAPC)	2.4[¶]	2.7[¶]	1.4[¶]	3.4[¶]	−0.7[¶]	5.1[¶]	3.7	1.8	−3.4[¶]	−0.4	1.8[¶]	4.4[¶]	4.8[¶]	3.7[¶]
Oropharynx	**18,010**	2007	0.46	0.73	0.23	0.46	0.7	—	0.15	0.31	—	0.82	1.1	1.98	1.84	0.91
		2016	0.54	0.92	0.2	0.59	0.59	—	0.17	0.35	—	0.36	1.4	2.22	2.07	1.03
		(AAPC)	1.9[¶]	2.4[¶]	0.3	3.0[¶]	−2.3[¶]	—	−1.7	2.2	—	0.8	2.2[¶]	2.3[¶]	1.8[¶]	1.3
Other oral cavity	**8,928**	2007	0.22	0.36	0.1	0.22	0.3	—	—	0.23	—	0.14	0.47	0.83	0.93	0.85
and pharynx[††]		2016	0.28	0.46	0.11	0.3	0.27	—	—	0.19	—	0.15	0.58	1.07	1.18	1.08
		(AAPC)	3.4[¶]	3.8[¶]	2.0	4.6[¶]	−0.3	—	—	−1.6	—	1.9	4.0[¶]	3.5[¶]	3.3[¶]	3.4[¶]
Cancers with decreasing or stable trends																
Lip	**20,180**	2007	0.65	1.12	0.29	0.77	0.09	—	—	0.3	0.07	0.43	0.8	1.78	3.22	4.74
		2016	0.48	0.78	0.25	0.58	0.07	—	0.1	0.2	0.04	0.23	0.73	1.32	2.41	3.51
		(AAPC)	−2.7[¶]	−3.3[¶]	−1.4	−2.9[¶]	−3.2	—	—	−3.8[¶]	−4.3[¶]	−5.9[¶]	−0.4	−3.2	−2.7[¶]	−3.5
Floor of mouth	**20,348**	2007	0.64	0.98	0.34	0.68	0.63	0.98	0.27	0.4	0.03	0.55	1.47	2.49	2.46	1.7
		2016	0.5	0.7	0.31	0.56	0.39	0.61	0.18	0.23	0.03	0.24	1.19	1.88	2.12	1.66
		(AAPC)	−3.1[¶]	−3.5[¶]	−2.0[¶]	−2.3[¶]	−5.8[¶]	—	−2.3	−5.4[¶]	—	−7.9[¶]	−2.0[¶]	−3.0[¶]	−2.6[¶]	−2.0[¶]
Soft palate and	**8,158**	2007	0.27	0.39	0.16	0.26	0.49	—	—	0.18	0.02	0.18	0.63	0.99	1.13	0.66
uvula		2016	0.19	0.26	0.12	0.19	0.25	—	0.1	0.12	0.02	0.09	0.45	0.75	0.67	0.56
		(AAPC)	−3.7[¶]	−4.0[¶]	−3.2[¶]	−3.0[¶]	−6.0[¶]	—	—	−4.5[¶]	—	−6.7[¶]	−3.4[¶]	−3.4[¶]	−4.7[¶]	−1.8[¶]
Hard palate	**8,308**	2007	0.24	0.26	0.23	0.23	0.35	—	0.19	0.22	0.09	0.2	0.4	0.58	0.89	1.3
		2016	0.23	0.24	0.22	0.22	0.28	—	0.25	0.19	0.08	0.16	0.32	0.61	0.91	1.31
		(AAPC)	−0.9[¶]	−1.2	−0.4	−0.7	−1.9	—	−3.0[¶]	−4.0[¶]	−2.5[¶]	−3.2[¶]	−1.8	0.4	−1.0	0.3
Cheek and other	**22,559**	2007	0.65	0.83	0.5	0.67	0.56	—	0.55	0.42	0.09	0.43	0.96	2.07	2.96	3.66
mouth		2016	0.65	0.82	0.49	0.69	0.46	—	0.7	0.4	0.08	0.41	1.08	1.82	3.05	3.74
		(AAPC)	−0.1	0.1	−0.3	0.1	−2.4[¶]	—	2.8	−1.0	0.1	−1.7	1.2[¶]	−1.1[¶]	0.2	0.6
Salivary gland	**42,238**	2007	1.23	1.66	0.94	1.29	0.92	—	0.82	0.91	0.38	0.92	1.7	3.21	5.08	7.14
		2016	1.21	1.55	0.96	1.26	1.16	0.8	0.89	0.84	0.46	1.02	1.47	2.94	4.77	6.86
		(AAPC)	0.1	−0.4	0.6	0.1	2.3[¶]	—	1.4	−0.8	1.7[¶]	0.9	−0.5	−0.8[¶]	0.2	0.0
Nasopharynx	**17,613**	2007	0.56	0.82	0.32	0.44	0.69	—	2.3	0.45	0.24	0.69	1.28	1.42	1.43	1.05
		2016	0.49	0.73	0.26	0.34	0.71	0.62	1.91	0.34	0.2	0.65	1.1	1.4	1.17	0.69
		(AAPC)	−1.3[¶]	−1.3[¶]	−1.4[¶]	−2.4[¶]	0.2	—	−1.7	−3.1[¶]	−1.7[¶]	−1.5	−1.3[¶]	−0.2	−2.4[¶]	−4.0
Hypopharynx	**22,828**	2007	0.71	1.24	0.27	0.68	1.27	0.89	0.3	0.5	—	0.38	1.56	2.95	3.22	2.06
		2016	0.55	0.94	0.21	0.55	0.76	0.6	0.38	0.37	0.03	0.22	1.27	2.21	2.47	1.72
		(AAPC)	−2.4[¶]	−3.2[¶]	−3.5[¶]	−1.9[¶]	−4.2[¶]	—	−1.5[¶]	−4.3[¶]	—	−5.6[¶]	−1.9[¶]	−2.4[¶]	−2.7[¶]	−0.9[¶]

Abbreviations: AI/AN = American Indian/Alaska Native; A/PI = Asian/Pacific Islander; NH = non-Hispanic.
* Per 100,000 standard population; overall rates were age-adjusted to the 2000 U.S. standard population.
† Cancer incidence data were compiled from cancer registries that meet the data quality criteria for all invasive cancer sites combined, representing 100% of the U.S. population.
§ Racial and ethnic identifications are mutually exclusive. Hispanic persons can be any race. Rates are not presented for those with unknown or other race or unknown ethnicity.
¶ Significant at p = 0.05. Trends were measured with AAPC in rates and were considered to increase or decrease if p<0.05; otherwise rates were considered stable.
** Data suppressed for rates when the number of cases was <16 in a year.
†† "Other oral cavity and pharynx" cancers include *International Classification of Diseases for Oncology, Third Edition* (ICD-O-3) codes C14.0 (Pharynx NOS), C14.2 (Waldeyers ring), C14.8 (Overlapping lesion of lip, oral cavity and pharynx).

Cancers of the oral cavity and pharynx can be caused by exposure to risk factors that are common in the United States, including tobacco use, alcohol use, and HPV infection. Cancer control initiatives that use proven population-based strategies to prevent tobacco use initiation, promote smoking cessation, reduce alcohol use, and increase HPV vaccination rates could help reduce cancer risk.

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State and regional cancer registry staff members.

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Progress Toward Measles Elimination — Eastern Mediterranean Region, 2013–2019

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In 1997, during the 41st session of the Regional Committee for the Eastern Mediterranean, the 21 countries in the World Health Organization (WHO) Eastern Mediterranean Region* (EMR) passed a resolution to eliminate† measles (*1*). In 2015, this goal was included as a priority in the Eastern Mediterranean Vaccine Action Plan 2016–2020 (EMVAP) (*2*), endorsed at the 62nd session of the Regional Committee (*3*). To achieve this goal, the WHO Regional Office for the Eastern Mediterranean developed a four-pronged strategy: 1) achieve ≥95% vaccination coverage with the first dose of measles-containing vaccine (MCV1) among children in every district of each country through routine immunization services; 2) achieve ≥95% vaccination coverage with a second MCV dose (MCV2) in every district of each country either through implementation of a routine 2-dose vaccination schedule or through supplementary immunization activities§ (SIAs); 3) conduct high-quality, case-based surveillance in all countries; and 4) provide optimal measles clinical case management, including dietary supplementation with vitamin A (*4*). This report describes progress toward measles elimination in EMR during 2013–2019 and updates a previous report (*5*). Estimated MCV1 coverage increased from 79% in 2013 to 82% in 2018. MCV2 coverage increased from 59% in 2013 to 74% in 2018. In addition, during 2013–2019, approximately 326.4 million children received MCV during SIAs. Reported confirmed measles incidence increased from 33.5 per 1 million persons in 2013 to 91.2 in 2018, with large outbreaks occurring in Pakistan, Somalia, and Yemen; incidence decreased to 23.3 in 2019. In 2019, the rate of discarded nonmeasles cases¶ was 5.4 per 100,000 population. To achieve measles elimination in the EMR, increased visibility of efforts to achieve the measles elimination goal is critically needed, as are sustained and predictable investments to increase MCV1 and MCV2 coverage, conduct high-quality SIAs, and reach populations at risk for not accessing immunization services or living in areas with civil strife.

Immunization Activities

MCV1 and MCV2 administrative coverage** data are reported each year from all EMR countries and areas to WHO and the United Nations Children's Fund (UNICEF) through the Joint Reporting Form. WHO and UNICEF use reported administrative coverage and available survey results to generate annual estimates of vaccination coverage through routine immunization services (*6*). During 2013–2018, estimated regional MCV1 coverage increased from 79% to 82%, and estimated MCV2 coverage increased from 59% to 74% (Table 1). In 2018, 11 (52%) of 21 countries and areas achieved ≥95% coverage with both MCV1 and MCV2. As of 2018, only one (5%) EMR country (Somalia) had not yet introduced MCV2. During 2013–2019, 326.4 million persons were vaccinated during 89 SIAs, with weighted regional SIA coverage of 98% (Table 2). Reported vaccination coverage was ≥90% in 25 (68%) of 37 nationwide SIAs, including ≥95% in 11 (30%).

Surveillance Activities

Case-based measles surveillance†† data are reported monthly to WHO from all EMR countries except Somalia. In Somalia,

* The Eastern Mediterranean Region, one of six regions of the World Health Organization, consists of 21 Member States and Palestine (West Bank and Gaza Strip), with a population of nearly 583 million persons. The member states include Afghanistan, Bahrain, Djibouti, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Pakistan, Qatar, Saudi Arabia, Somalia, Sudan, Syria, Tunisia, United Arab Emirates, and Yemen.

† Measles elimination is defined as the absence of endemic measles cases for a period of ≥12 months, in the presence of adequate surveillance.

§ SIAs are immunization campaigns, typically carried out using two targeted age ranges. An initial, nationwide catch-up SIA targets all children aged 9 months–14 years, with the goal of eliminating measles susceptibility in the population. Periodic follow-up SIAs then target all children born since the last SIA. Follow-up SIAs generally are conducted every 2 to 4 years and target children aged 9–59 months; the goal of a follow-up SIA is to vaccinate children who have not received a first dose and to protect children who did not respond to the first dose of measles vaccine.

¶ Suspected cases that have been investigated and determined not to be measles using laboratory testing in a proficient laboratory or epidemiologic linkage to a laboratory-confirmed outbreak of another communicable disease that is not measles are discarded as nonmeasles cases. A proficient laboratory is one that is WHO accredited or has an established quality assurance program with oversight by a WHO accredited laboratory.

** Administrative vaccination coverage is the number of vaccine doses administered divided by the estimated target population.

†† Case-based measles surveillance includes individual case investigation and blood specimen collection for laboratory testing.

TABLE 1. Measles-containing vaccine (MCV) schedule, estimated coverage with the first and second doses of MCV,[*] number of confirmed measles cases,[†] and confirmed measles incidence, by country/area — World Health Organization (WHO) Eastern Mediterranean Region, 2013, 2018, and 2019

Country/Area	MCV schedule[§]		2013				2018				2019	
			Coverage (%)				Coverage (%)					
	Age–1st dose (mos)	Age–2nd dose (mos)	MCV1	MCV2	No. of measles cases	Incidence[**]	MCV1	MCV2	No. of measles cases	Incidence[**]	No. of measles cases	Incidence[**]
Afghanistan	9	18	57	35	430	13.3	64	39	2,012	54.1	183	4.8
Bahrain	12	18	99	99	0	0.0	99	99	0	0.0	0	0.0
Djibouti	9	15	80	82	28	31.7	86	81	28	29.2	NR	NR
Egypt	12	18	96	96	405	4.6	94	94	23	0.2	0	0.0
Iran	12	18	98	97	189	2.5	99	98	203	2.5	0	0.0
Iraq	9	15	72	57	669	20.2	83	81	489	12.7	721	18.3
Jordan[††]	12	18	97	98	120	14.1	92	96	0	0.0	45	4.5
Kuwait[§§]	12	24	99	99	62	17.6	99	99	34	8.2	12	2.9
Lebanon[††]	12	18	82	65	1,761	297.8	82	63	943	137.5	1,069	155.9
Libya	12	18	96	95	164	25.9	97	96	1,059	158.6	188	27.7
Morocco	9	18	99	NA[§§]	92	2.7	99	99	8	0.2	12	0.3
Oman	12	18	99	99	0	0.0	99	99	0	0.0	0	0.0
Pakistan	9	15	68	43	8,749	45.7	76	67	33,007	155.5	2,066	9.5
Palestine	12	18	99	98	0	0.0	99	99	0	0.0	163	32.7
Qatar	12	18	97	99	73	31.2	99	95	2	0.7	5	1.8
Saudi Arabia[††,§§]	12	18	98	99	1,164	38.7	98	97	1,161	34.4	956	27.9
Somalia	9	NA[¶¶]	46	NA[¶¶]	3,173	242.9	46	NA[¶¶]	9,124	607.9	4,482	290.2
Sudan	9	18	86	57	2,813	75.9	88	72	4,980	119.1	3,555	83.0
Syria	12	18	58	51	740	37.8	63	54	329	19.4	27	1.6
Tunisia	12	18	94	98	16	1.5	96	99	12	1.0	1,870	159.9
United Arab Emirates[§§]	12	18	98	98	309	33.6	99	99	172	17.9	186	19.0
Yemen	9	18	70	47	400	15.9	64	46	10,640	373.4	1,163	39.9
EMR	**—**	**—**	**79**	**59**	**21,357**	**33.5**	**82**	**74**	**64,226**	**91.2**	**16,703**	**23.3**

Abbreviations: EMR = Eastern Mediterranean Region; MCV = measles-containing vaccine; MCV1 = first MCV dose; MCV2 = second MCV dose; NA = not applicable; NR = not reported.

* WHO and United Nations Children's Fund Estimates of National Immunization Coverage (WUENIC). For MCV1, among children aged 1 year or, if MCV1 is given at age ≥1 year, among children aged 24 months. For MCV2, among children at the recommended age for administration of MCV2, per the national immunization schedule. The WUENIC were last revised on July 15, 2019, and are available at https://www.who.int/immunization/monitoring_surveillance/data/en.

† Includes cases confirmed by laboratory or epidemiologic linkage and clinically compatible cases. Clinically compatible cases met the WHO measles clinical case definition, had no adequate specimen collected, and could not be epidemiologically linked to a laboratory-confirmed case of measles.

§ MCV schedule is the 2019 schedule.

¶ 2019 MCV1 and MCV2 coverage estimates not available at time of publication.

** Cases per million population.

†† Additional 9-month dose provided nationally.

§§ Additional dose provided nationally at age 5–6 years (United Arab Emirates), 6 years (Saudi Arabia), or 12 years (Kuwait).

¶¶ Dose was not included in the vaccination schedule for that year.

measles surveillance changed in 2014 from case-based surveillance with laboratory testing of a limited number of cases at hospitals in two regions to aggregate reporting[§§] of clinically compatible cases, without complete case investigations of each case, in all regions. The WHO Global Measles and Rubella Laboratory Network supports surveillance by providing laboratory confirmation and genotyping of reported cases (*7*). Measles virus genotypes are reported to the WHO global measles nucleotide surveillance database (*8*). Suspected measles cases are confirmed based on laboratory findings, an epidemiologic link, or clinical criteria. Case-based measles surveillance in EMR countries and areas is monitored using important surveillance performance indicators[¶¶] including 1) the number of suspected measles cases ultimately discarded as nonmeasles (target = two or more per 100,000 population); 2) the proportion of second-level units (e.g., districts) with two or more discarded cases per 100,000 (target = 80%); 3) suspected cases

§§ Aggregate measles surveillance involves a report of a summary of suspected measles cases, by age group and location (district), but does not include a line-listing of individual cases.

¶¶ Important surveillance performance indicators include 1) two or more discarded nonmeasles cases per 100,000 population at the national level per year; 2) two or more discarded nonmeasles cases per 100,000 per year in ≥80% of subnational administrative units; 3) adequate investigation of ≥80% of suspected measles cases conducted within 48 hours of notification; 4) adequate collection and testing in a proficient laboratory of specimens from ≥80% of suspected cases for detecting acute measles and rubella infection; 5) receipt of ≥80% of specimens at the laboratory within 5 days of collection; 6) report of ≥80% of serology results by the laboratory within 4 days of specimen receipt; and 7) on-time reporting of measles and rubella data to the national level by ≥80% of surveillance units.

TABLE 2. Characteristics of measles supplementary immunization activities (SIAs),* by year and country/area — World Health Organization Eastern Mediterranean Region, 2013–2019

Year	Country/Area	Age group targeted†	Measles-containing vaccine used	Extent of SIA	Population reached in targeted age group, no. (%)
2013	Afghanistan	9m–59m	M	Subnational	875,874 (85)
	Iran	9m–12y	MMR	Subnational	157,000 (97)
	Iraq	6y–12y	M	National	5,563,532 (96)
	Jordan	9m–14y	M	Subnational	639,420 (>100)
	Jordan	9m–14y	MR	National	3,361,516 (>100)
	Lebanon	9m–18y	M	Subnational	294,079 (85)
	Lebanon	9m–18y	M	Subnational	308,438 (76)
	Morocco	9m–19y	MR	National	10,191,571 (91)
	Pakistan	9m–9y	M	Subnational	4,002,154 (>100)
	Pakistan	6m–9y	M	Subnational	26,986,015 (96)
	Somalia	9m–59m	M	Subnational	923,580 (90)
	Sudan	9m–15y	M	National	14,976,050 (98)
	Syria	6y–10y	MMR	National	789,678 (72)
	Syria	12y–15y	MMR	National	759,427 (92)
	Yemen	6m–10y	M	Subnational	283,687 (93)
2014	Afghanistan	6m–10y	M	Subnational	321,750 (92)
	Afghanistan	9m–59m	M	Subnational	520,384 (95)
	Iraq	9m–59m	M	National	3,295,122 (96)
	Lebanon	9m–18y	MR	National	1,056,830 (72)
	Pakistan	6m–9y	M	Subnational	9,432,492 (>100)
	Pakistan	6m–9 y	M	Subnational	14,026,013 (>100)
	Pakistan	6m–9y	M	Subnational	1,439,892 (100)
	Somalia	9m–59m	M	Subnational	1,306,426 (88)
	Syria	7m–5y	MMR	National	766,305 (74)
	Yemen	9m–15y	MR	National	11,368,968 (93)
2015	Afghanistan	9–59m	M	National	6,191,955 (>100)
	Djibouti	9m–15y	M	National	277,119 (91)
	Djibouti	15y–25y	M	National	169,493 (76)
	Egypt	9m–10y	MR	National	23,356,156 (>100)
	Iran	9m–15y	MR	Subnational	1,804,000 (99)
	Iraq	9m–5y	MR	National	4,499,656 (94)
	Pakistan	6m–10y	M	Subnational	30,633,406 (>100)
	Pakistan	6m–10y	M	Subnational	227,762 (95)
	Pakistan	6m–10y	M	Subnational	204,308 (>100)
	Pakistan	6m–10y	M	Subnational	3,512,771 (>100)
	Pakistan	6m–10y	M	Subnational	413,695 (100)
	Pakistan	6m–10y	M	Subnational	1,519,242 (95)
	Somalia	9m–9y	M	Subnational	3,518,358 (91)
	Sudan	6m–15y	M	Subnational	1,026,990 (96)
	Sudan	6m–15y	M	Subnational	1,716,997 (>100)
	Sudan	6m–15y	M	Subnational	3,541,601 (100)
	Sudan	6m–15y	M	Subnational	3,078,800 (>100)
	Syria	6m–59m	MMR	National	1,619,630 (61)
	United Arab Emirates	1y–18y	MMR	National	915,480 (69)
	Yemen	6m–15y	MR	Subnational	1,590,462 (85)
2016	Afghanistan	9m–10y	M	Subnational	2,450,393 (>100)
	Egypt	11y–20y	MR	Subnational	642,178 (94)
	Egypt	6y	MR	Subnational	258,464 (>100)
	Iraq	6y	MMR	Subnational	722,680 (>100)
	Qatar	1y–13y	MMR	National	166,145 (87)
	Somalia	9m–59m	M	National	602,136 (89)
	Somalia	9m–59m	M	Subnational	140,533 (74)
	Sudan	6m–15y	M	Subnational	4,383,506 (>100)
	Syria	9m–59m	MR	Subnational	927,820 (91)
	United Arab Emirates	19y–34y	MMR	National	581,519 (46)
	Yemen	6m–15y	MR	Subnational	2,421,243 (92)

See table footnotes on the next page.

TABLE 2. (*Continued*) Characteristics of measles supplementary immunization activities (SIAs),* by year and country/area — World Health Organization Eastern Mediterranean Region, 2013–2019

Year	Country/Area	Age group targeted†	Measles-containing vaccine used	Extent of SIA	Population reached in targeted age group, no. (%)
2017	Afghanistan	9–59m	M	Subnational	1,053,452 (97)
	Djibouti	4y–8y	M	National	11,628 (92)
	Iraq	6y–13y	MMR	Subnational	319,314 (82)
	Kuwait	1y–19y	MMR	National	165,296 (16)
	Libya	3y–6y	MMR	National	721,488 (>100)
	Oman	20y–35y	MMR	National	1,658,642 (92)
	Pakistan	9m–59m	M	Subnational	1,279,819 (94)
	Somalia	6m–59m	M	National	4,400,000 (94)
	Somalia	6m–59m	M	Subnational	472,033 (94)
	Sudan	9m–15y	M	Subnational	2,066,281 (>100)
	Sudan	6m–>15y§	M	Subnational	73,680 (98)
	Syria	7m–59m	M	National	1,779,459 (72)
	Syria	5y–12y	MMR	National	2,978,998 (82)
	Yemen	6m–15y	MR	Subnational	205,731 (41)
	Yemen	6m–15y	MR	Subnational	166,654 (100)
2018	Afghanistan	9m–10y	M	National	12,590,923 (91)
	Djibouti	6m–59m	M	National	113,780 (>100)
	Iraq	9m–5y	MMR	National	2,095,740 (93)
	Libya	9m–14y	MR	National	2,654,466 (96)
	Pakistan	9m–10y	M	Subnational	91,111 (99)
	Pakistan	6m–59m	M	Subnational	914,058 (87)
	Pakistan	9m–59m	M	National	37,131,234 (>100)
	Somalia	6m–10y	M	National	4,496,540 (93)
	Syria	6y–12y	M	Subnational	1,439,848 (99)
	Syria	6y–12y	M	Subnational	1,142,817 (86)
	Yemen	6m–10y	MR	Subnational	572,961 (85)
	Yemen	6m–15y	MR	Subnational	294,452 (74)
2019	Iraq	9m–59m	MMR	National	2,421,421 (90)
	Jordan	6m–6y	M	Subnational	81,576 (90)
	Lebanon	6m–10y	M and MMR	National	253,204 (82)
	Somalia	6m–59m	M	Subnational	1,051,504 (91)
	Sudan	9m–15y	M	National	13,027,696 (98)
	Yemen	6m–14y	MR	National	11,959,569 (93)
2013–2019	**EMR**	—	—	—	**326,446,076 (98)¶**

Abbreviations: EMR = Eastern Mediterranean Region; M = measles vaccine; MMR = measles, mumps, and rubella vaccine; MR = measles and rubella vaccine.

* SIAs generally are carried out using two approaches. An initial, nationwide catch-up SIA targets all children aged 9 months–14 years; it has the goal of eliminating susceptibility to measles in the general population. Periodic follow-up SIAs then target all children born since the last SIA. Follow-up SIAs generally are conducted nationwide every 2–4 years and generally target children aged 9–59 months; their goal is to eliminate any measles susceptibility that has developed in recent birth cohorts and to protect children who did not respond to the first measles vaccination. The exact age range for follow-up SIAs depends on the age-specific incidence of measles, coverage with measles-containing vaccine through routine services, and the time since the last SIA.

† Targeted age groups varied by province.

§ Outbreak response immunization campaign that targeted children aged 6 months through 15 years and also young miners aged ≥15 years.

¶ Average SIA coverage, weighted by size of target population.

with adequate investigation*** (target = 80%); 4) suspected cases with adequate blood specimens††† (target = 80%); and 5) laboratory results available <5 days after specimen receipt (target = 80%).

During 2013–2019, the number of EMR countries and areas that met the target for suspected cases discarded as nonmeasles per 100,000 population at the national level increased from 14 (67%) to 18 (86%), and from seven (33%) to 11 (52%) at the subnational level. From 2013 to 2019, the rate of discarded nonmeasles cases decreased from 6.4 per 100,000 population to 5.4; the percentage of suspected cases with adequate investigations increased from 76% to 86%; the percentage of suspected cases with adequate specimens collected for laboratory testing decreased from 85% to 70%, and the proportion of blood specimens received by the laboratory with results available in <5 days decreased from 86% to 66% (Supplementary Table, https://stacks.cdc.gov/view/cdc/86628). The declines in the

*** Adequate investigation is a case investigated within 48 hours of notification that includes all 10 core variables: 1) case identification; 2) date of birth/age; 3) sex; 4) place of residence; 5) vaccination status or date of last vaccination; 6) date of rash onset; 7) date of notification; 8) date of investigation; 9) date of blood sample collection; and 10) place of infection or travel history.

††† An adequate blood specimen is a sample by venipuncture in a sterile tube with a volume of 5 ml for older children and adults and 1 ml for infants and younger children. Adequate samples for antibody detection are those collected within 28 days after onset of rash.

Summary

What is already known about this topic?

During 2008–2012, estimated first-dose coverage with measles-containing vaccine (MCV1) in the Eastern Mediterranean Region was 83%; reported measles cases approximately tripled, from 12,196 to 36,456, with large outbreaks in high-incidence countries.

What is added by this report?

Annual regional measles incidence increased from 33.5 per million population in 2013 to 91.2 in 2018, primarily because of large outbreaks in Pakistan, Somalia, and Yemen; then decreased to 23.3 in 2019.

What are the implications for public health practice?

To achieve measles elimination, efforts are needed to increase MCV1 and MCV2 coverage, conduct high-quality supplementary immunization activities, and reach populations at high risk for not accessing immunization services or living in areas with civil strife.

latter two performance indicators were largely because of the changes in Somalia's surveillance and a large-scale outbreak in Yemen during 2018–2019.

Measles Incidence and Genotypes

In EMR, reported measles cases decreased 74% from 2013 to 2014, from 16,531 to a record low of 9,499; however, in 2015, 2017, and 2018, reported measles cases increased to 21,734, 34,286 and 64,198, respectively, and then decreased to 16,703 in 2019 (Figure). Annual regional measles incidence per million population approximately tripled from 33.5 in 2013 to 91.2 in 2018, then decreased to 23.3 in 2019 (Table 1). The increase in measles cases during 2015–2018 occurred primarily because of large outbreaks in Somalia during 2015–2017, Pakistan during 2017–2018, and Yemen in 2018. The number of detected circulating measles virus genotypes in EMR decreased from four in 2013 (B3 in 13 countries, D4 in three countries, D8 in three countries, and H1 in one country) to two in 2019 (B3 in 15 countries and D8 in five countries).

Regional Verification of Measles Elimination

The EMR Verification Commission for Measles Elimination was established in February 2018 to evaluate the status of measles elimination in EMR countries based on documentation submitted annually by national verification committees. By the end of 2019, three (14%) EMR countries (Bahrain, Iran, and Oman) were verified as having achieved measles elimination (*9*).

Discussion

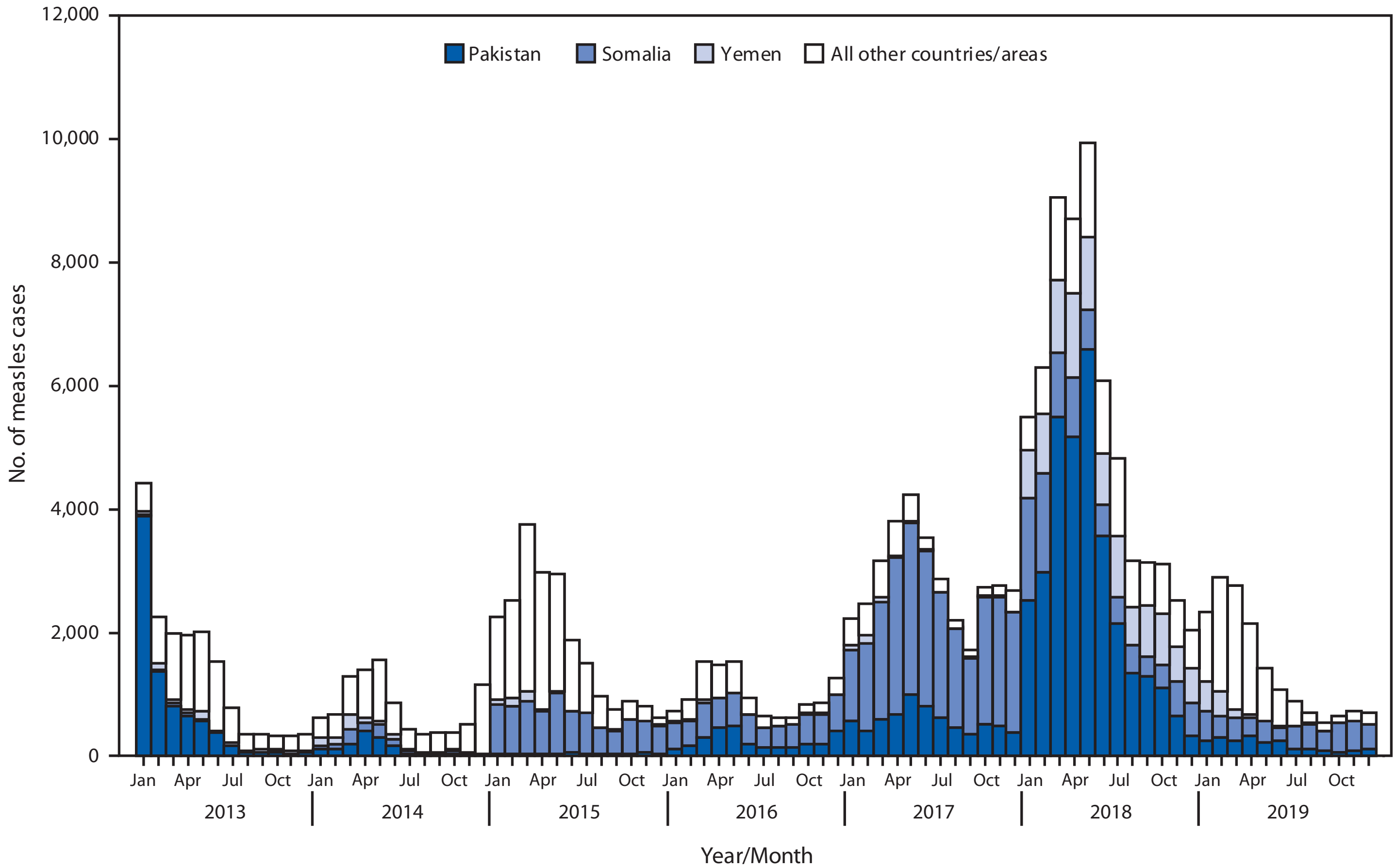
During 2013–2018, both MCV1 and MCV2 coverage in EMR increased but remained 14 percentage points and 22 percentage points below the WHO-recommended level of ≥95%. Although a few EMR countries have achieved and maintained measles elimination, large-scale measles outbreaks in others have revealed persistent suboptimal coverage with 2 doses of MCV through routine immunization services. In several EMR countries, major challenges to implementing measles elimination activities include civil unrest, armed conflict, and unpredictable mass population displacements and resettlements that can disrupt all aspects of planning and implementation of immunization services delivery, including SIAs. Conducting SIAs in areas with no local government requires building strong partnerships and close links with local communities. Implementing periodic SIAs according to WHO SIA guidelines (https://www.who.int/immunization/diseases/measles/SIA-Field-Guide.pdf) and using the WHO SIA readiness assessment tool (http://www9.who.int/immunization/diseases/measles/en/) to ensure a high-quality activity that achieves ≥95% coverage, particularly in areas with complex humanitarian emergencies, requires the availability of adequate funds for vaccines and supplies, operational costs, and experienced personnel who can implement a complex activity in a culturally appropriate manner under challenging circumstances.

Measles elimination efforts can leverage assets, experience, and capacity from the Global Polio Eradication Initiative (GPEI). The Eastern Mediterranean Regional Technical Advisory Group on Immunization recommended forming a multipartner taskforce to apply lessons learned from the GPEI and address gaps in measles vaccination coverage. These include mapping areas where children who are missed by routine immunization services live, identifying reasons for being missed, and developing a strategic plan that includes allocation of necessary resources for implementation (*10*).

The findings in this report are subject to at least two limitations. First, administrative coverage might overestimate vaccination coverage through erroneous inclusion of SIA doses or doses administered to children outside target age groups, inaccurate estimates of the target population size, and inaccurate reports of the number of doses delivered. Second, surveillance data likely underestimate measles incidence because not all patients seek care, and not all measles cases in patients who seek care are reported.

To accelerate progress toward measles elimination in EMR, the visibility of efforts to achieve the measles elimination goal must be raised, including the benefits of achieving measles elimination. The new global guidance document to

FIGURE. Confirmed measles cases,* by month of rash onset — World Health Organization (WHO) Eastern Mediterranean Region, 2013–2019



* Confirmed and clinically compatible measles cases reported by countries and areas to WHO. A case of measles was laboratory-confirmed when measles-specific immunoglobulin M antibody was detected in serum or measles-specific RNA was detected by polymerase chain reaction in a person who was not vaccinated during the 30 days before rash onset. A case of measles was confirmed by epidemiologic linkage when linked in time and place to a laboratory-confirmed measles case but lacked serologic confirmation. During 2013–2019, a case of measles meeting the WHO case definition but without a specimen collected could be reported as clinically compatible.

be submitted for approval by the World Health Assembly in 2020 (the Immunization Agenda 2030: A Global Strategy to Leave No One Behind [IA2030]),§§§ builds on lessons learned and progress made toward the Global Vaccine Action Plan goals and, importantly, identifies measles incidence as a signal for improving immunization services and strengthening primary health care systems. To achieve vaccination coverage and equity targets that leave no one behind and accelerate progress toward measles elimination and broader EMVAP and IA2030 goals, sustained and predictable investments and careful management of the leveraging of the substantial polio eradication infrastructure and resources are critically needed.

§§§ https://www.who.int/immunization/immunization_agenda_2030/en/.

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Community Transmission of SARS-CoV-2 at Two Family Gatherings — Chicago, Illinois, February–March 2020

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SARS-CoV-2, the virus that causes coronavirus disease 2019 (COVID-19), has spread rapidly around the world since it was first recognized in late 2019. Most early reports of person-to-person SARS-CoV-2 transmission have been among household contacts, where the secondary attack rate has been estimated to exceed 10% (*1*), in health care facilities (*2*), and in congregate settings (*3*). However, widespread community transmission, as is currently being observed in the United States, requires more expansive transmission events between nonhousehold contacts. In February and March 2020, the Chicago Department of Public Health (CDPH) investigated a large, multifamily cluster of COVID-19. Patients with confirmed COVID-19 and their close contacts were interviewed to better understand nonhousehold, community transmission of SARS-CoV-2. This report describes the cluster of 16 cases of confirmed or probable COVID-19, including three deaths, likely resulting from transmission of SARS-CoV-2 at two family gatherings (a funeral and a birthday party). These data support current CDC social distancing recommendations intended to reduce SARS-CoV-2 transmission. U.S residents should follow stay-at-home orders when required by state or local authorities.

During January 1–March 20, 2020, specimens that tested positive for SARS-CoV-2 at hospital, commercial, or public health laboratories were reported to CDPH; each triggered an epidemiologic investigation. Contact tracing interviews were conducted with patients with confirmed COVID-19 using a structured questionnaire designed to identify the date of symptom onset and any person with whom the patient had close contact since that date. The type of contact and setting in which the contact occurred were recorded. Close contacts of patients with confirmed or probable COVID-19 were interviewed and enrolled in active symptom monitoring using Research Electronic Data Capture software (REDCap, version 8.8.0, Vanderbilt University, 2020). Patients were classified as having confirmed COVID-19 if SARS-CoV-2 was detected by real-time reverse transcription–polymerase chain reaction testing of a nasopharyngeal or oropharyngeal specimen. Patients were classified as having probable COVID-19 if they developed new symptoms of fever, cough, or shortness of breath within 14 days of contact with a patient with confirmed or probable COVID-19 but did not undergo laboratory testing (consistent with CDC recommendations,* the Illinois Department of Public Health prioritizes testing for hospitalized patients and other high-risk groups).

In February 2020, a funeral was held for a decedent with a non-COVID-19, nonrespiratory cause of death. A close friend of the bereaved family (patient A1.1) attended the funeral; patients in this investigation were referred to by their family cluster letter (A or B), then by the assumed transmission generation (1–4), and finally, in sequence order within each generation (1–7)† (Figure 1). Patient A1.1 had recently traveled out of state and was experiencing mild respiratory symptoms; he was only tested later as part of the epidemiologic investigation and received a diagnosis of confirmed COVID-19. The evening before the funeral (investigation day 1), patient A1.1 shared a takeout meal, eaten from common serving dishes, with two family members of the decedent (patients B2.1 and B2.2) at their home. At the meal, which lasted approximately 3 hours, and the funeral, which lasted about 2 hours and involved a shared "potluck-style" meal, patient A1.1 also reported embracing family members of the decedent, including patients B2.1, B2.2, B2.3, and B3.1, to express condolences.

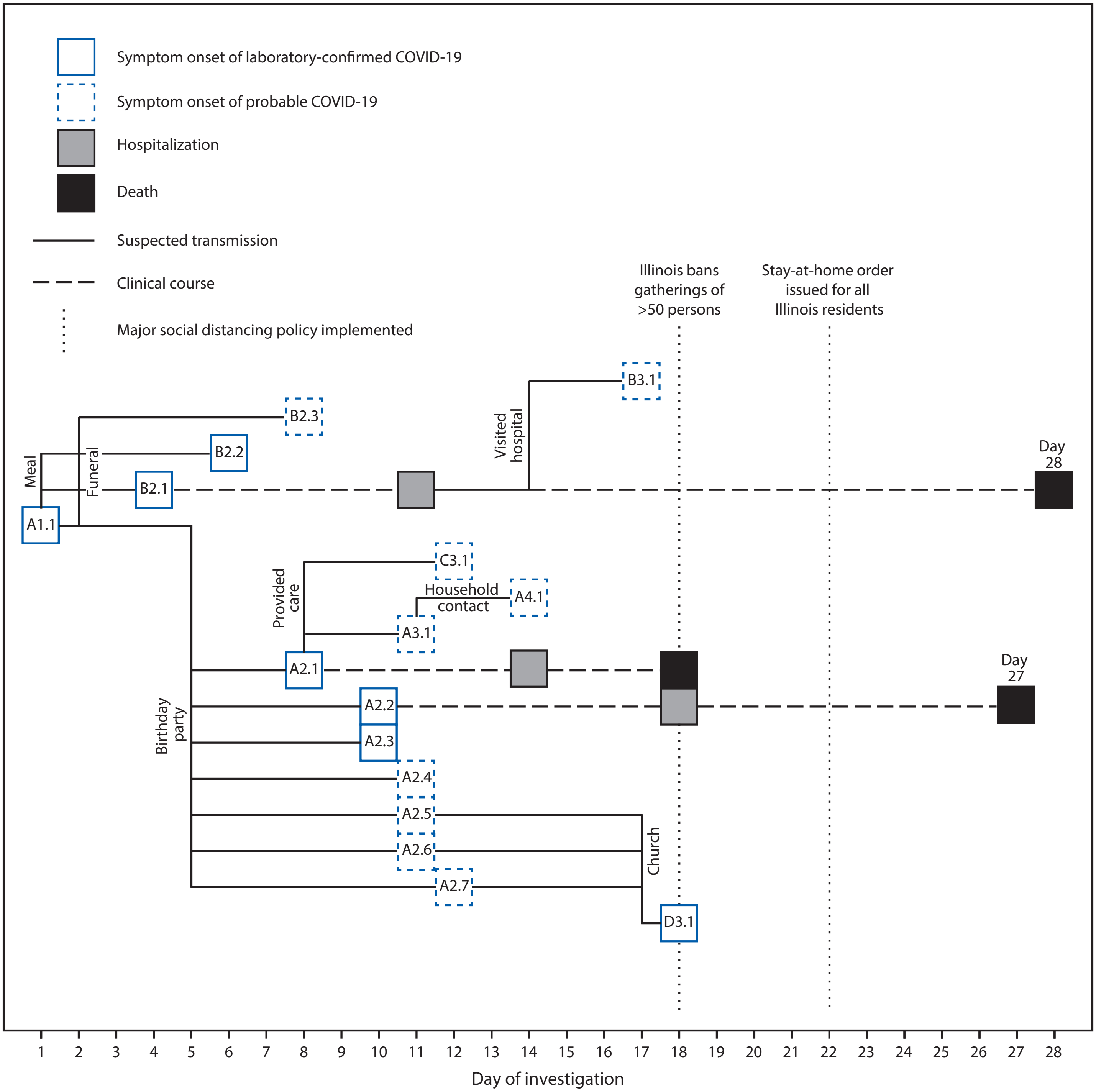
Patients B2.1 and B2.2 subsequently developed confirmed COVID-19 with onset of symptoms 2 and 4 days, respectively, after the funeral; patient B2.3 developed probable COVID-19 with symptom onset 6 days after the funeral (investigation day 8). Patient B2.1 was hospitalized on investigation day 11, required endotracheal intubation and mechanical ventilation for acute repiratory failure, and died on investigation day 28. Patients B2.2 and B2.3 were managed as outpatients, and both recovered.

During investigation days 11–14, another family member who had close physical contact with patient A1.1 at the funeral (patient B3.1) visited patient B2.1 on the acute medical inpatient ward, embraced patient B2.1, and provided limited personal care, while wearing no personal protective equipment (PPE). Patient B3.1 developed signs and symptoms consistent with COVID-19, including a fever and cough on investigation day 17, 3 days after last visiting B2.1. Patient B3.1 had

* CDC. Evaluating and testing persons for coronavirus disease 2019 (COVID-19). https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-criteria.html.

† For example, the likely index patient was the first person in the first generation and belonged to family A and is designated A1.1.

FIGURE 1. Timeline of events and symptom onsets, by day of investigation, in a cluster of COVID-19 likely transmitted at two family gatherings — Chicago, Illinois, February–March 2020



Abbreviation: COVID-19 = coronavirus disease 2019.

Notes: Patients were designated by their family cluster letter (A or B), then by the assumed transmission generation (1–4), and finally, by sequence within each generation (1–7). Patient A2.1 died on investigation day 18; patient A2.2 died on investigation day 27; and patient B2.1 died on investigation day 28.

also attended the funeral 15 days before symptom onset but described more extensive exposure while visiting patient B2.1 in the hospital.

Three days after the funeral, on investigation day 5, patient A1.1, who was still experiencing mild respiratory symptoms, attended a birthday party attended by nine other family members, hosted in the home of patient A2.1. Close contact between patient A1.1 and all other attendees occurred; patient A1.1 embraced others and shared food at the 3-hour party. Seven party attendees subsequently developed COVID-19 3–7 days after the event (Figure 2), including three with confirmed cases (patients A2.1, A2.2, and A2.3) and four with probable cases (patients A2.4, A2.5, A2.6, and A2.7). Two patients with confirmed COVID-19 (A2.1 and A2.2) were hospitalized; both required endotracheal intubation and mechanical ventilation, and both died. One patient with a confirmed case (A2.3) experienced mild symptoms of cough and subjective low-grade fever, as did the four others who received diagnoses of probable COVID-19. Two attendees did not develop symptoms within 14 days of the birthday party.

Two persons who provided personal care for patient A2.1 without using PPE, including one family member (patient A3.1) and a home care professional (patient C3.1), both developed probable COVID-19. It is likely that patient A3.1 subsequently transmitted SARS-CoV-2 to a household contact (patient A4.1), who did not attend the birthday party, but developed a new onset cough 3 days following unprotected, close contact with patient A3.1 while patient A3.1 was symptomatic.

Three symptomatic birthday party attendees with probable COVID-19 (patients A2.5, A2.6, and A2.7) attended church 6 days after developing their first symptoms (investigation day 17). Another church attendee (patient D3.1, a health care professional) developed confirmed COVID-19 following close contact with patients A2.5, A2.6, and A2.7, including direct conversations, sitting within one row for 90 minutes, and passing the offering plate.

The patients described in this report ranged in age from 5 to 86 years. The three patients who died (patients A2.1, B2.1 and A2.2) were aged >60 years, and all had at least one underlying cardiovascular or respiratory medical condition.

Summary

What is already known about this topic?

Early reports of person-to-person transmission of SARS-CoV-2 have been among household contacts, health care workers, and within congregate living facilities.

What is added by this report?

Investigation of COVID-19 cases in Chicago identified a cluster of 16 confirmed or probable cases, including three deaths, likely resulting from one introduction. Extended family gatherings including a funeral and a birthday party likely facilitated transmission of SARS-CoV-2 in this cluster.

What are the implications for public health practice?

U.S. residents should adhere to CDC recommendations for social distancing, avoid gatherings, and follow stay-at-home orders when required by state or local authorities.

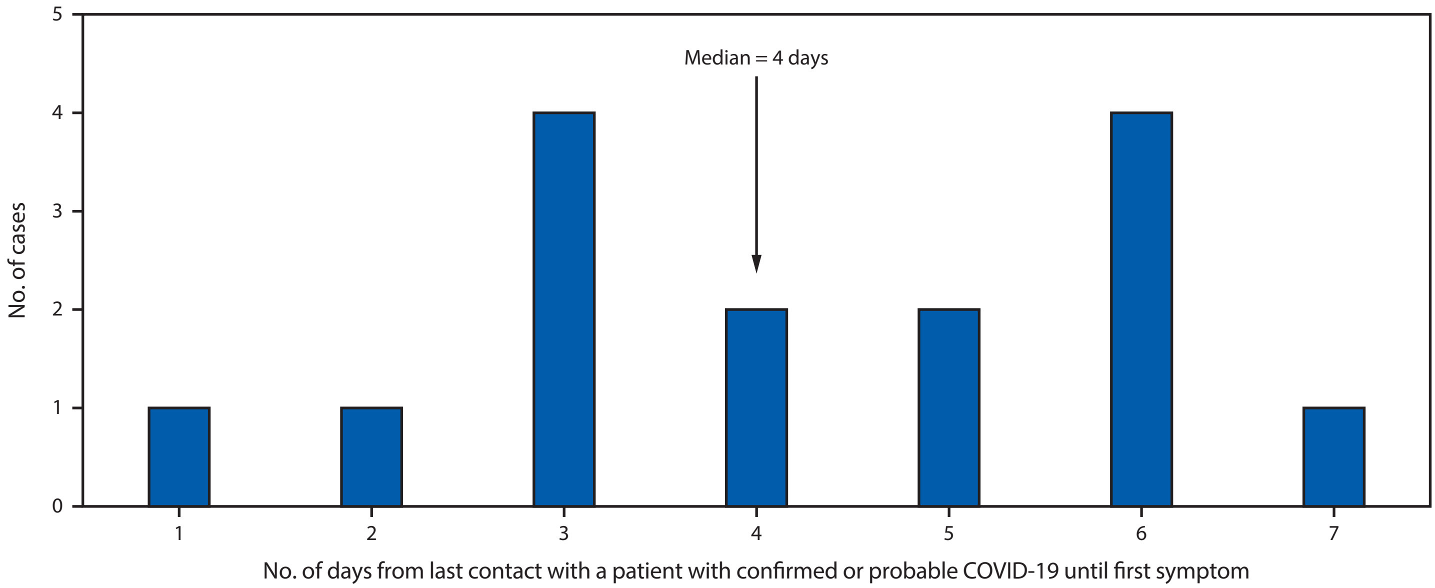
Discussion

This cluster comprised 16 cases of COVID-19 (seven confirmed and nine probable), with transmission mostly occurring between nonhousehold contacts at family gatherings. The median interval from last contact with a patient with confirmed or probable COVID-19 to first symptom onset was 4 days. Within 3 weeks after mild respiratory symptoms were noted in the index patient, 15 other persons were likely infected with SARS-CoV-2, including three who died. Patient A1.1, the index patient, was apparently able to transmit infection to 10 other persons, despite having no household contacts and experiencing only mild symptoms for which medical care was not sought (patient A1.1 was only tested later as part of this epidemiologic investigation). Super-spreading events have played a significant role in transmission of other recently emerged coronaviruses such as SARS-CoV and MERS-CoV (*4*,*5*), although their relevance to SARS-CoV-2 spread is debated (*6*).

These data illustrate the importance of social distancing for preventing SARS-CoV-2 transmission, even within families. In this cluster, extended family gatherings (a birthday party, funeral, and church attendance), all of which occurred before major social distancing policies were implemented, might have facilitated transmission of SARS-CoV-2 beyond household contacts into the broader community. These findings support CDC recommendations to avoid gatherings (*7*) and reinforce the executive order from the governor of Illinois prohibiting all public and private gatherings of any number of persons occurring outside a single household (*8*).

The findings in this investigation are subject to at least three limitations. First, lack of laboratory testing for probable cases means some probable COVID-19 patients might have instead experienced unrelated illnesses, although influenza-like illness was declining in Chicago at the time. Second, phylogenetic data, which could confirm presumed epidemiologic linkages, were unavailable. For example, patient B3.1 experienced exposure to two patients with confirmed COVID-19 in this cluster, and the causative exposure was presumed based on expected incubation periods. Patient D3.1 was a health care professional, and, despite not seeing any patients with known COVID-19, might have acquired SARS-CoV-2 during clinical practice rather than through contact with members of this cluster. Similarly, other members of the cluster might have

FIGURE 2. Likely incubation periods for confirmed and probable cases of COVID-19 following transmission of SARS-CoV-2 at two family gatherings (N = 15)* — Chicago, Illinois, February–March 2020



* The exposure of infection for the index patient, and consequently the incubation period, was unknown.

experienced community exposures to SARS-CoV-2, although these transmission events occurred before widespread community transmission of SARS-CoV-2 in Chicago. Finally, despite intensive epidemiologic investigation, not every confirmed or probable case related to this cluster might have been detected. Persons who did not display symptoms were not evaluated for COVID-19, which, given increasing evidence of substantial asymptomatic infection (*9*), means the size of this cluster might be underestimated.

In this cluster, two family gatherings outside the household likely facilitated the spread of SARS-CoV-2; one index patient who attended both events likely triggered a chain of transmission that included 15 other confirmed and probable cases of COVID-19 and ultimately resulted in three deaths. Media reports suggest the chain of transmission described in Chicago is not unique within the United States.[§] Together with evidence emerging from around the world (*10*), these data shed light on transmission beyond household contacts, including the potential for super-spreading events. More comprehensive information is needed to better understand the transmission of SARS-CoV-2 in community settings and households to better inform initiation and termination of public health policies related to social distancing or stay-at-home orders. Overall, these findings highlight the importance of adhering to current social distancing recommendations,[¶] including guidance to avoid any gatherings with persons from multiple households and following state or local stay-at-home orders.

[§] New York Times. After a funeral in a Georgia town, coronavirus 'hit like a bomb.' March 20, 2020. https://www.nytimes.com/2020/03/30/us/coronavirus-funeral-albany-georgia.html.

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Timing of Community Mitigation and Changes in Reported COVID-19 and Community Mobility — Four U.S. Metropolitan Areas, February 26–April 1, 2020

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Community mitigation activities (also referred to as nonpharmaceutical interventions) are actions that persons and communities can take to slow the spread of infectious diseases. Mitigation strategies include personal protective measures (e.g., handwashing, cough etiquette, and face coverings) that persons can use at home or while in community settings; social distancing (e.g., maintaining physical distance between persons in community settings and staying at home); and environmental surface cleaning at home and in community settings, such as schools or workplaces. Actions such as social distancing are especially critical when medical countermeasures such as vaccines or therapeutics are not available. Although voluntary adoption of social distancing by the public and community organizations is possible, public policy can enhance implementation. The CDC Community Mitigation Framework (*1*) recommends a phased approach to implementation at the community level, as evidence of community spread of disease increases or begins to decrease and according to severity. This report presents initial data from the metropolitan areas of San Francisco, California; Seattle, Washington; New Orleans, Louisiana; and New York City, New York* to describe the relationship between timing of public policy measures, community mobility (a proxy measure for social distancing), and temporal trends in reported coronavirus disease 2019 (COVID-19) cases. Community mobility in all four locations declined from February 26, 2020 to April 1, 2020, decreasing with each policy issued and as case counts increased. This report suggests that public policy measures are an important tool to support social distancing and provides some very early indications that these measures might help slow the spread of COVID-19.

When a novel virus with pandemic potential emerges, community mitigation strategies often are the most readily available interventions to slow transmission. CDC-recommended community mitigation interventions for COVID-19, caused by the SARS-CoV-2 virus, are based on evidence for other viral respiratory illnesses and emerging data on SARS-CoV-2 transmission and epidemiology, including groups at highest risk for hospitalization and death from COVID-19 (*1*,*2*).

Public policies to implement social distancing include emergency declarations, bans on gatherings of certain sizes, school closures, restrictions on businesses, and stay-at-home or shelter-in-place of residence orders. These strategies can substantially disrupt daily life; therefore, the intensity of their implementation should align with progression and severity of disease *(1)*. Understanding the timing and potential impact of policies designed to increase compliance with mitigation strategies will assist in guiding modification of those policies over the course of the COVID-19 pandemic as well as increasing the understanding of when and how to fully implement these strategies in future outbreaks where community mitigation is required.

Data from February 26–April 1, 2020 were examined from the core metropolitan statistical areas (MSAs) of Seattle, San Francisco, and New Orleans, and from the five boroughs of New York City (*3*). These areas were selected because each had substantial numbers of reported COVID-19 cases during the early stages of the U.S. epidemic (*4*). For each locality, the following data were analyzed: 1) types and timing of public policies issued to promote community mitigation interventions at the national, state, and local government levels; 2) cumulative number of reported COVID-19 cases; 3) average 3-day percentage change in reported cases; and 4) community mobility.

The types and timing of public policies issued were collected by using Google Alerts and targeted Google searches for news media coverage of state and local COVID-19 orders and proclamations, followed by searching state, county, parish, and city government websites to locate official copies of each order. Confirmed cumulative COVID-19 case count data

* San Francisco metropolitan statistical area (MSA) counties include Alameda, Contra Costa, San Francisco, San Mateo, and Marin; Seattle MSA counties include King, Snohomish, and Pierce; New York City boroughs include The Bronx, Brooklyn, Manhattan, Queens, and Staten Island; New Orleans MSA parishes include Jefferson, Orleans, Plaquemines, St. Bernard, St. Charles, St. James, St. John the Baptist, and St. Tammany.

were collected from USAFacts (*4*), which aggregates data on cases by date of report from CDC and state- and local-level public health agencies. The 3-day average percentage change in cumulative case count was calculated after the cumulative case count was >20 and is presented to describe more completely the trend in the epidemic growth rate. Community mobility was defined as the percentage of personal mobile devices (e.g., mobile phones, tablets, and watches) leaving home, using publicly accessible data from SafeGraph, a data company that aggregates anonymized location data from mobile devices (*5*). The percentage leaving home measure is the inverse of the SafeGraph "completely home" metric, an indicator that a device has not moved throughout the day beyond approximately 150 m (492 ft) of its common nighttime location. The average number of devices included in daily reporting was 80,095 in New Orleans (6.4% of population); 336,783 devices in New York City (4.0% of population); 163,981 devices in San Francisco (3.6% of population); and 177,027 devices in Seattle (4.8% of population).

In each of the four locations, a combination of state and local community mitigation policies was issued (Table). All four metropolitan areas were in states that declared a state of emergency and put local limits on mass gatherings, although these varied by numbers of people allowed and, in some cases, changed over time. All four issued school closure and stay-at-home orders at state or local levels, and three parishes in the New Orleans MSA were the only areas in this study to implement a curfew.

In addition to state and local policies, which were implemented beginning in March, on March 16, 2020, the White House announced the 15 Days to Slow the Spread guidelines for persons to take action to reduce the spread of COVID-19. This national action was extended for an additional 30 days on March 30, 2020.[†]

Timing of community mitigation policies in relation to the increasing cumulative case counts of COVID-19 varied by locality (Figure). In all four metropolitan areas, an emergency declaration was the first policy issued, before large increases in cumulative cases. Stay-at-home orders were the last mitigation policy to be issued in all areas except for the New Orleans MSA, where a curfew in three of eight parishes was issued after the stay-at-home order. In all four metropolitan areas, the percentage of residents leaving home declined as the number of policies issued increased (Figure); in all four localities the percentage leaving home was close to 80% on February 26, and by April 1 the percentage leaving home was 42% in New York City, 47% in San Francisco, 52% in Seattle, and 61% in New Orleans. Overall, across the four areas, emergency declarations (the first policies issued) did not result in a sustained change in mobility; however, declines in mobility occurred after implementation of combinations of policies (such as limits on gatherings or school closures) and after the White House 15 Days to Slow the Spread guidelines were implemented. There were additional declines in mobility following stay-at-home orders in all four locations. The average 3-day percentage change also varied by locality, with some variation across the four metropolitan areas during the first two weeks of March, followed by a decline and leveling in the last two weeks of March. These changes also follow the issuance of a set of policies and rapid decline in mobility mid-March.

Discussion

During February 26–April 1, 2020, as cumulative cases increased and community mitigation policies were implemented, community mobility declined in four U.S. metropolitan areas. With the exception of emergency declarations, which were implemented as cases increased in other regions and internationally, these policies were implemented during the period when case counts were increasing in each location, but the timing in relation to cumulative case counts varied. Public policies to increase compliance with social distancing, including limits on mass gatherings, school closures, business restrictions, and stay-at-home or shelter-in-place orders appear to be associated with decreases in mobility. Policies related to specific locations or community organizations (e.g., mass gatherings, schools, restaurants, and bars) were often implemented within one or two weeks of mid-March, likely a result of increased awareness and concern about the potential scope of the outbreak in the absence of mitigation. This awareness and concern also likely impacted the public, potentially leading to further decreases in mobility. Thus, the potential impact of interventions on mobility as well as this increased awareness of community spread of disease appears to be cumulative over time. Monitoring adherence to community mitigation strategies through mobility measures could improve the understanding of the types, combinations, and timing of policies that are associated with slowing the spread of COVID-19 as well as other infectious diseases. Finally, there appears to be very early indications of potential impact of policies and social distancing on later changes in cases. There are likely a variety of contributors to these changes, including public health efforts to contain spread and individual efforts to increase personal protective practices. However, both policies related to community mitigation and social distancing, operationalized here as community mobility, could have contributed to these changes.

The findings in this report are subject to at least four limitations. First, these data suggest temporal correlations between

[†] https://www.whitehouse.gov/wp-content/uploads/2020/03/03.16.20_coronavirus-guidance_8.5x11_315PM.pdf.

TABLE. Public policies ordering COVID-19 community mitigation interventions and dates of issuance* — four U.S. metropolitan areas, February 26–April 1, 2020

Mandatory intervention	New Orleans MSA parishes: Jefferson, Orleans, Plaquemines, St. Bernard, St. Charles, St. James, St. John the Baptist, St. Tammany	New York City boroughs: The Bronx, Brooklyn, Manhattan, Queens, Staten Island	San Francisco MSA counties: Alameda, Contra Costa, San Francisco, San Mateo, Marin	Seattle MSA counties: King, Snohomish, Pierce
State declaration of emergency	March 11	March 7	March 4	February 29
Local declaration of emergency	March 11: Orleans March 12: Jefferson March 13: St. Tammany, St. James March 14: St. Charles March 15: Plaquemines, St. John the Baptist March 16: St. Bernard	March 12: New York City	February 25: San Francisco March 1: Alameda March 3: San Mateo, Marin March 10: Contra Costa	March 2: King March 3: City of Seattle March 4: Snohomish
State limits on mass gatherings	March 13: limiting to <250 March 16: limiting to <10	March 12: limiting to <500 March 16: limiting to <50 March 23: banning all nonessential gatherings	March 11: limiting to <250	March 11: limiting to <250 for King, Pierce, Snohomish March 15: limiting to <50 statewide
Local limits on mass gatherings†	March 16: City of New Orleans, Orleans Parish canceling all public gatherings	March 15: New York City limiting to <500 March 20: New York City limiting to <50 March 25: New York City banning all nonessential gatherings	March 11: San Francisco limiting to <1,000 March 12: San Mateo limiting to <250 March 13: San Francisco limiting to <100 March 14: Contra Costa limiting to <100; San Mateo limiting to <50	March 11: Public Health Seattle & King County limiting to <250
State limits on senior living facilities	March 12§	March 12	NA¶	March 10: limiting visitors March 16: banning visitors
Local limits on senior living facilities	NR	NR	March 11: San Mateo March 12: San Francisco	NR
State school closure	March 13	March 16	NA**	March 12: state order for King, Pierce, Snohomish March 13: statewide
Local school closure	NR	March 15: New York City	March 13: Marin, San Mateo††	NA§§
State limits on bars and restaurants	March 16	March 16	March 19	March 16
Local limits on bars and restaurants	March 16: Orleans, City of New Orleans	March 16: New York City	NR	NR
State stay-at-home/ shelter-in-place order	March 22	March 20	March 19	March 23
Local stay-at-home/ shelter-in-place order	March 20: Orleans, City of New Orleans	March 20: New York City	March 16: Alameda, Contra Costa, Marin, San Francisco, San Mateo	March 24: Snohomish
Local curfew order	April 1: St. James, St. John the Baptist April 2: Plaquemines	NR	NR	NR

Abbreviations: COVID-19 = coronavirus disease 2019; MSA = metropolitan statistical area; NA = not applicable; NR = none reported.

* Issuance dates are the dates the issuing official signed the order implementing the mandatory intervention. In some instances, interventions were effective either immediately or within 1–3 days of issuance. Recommendations and guidance are not included.

† Dates reflect issuance of mandated restrictions on the size of mass gatherings. The cancellation of individual events is excluded.

§ Visitor limitations were issued for all licensed health care providers.

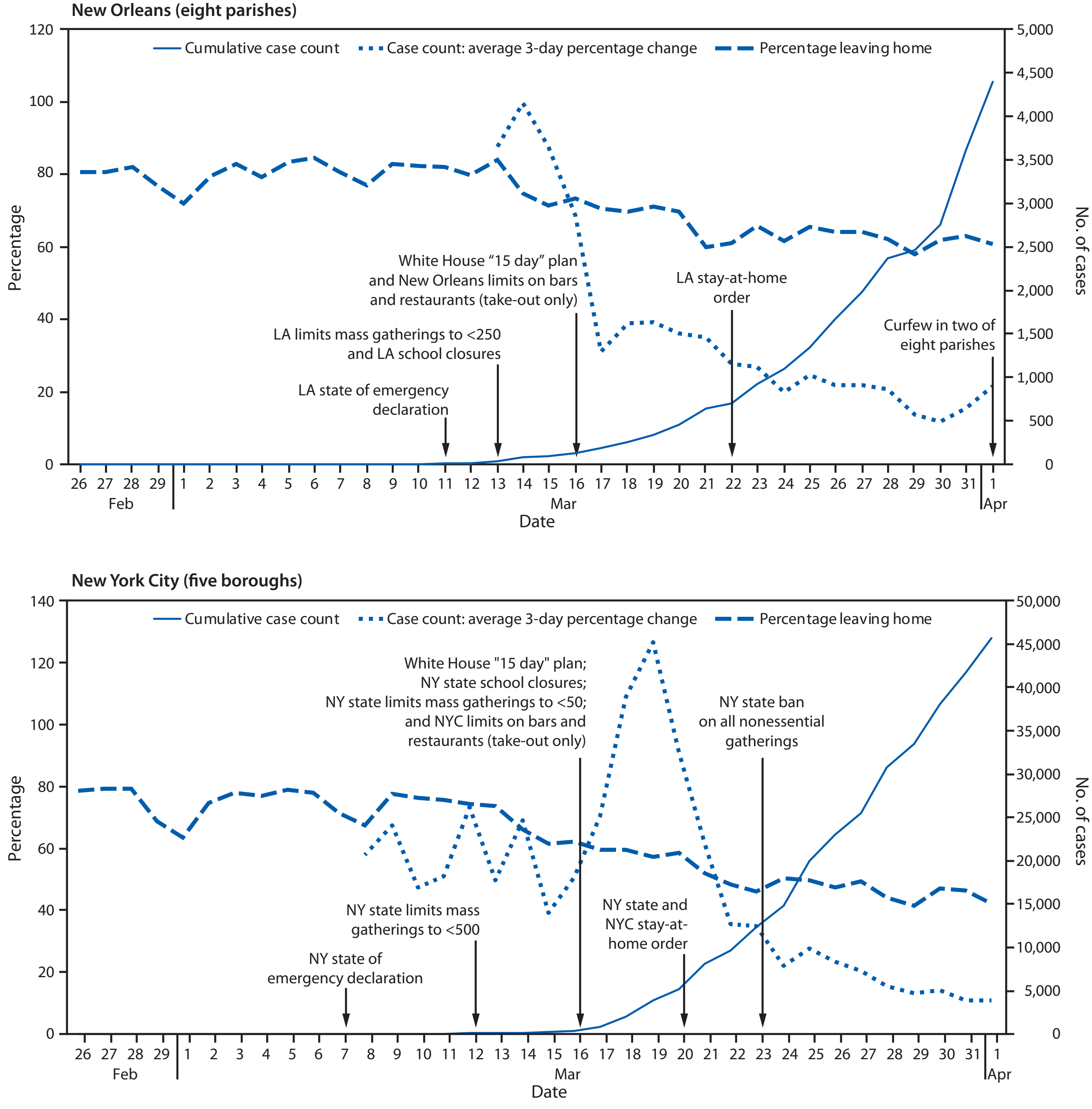
¶ Guidance states that the March 19 stay-at-home order "prohibits non-necessary visitation to these kinds of facilities except at the end-of-life."

** Although no statewide school closure mandate was issued, the governor's March 13 Executive Order N-26–20 describes multiple orders applicable to local educational agencies that choose to close to address COVID-19.

†† Schools also closed in other San Francisco MSA counties, but decisions were made at the school district level and not as mandatory policies implemented at the municipal, county, or state level.

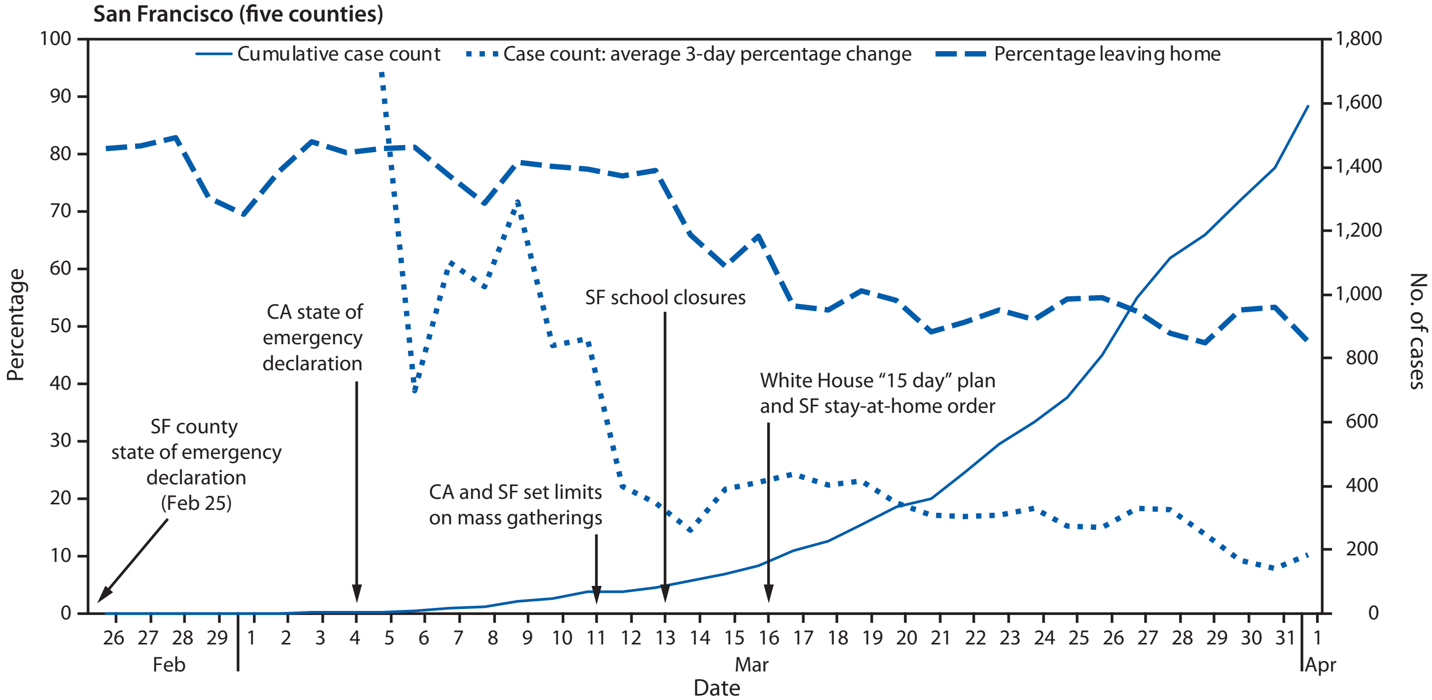
§§ Schools districts in the Seattle MSA began closing on March 11, but these decisions were made at the district level and not as mandatory policies implemented at the municipal, county, or state level.

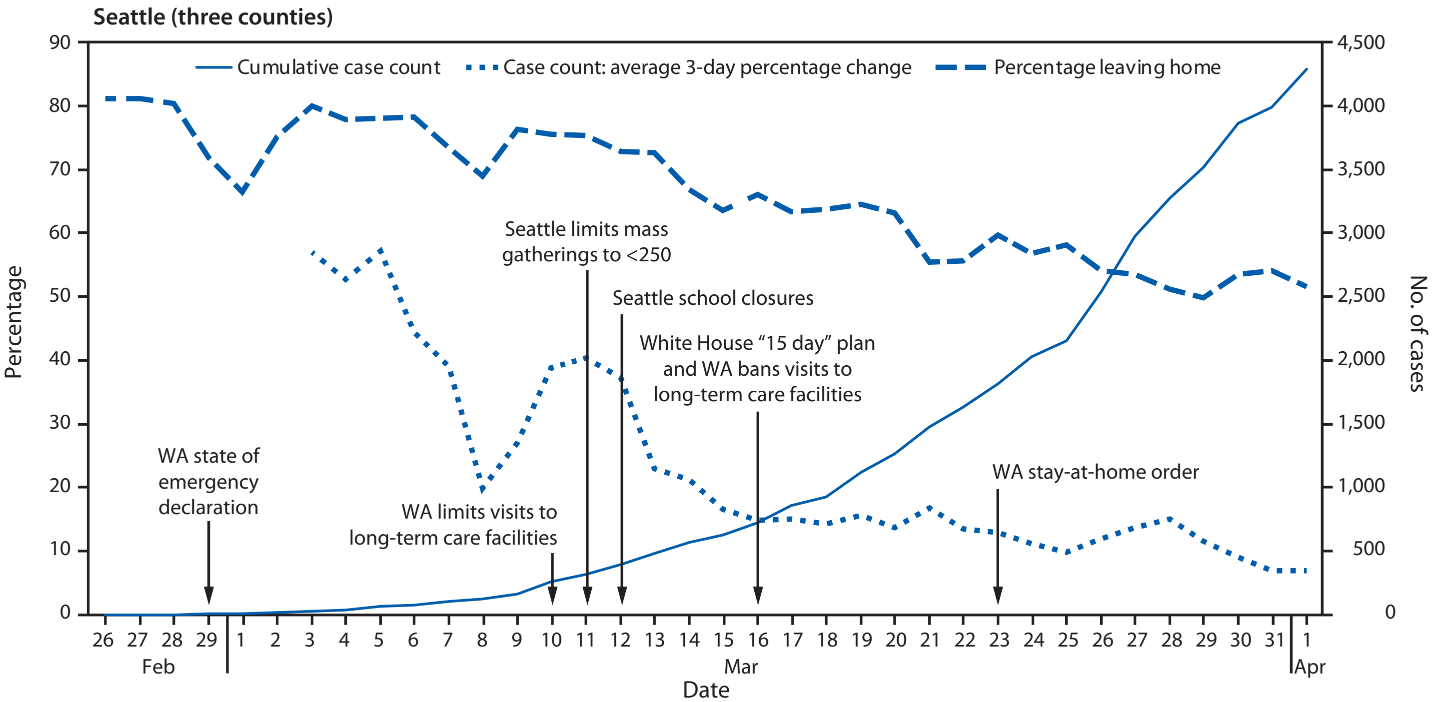
FIGURE. Selected community mitigation interventions,* cumulative COVID-19 case counts, average 3-day percentage change in case counts,† and percentage leaving home — four U.S. metropolitan areas,§,¶ February 26–April 1, 2020



See figure footnotes on the next page.

FIGURE. (*Continued*) Selected community mitigation interventions,* cumulative COVID-19 case counts, average 3-day percentage change in case counts,† and percentage leaving home — four U.S. metropolitan areas,§,¶ February 26–April 1, 2020





Abbreviations: CA = California; COVID-19 = coronavirus disease 2019; LA = Louisiana; NY = New York; NYC = New York City; SF = San Francisco; WA = Washington.

* Public policies ordering COVID-19 community mitigation interventions presented by date of issuance.

† Plotting of average 3-day percentage change begins when cumulative case count >20.

§ San Francisco metropolitan statistical area (MSA) counties include Alameda, Contra Costa, San Francisco, San Mateo, and Marin; Seattle MSA counties include King, Snohomish, and Pierce; New York City boroughs include The Bronx, Brooklyn, Manhattan, Queens, and Staten Island; New Orleans MSA parishes include Jefferson, Orleans, Plaquemines, St. Bernard, St. Charles, St. James, St. John the Baptist, and St. Tammany.

¶ The primary and secondary vertical axis are different across locations and set according to each location's data.

Summary

What is already known on this topic?

Implementing community mitigation strategies, including personal protective measures persons should adopt in community settings, social distancing, and environmental cleaning in community settings, during a pandemic can slow the spread of infections.

What is added by this report?

During February 26–April 1, 2020, community mobility (a proxy measure for social distancing) in the metropolitan areas of Seattle, San Francisco, New York City, and New Orleans declined, decreasing with each community mitigation policy issued and as case counts increased.

What are the implications for public health practice?

Public policies to increase compliance with community mitigation strategies might be effective in decreasing community mobility; however, more information is needed to assess impact on disease transmission.

issuance of public policies to increase mitigation strategies and rising case counts, on one hand, and decreases in mobility, on the other as well as first indications that these changes might impact growth of infections. The trends suggest an association but cannot prove causality. Second, although mobile device data can be used to understand movement within a community, the characteristics of those persons using these devices (e.g., age, gender, race, and ethnicity) are not known, so the results might not be generalizable or reflective of actual mobility patterns. Further, mobile phone coverage was limited to 3%–6% of the population in each location. In addition, the data presented here track mobile devices, not persons, who might have multiple devices (e.g., phone and tablet), who might not take their devices when they leave the home, or who might travel outside their home but remain within 150 m (492 ft) of their usual nighttime location. Third, confirmed cumulative cases of COVID-19 might not reflect the actual number of cases because of variability in access to testing and recommendations for who should be tested during this period. Finally, these four urban metropolitan areas are not representative of communities across the United States, and community mitigation policies might have a very different impact on mobility in suburban and rural communities.

These temporal trend data provide a preliminary examination of local timing of community mitigation measures and potential impacts on community mobility as well as very early indications of the impact of community mitigation on disease growth. As the COVID-19 pandemic spreads across the United States, the ability to assess the impact of mitigation strategies on reducing COVID-19 transmission will improve. Decreasing numbers of new cases are needed to curtail the COVID-19 pandemic in communities and relieve pressure on the health care system. Better understanding of the short- and long-term impact of the community disruption that results from these measures is critical. However, this analysis suggests that policies to increase social distancing when case counts are increasing can be an important tool for communities as changes in behavior result in decreased spread of COVID-19.

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Hospitalization Rates and Characteristics of Patients Hospitalized with Laboratory-Confirmed Coronavirus Disease 2019 — COVID-NET, 14 States, March 1–30, 2020

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Since SARS-CoV-2, the novel coronavirus that causes coronavirus disease 2019 (COVID-19), was first detected in December 2019 (*1*), approximately 1.3 million cases have been reported worldwide (*2*), including approximately 330,000 in the United States (*3*). To conduct population-based surveillance for laboratory-confirmed COVID-19–associated hospitalizations in the United States, the COVID-19–Associated Hospitalization Surveillance Network (COVID-NET) was created using the existing infrastructure of the Influenza Hospitalization Surveillance Network (FluSurv-NET) (*4*) and the Respiratory Syncytial Virus Hospitalization Surveillance Network (RSV-NET). This report presents age-stratified COVID-19–associated hospitalization rates for patients admitted during March 1–28, 2020, and clinical data on patients admitted during March 1–30, 2020, the first month of U.S. surveillance. Among 1,482 patients hospitalized with COVID-19, 74.5% were aged ≥50 years, and 54.4% were male. The hospitalization rate among patients identified through COVID-NET during this 4-week period was 4.6 per 100,000 population. Rates were highest (13.8) among adults aged ≥65 years. Among 178 (12%) adult patients with data on underlying conditions as of March 30, 2020, 89.3% had one or more underlying conditions; the most common were hypertension (49.7%), obesity (48.3%), chronic lung disease (34.6%), diabetes mellitus (28.3%), and cardiovascular disease (27.8%). These findings suggest that older adults have elevated rates of COVID-19–associated hospitalization and the majority of persons hospitalized with COVID-19 have underlying medical conditions. These findings underscore the importance of preventive measures (e.g., social distancing, respiratory hygiene, and wearing face coverings in public settings where social distancing measures are difficult to maintain)[†] to protect older adults and persons with underlying medical conditions, as well as the general public. In addition, older adults and persons with serious underlying medical conditions should avoid contact with persons who are ill and immediately contact their health care provider(s) if they have symptoms consistent with COVID-19 (https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html) (*5*). Ongoing monitoring of hospitalization rates, clinical characteristics, and outcomes of hospitalized patients will be important to better understand the evolving epidemiology of COVID-19 in the United States and the clinical spectrum of disease, and to help guide planning and prioritization of health care system resources.

COVID-NET conducts population-based surveillance for laboratory-confirmed COVID-19–associated hospitalizations among persons of all ages in 99 counties in 14 states (California, Colorado, Connecticut, Georgia, Iowa, Maryland, Michigan, Minnesota, New Mexico, New York, Ohio, Oregon, Tennessee, and Utah), distributed across all 10 U.S Department of Health and Human Services regions.[§] The catchment area represents approximately 10% of the U.S. population. Patients must be residents of a designated COVID-NET catchment area and hospitalized within 14 days of a positive SARS-CoV-2 test to meet the surveillance case definition. Testing is requested at the discretion of treating health care providers. Laboratory-confirmed SARS-CoV-2 is defined as a positive result by any test that has received Emergency Use Authorization for SARS-CoV-2 testing.[¶] COVID-NET surveillance officers in each state identify cases through active review of notifiable disease and laboratory databases and hospital admission and infection control practitioner logs. Weekly age-stratified hospitalization rates are estimated using the number of catchment area residents hospitalized with laboratory-confirmed COVID-19 as the numerator and National Center for Health Statistics vintage 2018 bridged-race postcensal population estimates for the denominator.** As of April 3, 2020, COVID-NET

* These authors contributed equally.

† https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/diy-cloth-face-coverings.html.

§ https://www.hhs.gov/about/agencies/iea/regional-offices/index.html.

¶ https://www.fda.gov/medical-devices/emergency-situations-medical-devices/emergency-use-authorizations.

** https://www.cdc.gov/nchs/nvss/bridged_race.htm.

hospitalization rates are being published each week at https://gis.cdc.gov/grasp/covidnet/COVID19_3.html. For each case, trained surveillance officers conduct medical chart abstractions using a standard case report form to collect data on patient characteristics, underlying medical conditions, clinical course, and outcomes. Chart reviews are finalized once patients have a discharge disposition. COVID-NET surveillance was initiated on March 23, 2020, with retrospective case identification of patients admitted during March 1–22, 2020, and prospective case identification during March 23–30, 2020. Clinical data on underlying conditions and symptoms at admission are presented through March 30; hospitalization rates are updated weekly and, therefore, are presented through March 28 (epidemiologic week 13).

The COVID-19–associated hospitalization rate among patients identified through COVID-NET for the 4-week period ending March 28, 2020, was 4.6 per 100,000 population (Figure 1). Hospitalization rates increased with age, with a rate of 0.3 in persons aged 0–4 years, 0.1 in those aged 5–17 years, 2.5 in those aged 18–49 years, 7.4 in those aged 50–64 years, and 13.8 in those aged ≥65 years. Rates were highest among persons aged ≥65 years, ranging from 12.2 in those aged 65–74 years to 17.2 in those aged ≥85 years. More than half (805; 54.4%) of hospitalizations occurred among men; COVID-19-associated hospitalization rates were higher among males than among females (5.1 versus 4.1 per 100,000 population). Among the 1,482 laboratory-confirmed COVID-19–associated hospitalizations reported through COVID-NET, six (0.4%) each were patients aged 0–4 years and 5–17 years, 366 (24.7%) were aged 18–49 years, 461 (31.1%) were aged 50–64 years, and 643 (43.4%) were aged ≥65 years. Among patients with race/ethnicity data (580), 261 (45.0%) were non-Hispanic white (white), 192 (33.1%) were non-Hispanic black (black), 47 (8.1%) were Hispanic, 32 (5.5%) were Asian, two (0.3%) were American Indian/Alaskan Native, and 46 (7.9%) were of other or unknown race. Rates varied widely by COVID-NET surveillance site (Figure 2).

During March 1–30, underlying medical conditions and symptoms at admission were reported through COVID-NET for approximately 180 (12.1%) hospitalized adults (Table); 89.3% had one or more underlying conditions. The most commonly reported were hypertension (49.7%), obesity (48.3%), chronic lung disease (34.6%), diabetes mellitus (28.3%), and cardiovascular disease (27.8%). Among patients aged 18–49 years, obesity was the most prevalent underlying condition, followed by chronic lung disease (primarily asthma) and diabetes mellitus. Among patients aged 50–64 years, obesity was most prevalent, followed by hypertension and diabetes mellitus; and among those aged ≥65 years, hypertension was most prevalent, followed by cardiovascular disease and diabetes mellitus. Among 33 females aged 15–49 years hospitalized with COVID-19, three (9.1%) were pregnant. Among 167 patients with available data, the median interval from symptom onset to admission was 7 days (interquartile range [IQR] = 3–9 days). The most common signs and symptoms at admission included cough (86.1%), fever or chills (85.0%), and shortness of breath (80.0%). Gastrointestinal symptoms were also common; 26.7% had diarrhea, and 24.4% had nausea or vomiting.

Discussion

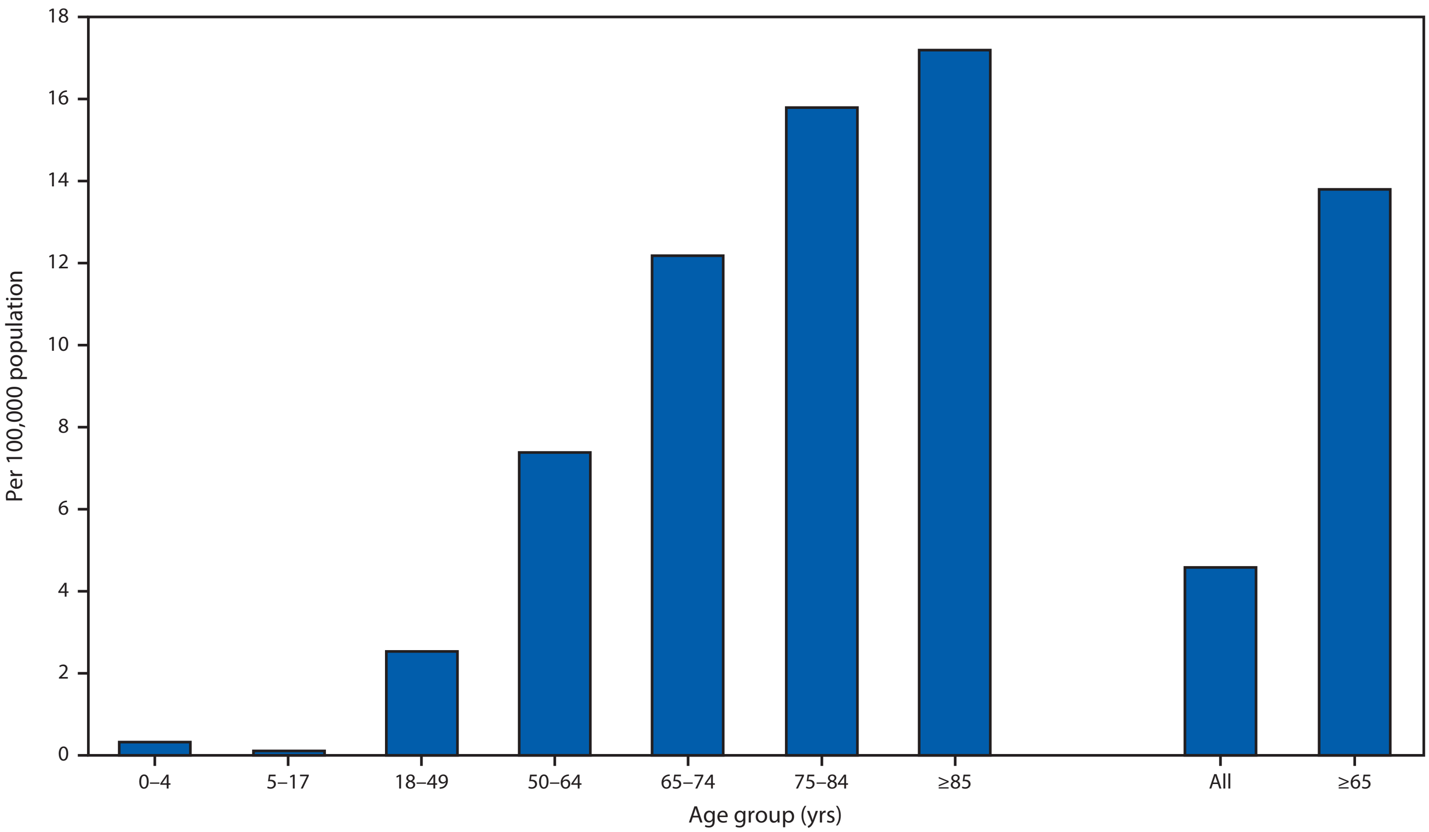
During March 1–28, 2020, the overall laboratory-confirmed COVID-19–associated hospitalization rate was 4.6 per 100,000 population; rates increased with age, with the highest rates among adults aged ≥65 years. Approximately 90% of hospitalized patients identified through COVID-NET had one or more underlying conditions, the most common being obesity, hypertension, chronic lung disease, diabetes mellitus, and cardiovascular disease.

Using the existing infrastructure of two respiratory virus surveillance platforms, COVID-NET was implemented to produce robust, weekly, age-stratified hospitalization rates using standardized data collection methods. These data are being used, along with data from other surveillance platforms (https://www.cdc.gov/coronavirus/2019-ncov/covid-data/covidview.html), to monitor COVID-19 disease activity and severity in the United States. During the first month of surveillance, COVID-NET hospitalization rates ranged from 0.1 per 100,000 population in persons aged 5–17 years to 17.2 per 100,000 population in adults aged ≥85 years, whereas cumulative influenza hospitalization rates during the first 4 weeks of each influenza season (epidemiologic weeks 40–43) over the past 5 seasons have ranged from 0.1 in persons aged 5–17 years to 2.2–5.4 in adults aged ≥85 years (*6*). COVID-NET rates during this first 4-week period of surveillance are preliminary and should be interpreted with caution; given the rapidly evolving nature of the COVID-19 pandemic, rates are expected to increase as additional cases are identified and as SARS-CoV-2 testing capacity in the United States increases.

In the COVID-NET catchment population, approximately 49% of residents are male and 51% of residents are female, whereas 54% of COVID-19-associated hospitalizations occurred in males and 46% occurred in females. These data suggest that males may be disproportionately affected by COVID-19 compared with females. Similarly, in the COVID-NET catchment population, approximately 59% of residents are white, 18% are black, and 14% are Hispanic; however, among 580 hospitalized COVID-19 patients with race/ethnicity data, approximately 45% were white, 33% were black, and 8% were Hispanic, suggesting that black populations might be disproportionately affected by COVID-19. These findings, including the potential impact of both sex and race on COVID-19-associated hospitalization rates, need to be confirmed with additional data.

Most of the hospitalized patients had underlying conditions, some of which are recognized to be associated with severe COVID-19 disease, including chronic lung disease, cardiovascular disease, diabetes mellitus (5). COVID-NET does not collect data on nonhospitalized patients; thus, it was not possible to compare the prevalence of underlying conditions in hospitalized versus nonhospitalized patients. Many of the documented underlying conditions among hospitalized COVID-19 patients are highly prevalent in the United States. According to data from the National Health and Nutrition Examination Survey, hypertension prevalence among U.S. adults is 29% overall, ranging from 7.5%–63% across age groups (*7*), and age-adjusted obesity prevalence is 42% (range across age groups = 40%–43%) (*8*). Among hospitalized COVID-19 patients, hypertension prevalence was 50% (range across age groups = 18%–73%), and obesity prevalence was 48% (range across age groups = 41%–59%). In addition, the prevalences of several underlying conditions identified through COVID-NET were similar to those for hospitalized influenza patients identified through FluSurv-NET during influenza seasons 2014–15 through 2018–19: 41%–51% of patients had cardiovascular disease (excluding hypertension), 39%–45% had chronic metabolic disease, 33%–40% had obesity, and 29%–31% had chronic lung disease (*6*). Data on hypertension are not collected by FluSurv-NET. Among women aged 15–49 years hospitalized with COVID-19 and identified through COVID-NET, 9% were pregnant, which is similar to an estimated 9.9% of the general population

FIGURE 1. Laboratory-confirmed coronavirus disease 2019 (COVID-19)–associated hospitalization rates,* by age group — COVID-NET, 14 states,† March 1–28, 2020

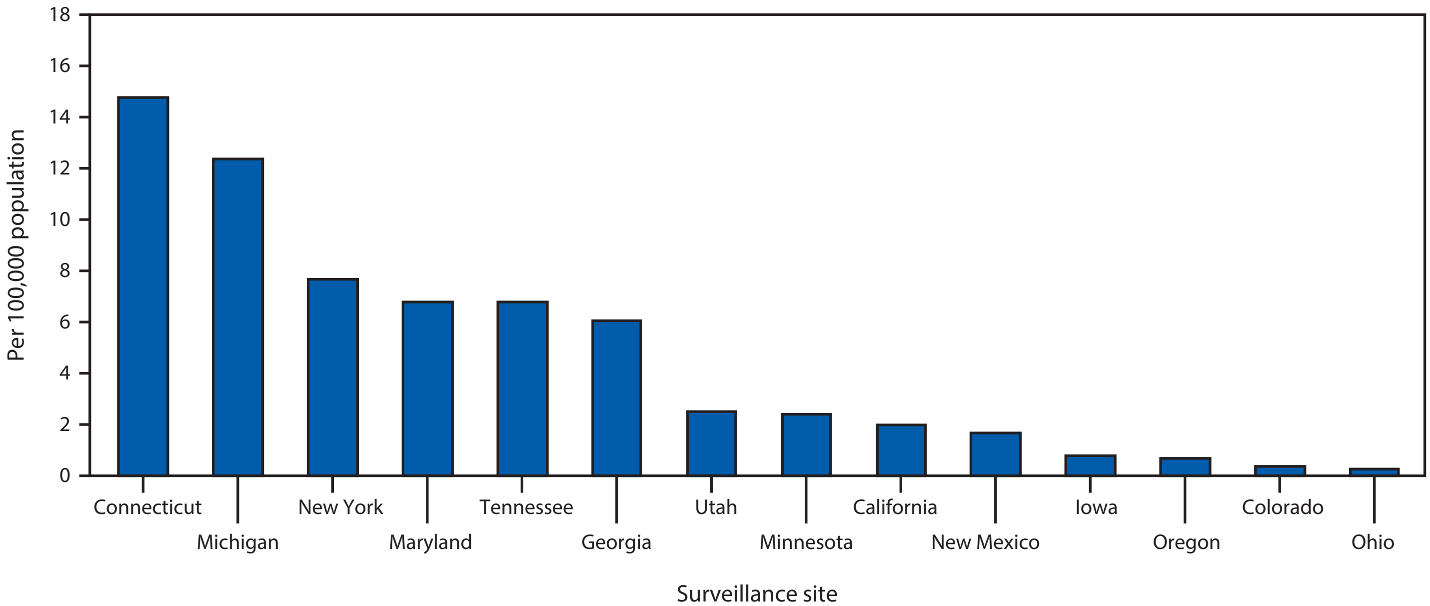


Abbreviation: COVID-NET = Coronavirus Disease 2019–Associated Hospitalization Surveillance Network.

* Number of patients hospitalized with COVID-19 per 100,000 population.

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

FIGURE 2. Laboratory-confirmed coronavirus disease 2019 (COVID-19)–associated hospitalization rates,* by surveillance site†— COVID-NET, 14 states, March 1–28, 2020



Abbreviation: COVID-NET = Coronavirus Disease 2019–Associated Hospitalization Surveillance Network.
* Number of patients hospitalized with COVID-19 per 100,000 population.
† Counties included in COVID-NET surveillance: California (Alameda, Contra Costa, and San Francisco counties); Colorado (Adams, Arapahoe, Denver, Douglas, and Jefferson counties); Connecticut (New Haven and Middlesex counties); Georgia (Clayton, Cobb, DeKalb, Douglas, Fulton, Gwinnett, Newton, and Rockdale counties); Iowa (one county represented); Maryland (Allegany, Anne Arundel, Baltimore, Baltimore City, Calvert, Caroline, Carroll, Cecil, Charles, Dorchester, Frederick, Garrett, Harford, Howard, Kent, Montgomery, Prince George's, Queen Anne's, St. Mary's, Somerset, Talbot, Washington, Wicomico, and Worcester counties); Michigan (Clinton, Eaton, Genesee, Ingham, and Washtenaw counties); Minnesota (Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, and Washington counties); New Mexico (Bernalillo, Chaves, Dona Ana, Grant, Luna, San Juan, and Santa Fe counties); New York (Albany, Columbia, Genesee, Greene, Livingston, Monroe, Montgomery, Ontario, Orleans, Rensselaer, Saratoga, Schenectady, Schoharie, Wayne, and Yates counties); Ohio (Delaware, Fairfield, Franklin, Hocking, Licking, Madison, Morrow, Perry, Pickaway and Union counties); Oregon (Clackamas, Multnomah, and Washington counties); Tennessee (Cheatham, Davidson, Dickson, Robertson, Rutherford, Sumner, Williamson, and Wilson counties); and Utah (Salt Lake County).

of women aged 15–44 years who are pregnant at any given time based on 2010 data.[††] Similar to other reports from the United States (*9*) and China (*1*), these findings indicate that a high proportion of U.S. patients hospitalized with COVID-19 are older and have underlying medical conditions.

The findings in this report are subject to at least three limitations. First, hospitalization rates by age and COVID-NET site are preliminary and might change as additional cases are identified from this surveillance period. Second, whereas minimum case data to produce weekly age-stratified hospitalization rates are usually available within 7 days of case identification, availability of detailed clinical data are delayed because of the need for medical chart abstractions. As of March 30, chart abstractions had been conducted for approximately 200 COVID-19 patients; the frequency and distribution of underlying conditions during this time might change as additional data become available. Clinical course and outcomes will be presented once the number of cases with complete medical chart abstractions are sufficient; many patients are still hospitalized at the time of this report. Finally, testing for SARS-CoV-2 among patients identified through COVID-NET is performed at the discretion of treating health care providers, and testing practices and capabilities might vary widely across providers and facilities. As a result, underascertainment of cases in COVID-NET is likely. Additional data on testing practices related to SARS-CoV-2 will be collected in the future to account for underascertainment using described methods (*10*).

Early data from COVID-NET suggest that COVID-19–associated hospitalizations in the United States are highest among older adults, and nearly 90% of persons hospitalized have one or more underlying medical conditions. These findings underscore the importance of preventive measures (e.g., social distancing, respiratory hygiene, and wearing face coverings in public settings where social distancing measures are difficult to maintain) to protect older adults and persons with underlying medical conditions. Ongoing monitoring of hospitalization rates, clinical characteristics, and outcomes of hospitalized patients will be important to better understand the evolving epidemiology of COVID-19 in the United States and the clinical spectrum of disease, and to help guide planning and prioritization of health care system resources.

†† https://www.cdc.gov/nchs/data/hestat/pregnancy/2010_pregnancy_rates.htm.

TABLE. Underlying conditions and symptoms among adults aged ≥18 years with coronavirus disease 2019 (COVID-19)–associated hospitalizations — COVID-NET, 14 states,* March 1–30, 2020†

Underlying condition	Age group (yrs), no./total no. (%)			
	Overall	18–49	50–64	≥65 years
Any underlying condition	159/178 (89.3)	41/48 (85.4)	51/59 (86.4)	67/71 (94.4)
Hypertension	79/159 (49.7)	7/40 (17.5)	27/57 (47.4)	45/62 (72.6)
Obesity§	73/151 (48.3)	23/39 (59.0)	25/51 (49.0)	25/61 (41.0)
Chronic metabolic disease¶	60/166 (36.1)	10/46 (21.7)	21/56 (37.5)	29/64 (45.3)
Diabetes mellitus	47/166 (28.3)	9/46 (19.6)	18/56 (32.1)	20/64 (31.3)
Chronic lung disease	55/159 (34.6)	16/44 (36.4)	15/53 (28.3)	24/62 (38.7)
Asthma	27/159 (17.0)	12/44 (27.3)	7/53 (13.2)	8/62 (12.9)
Chronic obstructive pulmonary disease	17/159 (10.7)	0/44 (0.0)	3/53 (5.7)	14/62 (22.6)
Cardiovascular disease**	45/162 (27.8)	2/43 (4.7)	11/56 (19.6)	32/63 (50.8)
Coronary artery disease	23/162 (14.2)	0/43 (0.0)	7/56 (12.5)	16/63 (25.4)
Congestive heart failure	11/162 (6.8)	2/43 (4.7)	3/56 (5.4)	6/63 (9.5)
Neurologic disease	22/157 (14.0)	4/42 (9.5)	4/55 (7.3)	14/60 (23.3)
Renal disease	20/153 (13.1)	3/41 (7.3)	2/53 (3.8)	15/59 (25.4)
Immunosuppressive condition	15/156 (9.6)	5/43 (11.6)	4/54 (7.4)	6/59 (10.2)
Gastrointestinal/Liver disease	10/152 (6.6)	4/42 (9.5)	0/54 (0.0)	6/56 (10.7)
Blood disorder	9/156 (5.8)	1/43 (2.3)	1/55 (1.8)	7/58 (12.1)
Rheumatologic/Autoimmune disease	3/154 (1.9)	1/42 (2.4)	0/54 (0.0)	2/58 (3.4)
Pregnancy††	3/33 (9.1)	3/33 (9.1)	N/A	N/A
Symptom§§				
Cough	155/180 (86.1)	43/47 (91.5)	54/60 (90.0)	58/73 (79.5)
Fever/Chills	153/180 (85.0)	38/47 (80.9)	53/60 (88.3)	62/73 (84.9)
Shortness of breath	144/180 (80.0)	40/47 (85.1)	50/60 (83.3)	54/73 (74.0)
Myalgia	62/180 (34.4)	20/47 (42.6)	23/60 (38.3)	19/73 (26.0)
Diarrhea	48/180 (26.7)	10/47 (21.3)	17/60 (28.3)	21/73 (28.8)
Nausea/Vomiting	44/180 (24.4)	12/47 (25.5)	17/60 (28.3)	15/73 (20.5)
Sore throat	32/180 (17.8)	8/47 (17.0)	13/60 (21.7)	11/73 (15.1)
Headache	29/180 (16.1)	10/47 (21.3)	12/60 (20.0)	7/73 (9.6)
Nasal congestion/Rhinorrhea	29/180 (16.1)	8/47 (17.0)	13/60 (21.7)	8/73 (11.0)
Chest pain	27/180 (15.0)	9/47 (19.1)	13/60 (21.7)	5/73 (6.8)
Abdominal pain	15/180 (8.3)	6/47 (12.8)	6/60 (10.0)	3/73 (4.1)
Wheezing	12/180 (6.7)	3/47 (6.4)	2/60 (3.3)	7/73 (9.6)
Altered mental status/Confusion	11/180 (6.1)	3/47 (6.4)	2/60 (3.3)	6/73 (8.2)

Abbreviations: COVID-NET = Coronavirus Disease 2019–Associated Hospitalization Surveillance Network; N/A = not applicable.

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

† COVID-NET included data for one child aged 5–17 years with underlying medical conditions and symptoms at admission; data for this child are not included in this table. This child was reported to have chronic lung disease (asthma). Symptoms included fever, cough, gastrointestinal symptoms, shortness of breath, chest pain, and a sore throat on admission.

§ Obesity is defined as calculated body mass index (BMI) ≥30 kg/m2, and if BMI is missing, by International Classification of Diseases discharge diagnosis codes. Among 73 patients with obesity, 51 (69.9%) had obesity defined as BMI 30–<40 kg/m2, and 22 (30.1%) had severe obesity defined as BMI ≥40 kg/m2.

¶ Among the 60 patients with chronic metabolic disease, 45 had diabetes mellitus only, 13 had thyroid dysfunction only, and two had diabetes mellitus and thyroid dysfunction.

** Cardiovascular disease excludes hypertension.

†† Restricted to women aged 15–49 years.

§§ Symptoms were collected through review of admission history and physical exam notes in the medical record and might be determined by subjective or objective findings. In addition to the symptoms in the table, the following less commonly reported symptoms were also noted for adults with information on symptoms (180): hemoptysis/bloody sputum (2.2%), rash (1.1%), conjunctivitis (0.6%), and seizure (0.6%).

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Summary

What is already known about this topic?

Population-based rates of laboratory-confirmed coronavirus disease 2019 (COVID-19)–associated hospitalizations are lacking in the United States.

What is added by this report?

COVID-NET was implemented to produce robust, weekly, age-stratified COVID-19–associated hospitalization rates. Hospitalization rates increase with age and are highest among older adults; the majority of hospitalized patients have underlying conditions.

What are the implications for public health practice?

Strategies to prevent COVID-19, including social distancing, respiratory hygiene, and face coverings in public settings where social distancing measures are difficult to maintain, are particularly important to protect older adults and those with underlying conditions. Ongoing monitoring of hospitalization rates is critical to understanding the evolving epidemiology of COVID-19 in the United States and to guide planning and prioritization of health care resources.

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Geographic Differences in COVID-19 Cases, Deaths, and Incidence — United States, February 12–April 7, 2020

CDC COVID-19 Response Team

On April 10, 2020, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

Community transmission of coronavirus disease 2019 (COVID-19) was first detected in the United States in February 2020. By mid-March, all 50 states, the District of Columbia (DC), New York City (NYC), and four U.S. territories had reported cases of COVID-19. This report describes the geographic distribution of laboratory-confirmed COVID-19 cases and related deaths reported by each U.S. state, each territory and freely associated state,* DC, and NYC during February 12–April 7, 2020, and estimates cumulative incidence for each jurisdiction. In addition, it projects the jurisdiction-level trajectory of this pandemic by estimating case doubling times on April 7 and changes in cumulative incidence during the most recent 7-day period (March 31–April 7). As of April 7, 2020, a total of 395,926 cases of COVID-19, including 12,757 related deaths, were reported in the United States. Cumulative COVID-19 incidence varied substantially by jurisdiction, ranging from 20.6 cases per 100,000 in Minnesota to 915.3 in NYC. On April 7, national case doubling time was approximately 6.5 days, although this ranged from 5.5 to 8.0 days in the 10 jurisdictions reporting the most cases. Absolute change in cumulative incidence during March 31–April 7 also varied widely, ranging from an increase of 8.3 cases per 100,000 in Minnesota to 418.0 in NYC. Geographic differences in numbers of COVID-19 cases and deaths, cumulative incidence, and changes in incidence likely reflect a combination of jurisdiction-specific epidemiologic and population-level factors, including 1) the timing of COVID-19 introductions; 2) population density; 3) age distribution and prevalence of underlying medical conditions among COVID-19 patients (*1–3*); 4) the timing and extent of community mitigation measures; 5) diagnostic testing capacity; and 6) public health reporting practices. Monitoring jurisdiction-level numbers of COVID-19 cases, deaths, and changes in incidence is critical for understanding community risk and making decisions about community mitigation, including social distancing, and strategic health care resource allocation.

This analysis includes all laboratory-confirmed COVID-19 cases† reported to CDC during February 12–April 7 from health departments in all 50 U.S. states, eight U.S. territories and freely associated states, DC, and NYC. Beginning on March 3, jurisdictions reported aggregate numbers of cases and deaths daily. Cases and deaths reported by the state of New York are exclusive of those reported by NYC. National and jurisdiction-specific case doubling times for the 10 jurisdictions with the most cases were estimated for April 7 by calculating the number of days before April 7 in which the observed cases were equal to half that reported on April 7. National and jurisdiction-specific cumulative incidences were estimated using 2018 population estimates.§ Absolute 7-day changes in cumulative incidence were calculated by subtracting the jurisdiction-specific cumulative incidence on March 31 from that observed on April 7.

As of April 7, a total of 395,926 COVID-19 cases were reported in the United States (Table). Cases were reported by all 50 states, DC, NYC, Guam, the Northern Mariana Islands, Puerto Rico, and the U.S. Virgin Islands. Two thirds of all COVID-19 cases (66.7%) were reported by eight jurisdictions: NYC (76,876), New York (61,897), New Jersey (44,416), Michigan (18,970), Louisiana (16,284), California (15,865), Massachusetts (15,202), and Pennsylvania (14,559) (Figure 1). The overall cumulative COVID-19 incidence in the United States was 119.6 cases per 100,000 population on April 7 (Table). Among jurisdictions in the continental United States, cumulative incidence was lowest in Minnesota (20.6) and highest in NYC (915.3). Nine reporting jurisdictions had rates above the national rate: NYC (915.3), New York (555.5), New Jersey (498.6), Louisiana (349.4), Massachusetts (220.3), Connecticut (217.8), Michigan (189.8), DC (172.4), and Rhode Island (133.7).

* American Samoa, Federated States of Micronesia, Guam, Marshall Islands, Northern Mariana Islands, Palau, Puerto Rico, and U.S. Virgin Islands.

† Laboratory-confirmed cases include those cases for which SARS-CoV-2, the virus that causes COVID-19, was detected by reverse transcription–polymerase chain reaction (RT-PCR) testing at a commercial, public health, or CDC laboratory. Cases among persons repatriated to the United States on State Department–chartered flights were excluded.

§ 2018 population estimates for the U.S. states, DC, and Puerto Rico were obtained from the U.S. Census Bureau (https://www.census.gov/data/tables/time-series/demo/popest/2010s-state-total.html); 2018 population estimates for NYC were obtained from the U.S. Census State Population Totals and Components of Change: 2010–2019 tables (https://www.census.gov/data/tables/time-series/demo/popest/2010s-state-total.html) and were subtracted from New York State estimates; the remaining jurisdictions' estimates were obtained from The World Bank (https://data.worldbank.org/).

TABLE. Reported COVID-19 cases and deaths and estimated cumulative incidence,* March 31 and April 7, 2020, and change in cumulative incidence from March 31 to April 7, 2020 — U.S. jurisdictions

Jurisdiction	March 31		April 7			March 31–April 7
	No. of cases	Cumulative incidence*	No. of cases	No. (%) of deaths	Cumulative incidence*	Absolute change in cumulative incidence*
States, District of Columbia, and New York City						
Alabama	999	20.4	2,197	39 (1.8)	44.9	24.5
Alaska	133	18.0	213	6 (2.8)	28.9	10.8
Arizona	1,289	18.0	2,575	73 (2.8)	35.9	17.9
Arkansas	560	18.6	993	18 (1.8)	32.9	14.4
California	8,131	20.6	15,865	374 (2.4)	40.1	19.6
Colorado	2,966	52.1	5,429	179 (3.3)	95.3	43.2
Connecticut	3,128	87.6	7,781	277 (3.6)	217.8	130.2
Delaware	319	33.0	928	16 (1.7)	95.9	63.0
District of Columbia	495	70.5	1,211	24 (2.0)	172.4	101.9
Florida	6,490	30.5	14,302	296 (2.1)	67.1	36.7
Georgia	4,585	43.6	9,713	351 (3.6)	92.3	48.7
Hawaii	185	13.0	362	5 (1.4)	25.5	12.5
Idaho	525	29.9	1,210	15 (1.2)	69.0	39.0
Illinois	5,994	47.0	13,549	380 (2.8)	106.3	59.3
Indiana	2,159	32.3	5,507	173 (3.1)	82.3	50.0
Iowa	497	15.7	1,048	26 (2.5)	33.2	17.5
Kansas	428	14.7	900	27 (3.0)	30.9	16.2
Kentucky	591	13.2	1,149	65 (5.7)	25.7	12.5
Louisiana	5,237	112.4	16,284	582 (3.6)	349.4	237.1
Maine	303	22.6	519	12 (2.3)	38.8	16.1
Maryland	1,660	27.5	5,529	124 (2.2)	91.5	64.0
Massachusetts	6,620	95.9	15,202	356 (2.3)	220.3	124.3
Michigan	7,615	76.2	18,970	845 (4.5)	189.8	113.6
Minnesota	689	12.3	1,154	39 (3.4)	20.6	8.3
Mississippi	1,073	35.9	2,003	67 (3.3)	67.1	31.1
Missouri	1,327	21.7	3,037	53 (1.7)	49.6	27.9
Montana	203	19.1	332	6 (1.8)	31.3	12.1
Nebraska	177	9.2	478	10 (2.1)	24.8	15.6
Nevada	1,113	36.7	2,087	71 (3.4)	68.8	32.1
New Hampshire	367	27.1	747	13 (1.7)	55.1	28.0
New Jersey	18,696	209.9	44,416	1,232 (2.8)	498.6	288.7
New Mexico	315	15.0	794	13 (1.6)	37.9	22.9
New York†	32,656	293.1	61,897	1,378 (2.2)	555.5	262.4
New York City	41,771	497.3	76,876	4,111 (5.3)	915.3	418.0
North Carolina	1,584	15.3	3,221	46 (1.4)	31.0	15.8
North Dakota	126	16.6	237	4 (1.7)	31.2	14.6
Ohio	2,199	18.8	4,782	167 (3.5)	40.9	22.1
Oklahoma	565	14.3	1,472	67 (4.6)	37.3	23.0
Oregon	690	16.5	1,181	33 (2.8)	28.2	11.7
Pennsylvania	4,843	37.8	14,559	240 (1.6)	113.7	75.9
Rhode Island	520	49.2	1,414	30 (2.1)	133.7	84.6
South Carolina	1,083	21.3	2,417	51 (2.1)	47.5	26.2
South Dakota	108	12.2	320	6 (1.9)	36.3	24.0
Tennessee	2,239	33.1	4,139	72 (1.7)	61.1	28.1
Texas	3,266	11.4	8,262	154 (1.9)	28.8	17.4
Utah	934	29.5	1,804	13 (0.7)	57.1	27.5
Vermont	293	46.8	575	23 (4.0)	91.8	45.0
Virginia	1,484	17.4	3,645	75 (2.1)	42.8	25.4
Washington	4,896	65.0	8,682	394 (4.5)	115.2	50.2
West Virginia	162	9.0	412	4 (1.0)	22.8	13.8
Wisconsin	1,351	23.2	2,578	92 (3.6)	44.3	21.1
Wyoming	120	20.8	221	0 (—)	38.3	17.5

See table footnotes on next page.

TABLE. (*Continued*) Reported COVID-19 cases and deaths and estimated cumulative incidence,* March 31 and April 7, 2020, and change in cumulative incidence from March 31 to April 7, 2020 — U.S. jurisdictions

	March 31		April 7			March 31–April 7
Jurisdiction	**No. of cases**	**Cumulative incidence***	**No. of cases**	**No. (%) of deaths**	**Cumulative incidence***	**Absolute change in cumulative incidence***
Territories and freely associated states						
American Samoa	0	0.0	0	0 (—)	0.0	0.0
Federated States of Micronesia	0	0.0	0	0 (—)	0.0	0.0
Guam	71	42.8	122	4 (3.3)	73.6	30.8
Marshall Islands	0	0.0	0	0 (—)	0.0	0.0
Northern Mariana Islands	2	3.5	8	2 (25.0)	14.1	10.5
Palau	0	0.0	0	0 (—)	0.0	0.0
Puerto Rico	239	7.5	573	23 (4.0)	17.9	10.5
U.S. Virgin Islands	30	28.0	45	1 (2.2)	42.1	14.0
U.S. Total	**186,101**	**56.2**	**395,926**	**12,757 (3.2)**	**119.6**	**63.4**

* Cases per 100,000 population.
† Excludes New York City.

On April 7, nationwide case doubling time was approximately 6.5 days. Among the 10 jurisdictions reporting the most cases, doubling time ranged from 5.5 days in Louisiana to 8.0 days in NYC. During March 31–April 7, the overall cumulative incidence of COVID-19 increased by 63.4 cases per 100,000 (Table). This increase ranged from 8.3 in Minnesota to 418.0 in NYC. During the 7-day period, increases in 11 jurisdictions exceeded the national increase: NYC (418.0), New Jersey (288.7), New York (262.4), Louisiana (237.1), Connecticut (130.2), Massachusetts (124.3), Michigan (113.6), DC (101.9), Rhode Island (84.6), Pennsylvania (75.9), and Maryland (64.0) (Figure 2).

By April 7, 55 (98.2%) of the 56 jurisdictions reporting COVID-19 cases also reported at least one related death (Table); however, approximately half (52.7%) of all deaths (12,757) were reported from three jurisdictions: NYC (4,111), New York (1,378), and New Jersey (1,232) (Figure 3). Other jurisdictions reporting ≥300 deaths included Michigan (845), Louisiana (582), Washington (394), Illinois (380), California (374), Massachusetts (356), and Georgia (351). Case-fatality ratios ranged from 0.7% in Utah to 5.7% in Kentucky.

Discussion

As of April 7, 2020, a total of 395,926 COVID-19 cases, including 12,757 deaths, were reported in the United States. The national cumulative incidence of 119.6 COVID-19 cases per 100,000 obscures significant geographic variation across reporting jurisdictions, with cumulative incidence in the continental U.S. ranging from 20.6 to 915.3 cases per 100,000. Increases in cumulative incidence during the most recent 7-day period (March 31–April 7) also varied widely, from 8.3 to 418.0 cases per 100,000. Geographic variation in numbers of COVID-19 cases and deaths, cumulative incidence, and changes in cumulative incidence likely reflects differences in epidemiologic and population factors as well as clinical and public health practices.

Differences in the timing of introduction and early transmission of SARS-CoV-2 (the virus that causes COVID-19) across jurisdictions might explain some of the observed geographic variation. The first documented U.S. cases of COVID-19 were among travelers returning from China and their immediate household contacts (*4*). During the third week of February, California, Oregon, and Washington reported the first U.S. cases with no known travel to China or exposure to a person with confirmed COVID-19. Case investigations indicated community transmission in these jurisdictions. Although one case of COVID-19 with an unknown exposure was reported during the fourth week of February in Florida, other cases with unknown exposure (i.e., community transmission) were not widely reported elsewhere until early March.

Because COVID-19 is primarily transmitted by respiratory droplets, population density might also play a significant role in the acceleration of transmission. Cumulative incidence in urban areas like NYC and DC exceeds the national average. Louisiana, which experienced a temporarily high population density because of an influx of visitors during Mardi Gras celebrations in mid-February, has a higher cumulative incidence and greater increase in cumulative incidence than other states in the South. Mardi Gras, which concluded on February 25, occurred at a time when cancelling mass gatherings (e.g., festivals, conferences, and sporting events) was not yet common in the United States.¶

The differential implementation and timing of community mitigation strategies across jurisdictions might have contributed to observed variation in incidence and changing

¶ CDC updated its interim guidance on COVID-19 on March 12, 2020, to reflect considerations for postponing or cancelling mass gatherings (e.g., >250 persons). https://www.cdc.gov/coronavirus/2019-ncov/community/large-events/mass-gatherings-ready-for-covid-19.html.

Summary

What is already known about this topic?

Community transmission of COVID-19 was first detected in the United States in February 2020. By mid-March, all 50 states, the District of Columbia, New York City, and four U.S. territories had reported cases of COVID-19.

What is added by this report?

As of April 7, cumulative incidence of COVID-19 ranged widely across U.S. jurisdictions (from 20.6 to 915.3 cases per 100,000) and 7-day increases in incidence varied considerably (from 8.3 to 418.0). This report highlights geographic differences in cases, deaths, incidence, and changing incidence.

What are the implications for public health practice?

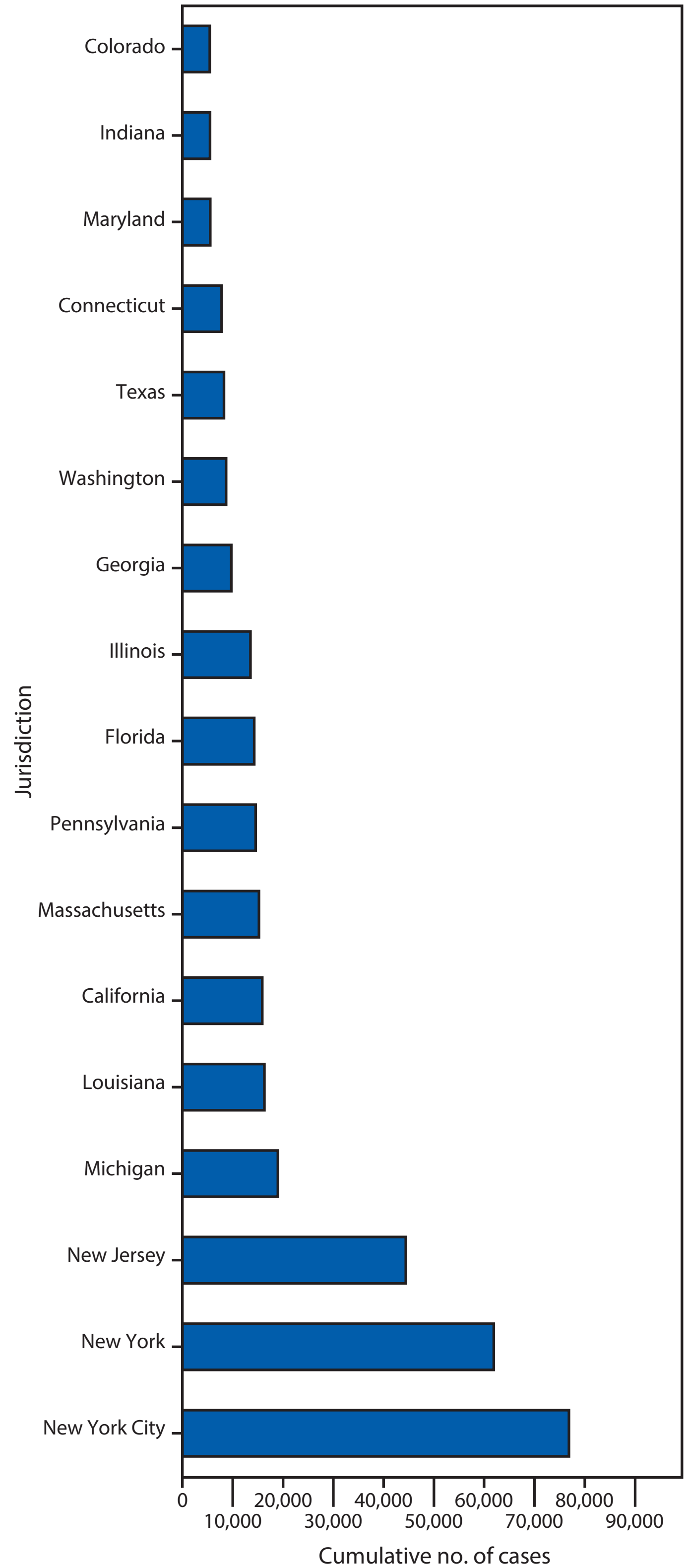
Monitoring jurisdiction-level numbers of COVID-19 cases, deaths, and changes in incidence is critical for understanding community risk and making decisions about community mitigation, including social distancing, and strategic health care resource allocation.

incidences in this analysis. Community mitigation strategies, including school and workplace closures, cancellation of mass gatherings, and shelter-in-place orders, are recommended public health practices to reduce transmission during pandemics (*5*). COVID-19 modeling estimates suggest that mitigation could lead to substantial reductions in rates of infection, hospitalization, critical care, and death in North America (*6*). The effectiveness of these strategies to mitigate rates of infection and poor outcomes relies on their timely implementation before high levels of community transmission have been observed (*7*,*8*).

Differences in the availability of and approaches to SARS-CoV-2 testing, including testing patients across the spectrum of illness severity, likely contribute to geographic differences in COVID-19 incidence across jurisdictions. For example, the state of New York (excluding NYC) reported administering 4.9 tests per 1,000 population, which was higher than the national average of 1.6 (CDC, unpublished data, March 25, 2020); this expanded level of testing might have contributed to better ascertainment of cases and might partially explain the state's higher case count and cumulative incidence. Jurisdictions that expanded public health and commercial laboratory testing later in March might also observe increases in cases and incidence as testing expands.

Differences in the numbers of deaths across jurisdictions might reflect the degree to which COVID-19 has been introduced into populations at high risk for severe outcomes (e.g., older adults or those with a high prevalence of underlying medical conditions). In Washington, which reported rapid spread of COVID-19 in several skilled nursing and long-term

FIGURE 1. Cumulative number of reported COVID-19 cases, by jurisdiction — selected U.S. jurisdictions,*,† April 7, 2020

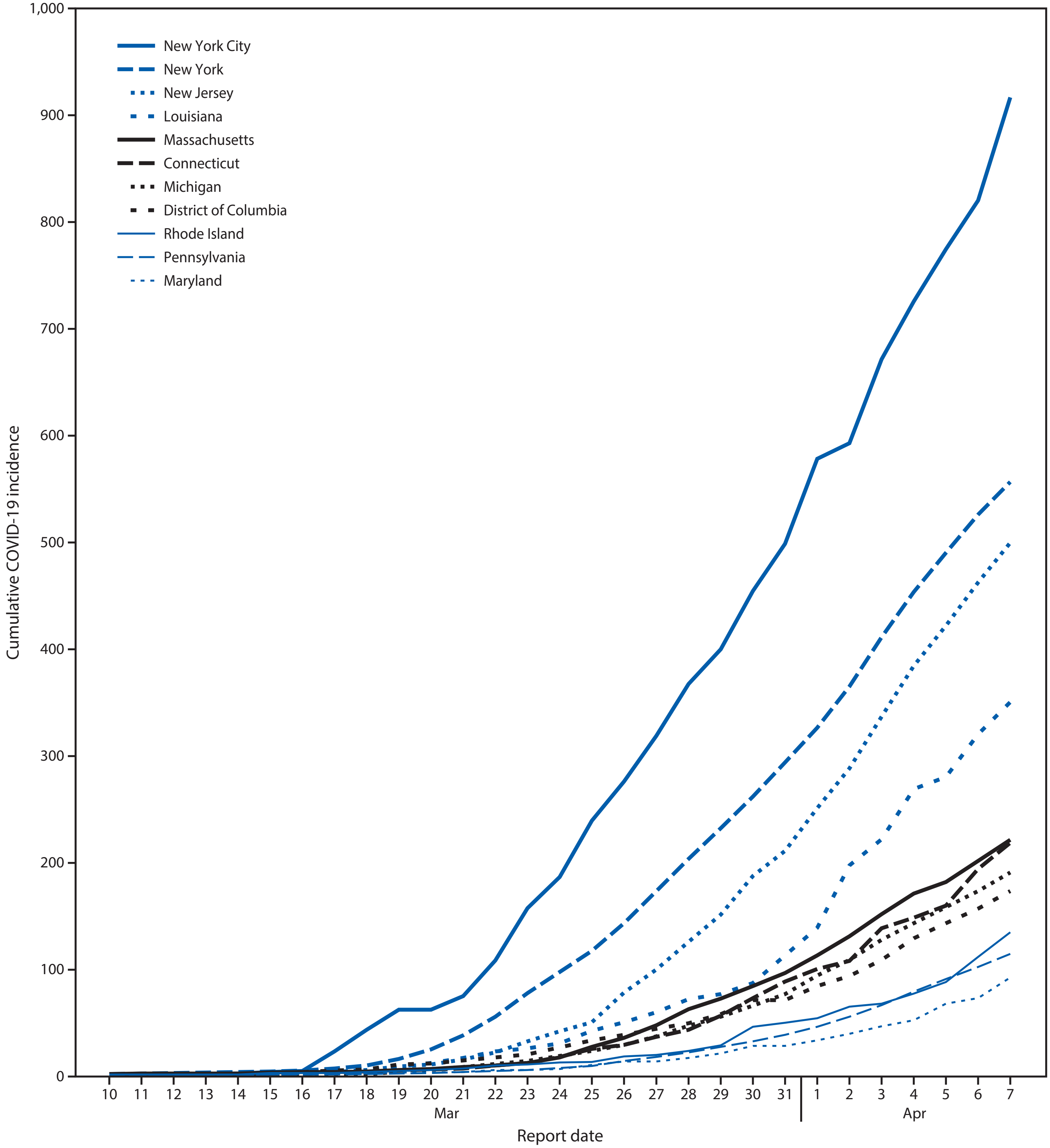


Abbreviation: COVID-19 = coronavirus disease 2019.

* Restricted to U.S. reporting jurisdictions with ≥5,000 COVID-19 cases reported as of April 7, 2020.

† Data from New York are exclusive of New York City.

FIGURE 2. Cumulative incidence* of COVID-19, by report date — selected U.S. jurisdictions,†,§ March 10–April 7, 2020



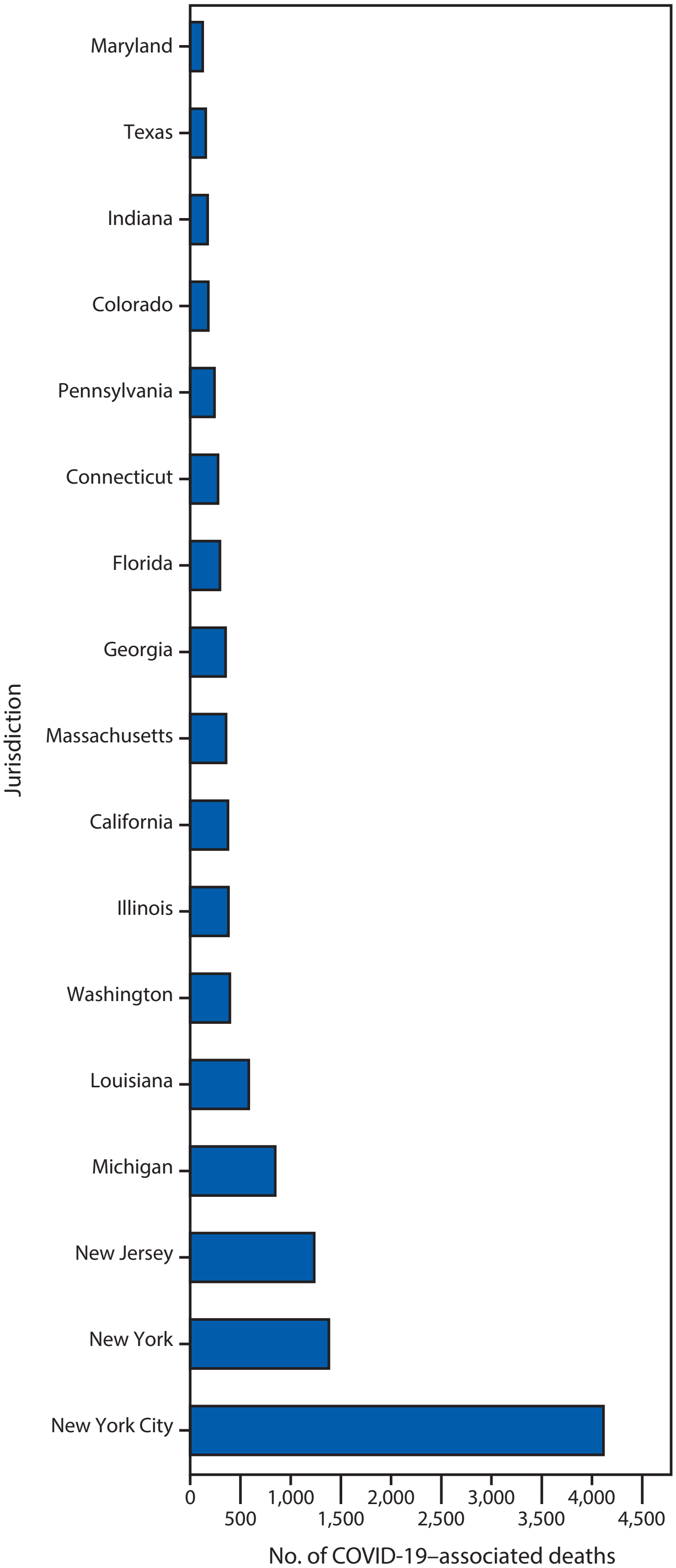
Abbreviation: COVID-19 = coronavirus disease 2019.

* Cases per 100,000 population.

† Restricted to the 11 jurisdictions reporting the largest absolute increase in COVID-19 cumulative incidence during the most recent 7-day reporting period, March 31–April 7, 2020.

§ Data from New York are exclusive of New York City.

FIGURE 3. Number of reported COVID-19–related deaths, by jurisdiction — selected U.S. jurisdictions,*,† April 7, 2020



Abbreviation: COVID-19 = coronavirus disease 2019.
* Restricted to U.S. reporting jurisdictions with ≥5,000 COVID-19 cases reported as of April 7, 2020.
† Data from New York are exclusive of New York City.

care facilities (*2*,*9*), the high number of deaths observed (394 [4.5%] among 8,682 cases) partially reflects the age and underlying medical conditions of populations affected by the outbreak (*1*,*3*). Geographic differences in reported case-fatality ratios might also reflect differences in testing practices; jurisdictions with relatively high proportions of deaths might be those where testing has been more limited and restricted to the most severely ill.

The findings in this report are subject to at least three limitations. First, reported COVID-19 cases are likely underestimated because of incomplete detection of cases and delays in case reporting. Reported deaths are also likely underestimated because of incomplete follow-up on all reported COVID-19 cases as well as death among persons infected with SARS-CoV-2 who did not receive a COVID-19 diagnosis. Second, the degree to which cases might go undetected or unreported varies across jurisdictions and might contribute significantly to the geographic variation observed in this analysis. Jurisdiction-level testing practices differ widely, and rapid increases in COVID-19 case detection have placed a high demand on health department infrastructure, leading to differential delays in case reporting. Finally, estimates of incidence, case-fatality ratios, and changes in incidence at the state and territorial levels might not be directly comparable across jurisdictions; further, COVID-19 "hotspots" and the effects of community mitigation efforts occurring within smaller geographic areas might be muted at this higher level of analysis.

Approximately 396,000 COVID-19 cases and 12,800 related deaths were reported in the United States as of April 7. The nation's 60 reporting jurisdictions are experiencing various levels of COVID-19 transmission, resulting in substantial geographic differences in numbers of cases and deaths, incidence, and changes in incidence. Monitoring changes in numbers of reported cases and disease incidence within jurisdictions over time is critical to understanding and responding to the evolving local epidemiology of this outbreak. A clear picture of the magnitude and changing incidence within a jurisdiction will inform decisions regarding implementation of community mitigation strategies, including social distancing, and strategic allocation of human and capital resources, such as those supporting the health care infrastructure.

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Transmission of COVID-19 to Health Care Personnel During Exposures to a Hospitalized Patient — Solano County, California, February 2020

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On February 26, 2020, the first U.S. case of community-acquired coronavirus disease 2019 (COVID-19) was confirmed in a patient hospitalized in Solano County, California (*1*). The patient was initially evaluated at hospital A on February 15; at that time, COVID-19 was not suspected, as the patient denied travel or contact with symptomatic persons. During a 4-day hospitalization, the patient was managed with standard precautions and underwent multiple aerosol-generating procedures (AGPs), including nebulizer treatments, bilevel positive airway pressure (BiPAP) ventilation, endotracheal intubation, and bronchoscopy. Several days after the patient's transfer to hospital B, a real-time reverse transcription–polymerase chain reaction (real-time RT-PCR) test for SARS-CoV-2 returned positive. Among 121 hospital A health care personnel (HCP) who were exposed to the patient, 43 (35.5%) developed symptoms during the 14 days after exposure and were tested for SARS-CoV-2; three had positive test results and were among the first known cases of proabable occupational transmission of SARS-CoV-2 to HCP in the United States. Little is known about specific risk factors for SARS-CoV-2 transmission in health care settings. To better characterize and compare exposures among HCP who did and did not develop COVID-19, standardized interviews were conducted with 37 hospital A HCP who were tested for SARS-CoV-2, including the three who had positive test results. Performing physical examinations and exposure to the patient during nebulizer treatments were more common among HCP with laboratory-confirmed COVID-19 than among those without COVID-19; HCP with COVID-19 also had exposures of longer duration to the patient. Because transmission-based precautions were not in use, no HCP wore personal protective equipment (PPE) recommended for COVID-19 patient care during contact with the index patient. Health care facilities should emphasize early recognition and isolation of patients with possible COVID-19 and use of recommended PPE to minimize unprotected, high-risk HCP exposures and protect the health care workforce.

HCP with potential exposures to the index patient at hospital A were identified through medical record review. Hospital and health department staff members contacted HCP for initial risk stratification and classified HCP into categories of high, medium, low, and no identifiable risk, according to CDC guidance.* HCP at high or medium risk were furloughed and actively monitored; those at low risk were asked to self-monitor for symptoms for 14 days from their last exposure.† Nasopharyngeal and oropharyngeal specimens were collected once from HCP who developed symptoms consistent with COVID-19§ during their 14-day monitoring period, and specimens were tested for SARS-CoV-2 using real-time RT-PCR at the California Department of Public Health. Serologic testing and testing for other respiratory viruses was not performed.

The investigation team, including hospital, local and state health departments, and CDC staff members, attempted to contact all 43 tested HCP by phone to conducted interviews regarding index patient exposures using a standardized exposure assessment tool. Two-sided p-values were calculated using Fisher's exact test for categorical variables and Wilcoxon rank-sum test for continuous variables; p-values <0.05 were considered statistically significant. Analyses were conducted using SAS (version 9.4; SAS Institute). The California Health and Human Services Agency's Committee for the Protection of Human Subjects and CDC determined this investigation to be public health practice.

Hospital A identified 145 HCP with potential exposure to the index patient. After the initial interview, 24 (17%) HCP were classified as having no identifiable risk; the remaining 121 were classified as having high (14), medium (80), or low (27) risk. Over the course of their monitoring periods, 43 (36%) of these HCP became symptomatic and underwent testing for SARS-CoV-2, with a median of 10 days from last exposure to specimen collection (Table 1); SARS-CoV-2 was detected in three (7%) HCP. Thirty-seven of 43 (86%) HCP who were tested were interviewed, including all three HCP with positive test results.¶

* Exposure was defined according to CDC guidance for HCP with potential exposure to COVID-19, which categorizes exposures based on factors such as exposure to the patient during AGPs, personal protective equipment use, and source control (e.g., patient wearing a facemask) during exposure. https://www.cdc.gov/coronavirus/2019-ncov/hcp/guidance-risk-assesment-hcp.html.

† HCP categorized as being at low risk were allowed to continue to report to work but were checked for symptoms before the start of each shift; no additional follow-up was conducted for HCP categorized as having no identifiable risk.

§ Including fever (subjective or measured at ≥100.4°F [38°C]), cough, shortness of breath, or sore throat.

¶ One of the remaining six HCP declined to participate; the other five could not be reached after at least three attempted phone calls.

Among 43 HCP who were tested, 84% were female, 51% were registered nurses, and 95% were at high or medium risk (Table 1). Among the three HCP with COVID-19, two had high-risk and one had medium-risk exposures. Both HCP at high risk who developed COVID-19 had frequent, close contact with the index patient; one reported being present for a total of 3 hours while the patient was on BiPAP, and the other participated in BiPAP placement and intubation. Neither wore a facemask, respirator, eye protection, or gown. The third staff member with COVID-19, who was at medium risk, reported close contact with the patient for a total of 2 hours but not during AGPs. This staff member reported wearing a facemask and gloves most of the time but removed the mask occasionally to speak and did not wear eye protection.

Seventeen (46%) of 37 interviewed HCP reported exposure to the patient during at least one AGP (Table 2).** Being present for or assisting with nebulizer treatments was more common among HCP who developed COVID-19 (67%) than among those who did not (9%) (p = 0.04); being present for or assisting with BiPAP was also more common among HCP with COVID-19, although the difference was not statistically significant (p = 0.06). The median estimated duration of overall exposure to the patient was higher among HCP with COVID-19 (120 minutes) than among those without COVID-19 (25 minutes) (p = 0.06). Similarly, the median duration of exposure during AGPs†† was higher among HCP with COVID-19 (95 minutes) than among those without COVID-19 (0 minutes) (p = 0.13) (Table 3). Among non-AGP clinical activities, performing a physical examination was more common among HCP with COVID-19 (p = 0.02) (Table 2). Some HCP reported wearing gloves or facemasks during index patient care activities (Table 3); however, none reported use of eye protection, gowns, N95 respirators, or powered air-purifying respirators (PAPRs). At hospital B, 146 HCP had high-, medium-, or low-risk exposures; eight became symptomatic and were tested, none of whom had SARS-CoV-2 detected (CS Martin, MSN, personal communication, 2020).

** For the purposes of this report, the following procedures during the patient's hospitalization were considered AGPs: airway suctioning, noninvasive positive pressure ventilation including BiPAP, manual ventilation, nebulizer treatments, breaking the ventilator circuit, sputum induction, intubation, and bronchoscopy. Exposure during an AGP included both direct participation in AGP (i.e., performing or assisting with intubation), as well as presence in the patient's room while AGP was being performed.

†† This was estimated by asking interviewed HCP to report the number and average duration of each exposure to the patient during each AGP. Total estimated duration for each AGP was calculated by multiplying the number of exposures by average duration of exposure during that AGP. Total estimated exposure time for all AGPs was calculated by adding total duration of exposures across all AGPs.

TABLE 1. Demographic characteristics, exposure risk categories, and job titles of 43 health care personnel (HCP) who were exposed to a hospitalized patient with COVID-19, became symptomatic, and were tested for SARS-CoV-2 — Solano County, California, February 2020

Characteristic	No. (%)
Total HCP	**43 (100)**
Age in yrs, median (range)	39 (27–60)
Sex	
Female	36 (84)
Male	7 (16)
Risk category*	
High	5 (12)
Medium	36 (84)
Low	2 (5)
Days from last contact with index patient to SARS-CoV-2 specimen collection, median (range)	10 (8–14)
Job title	
Registered nurse	22 (51)
Respiratory therapist	4 (9)
Phlebotomist	4 (9)
Certified nursing assistant	3 (7)
Physician	3 (7)
Environmental services worker	3 (7)
Nutrition services worker	2 (5)
Pharmacist	1 (2)
Other	1 (2)

Abbreviation: COVID-19 = coronavirus disease 2019.
* According to initial risk stratification by hospital and public health staff members.

Discussion

HCP are at high risk for acquiring infections during novel disease outbreaks, especially before transmission dynamics are fully characterized. The cases reported here are among the first known reports of occupational transmission of SARS-CoV-2 to HCP in the United States, although more cases have since been identified (*2*). Little is known to date about SARS-CoV-2 transmission in health care settings. Reports from Illinois, Singapore, and Hong Kong have described cohorts of HCP exposed to patients with COVID-19 without any documented HCP transmission (*3–5*); most HCP exposures in these cases occurred with patients while HCP were using contact, droplet, or airborne precautions.§§ As community transmission of COVID-19 increases, determining whether HCP infections are acquired in the workplace or in the community becomes more difficult. This investigation presented a unique opportunity to analyze exposures associated with COVID-19 transmission in a health care setting without recognized community exposures. Describing exposures among HCP who did and

§§ Additional detail on recommended transmission-based precautions recommended for patients with suspected or confirmed COVID-19. https://www.cdc.gov/coronavirus/2019-ncov/infection-control/control-recommendations.html.

TABLE 2. Reported patient care activities, including aerosol-generating procedures (AGPs), conducted by 37 health care personnel (HCP) who were tested for SARS-CoV-2 and participated in interviews — Solano County, California, February 2020

	No. (%)		
Exposures	HCP with COVID-19	HCP without COVID-19	p-value
Total HCP	**3**	**34**	**N/A**
Non-AGP activities*			
Taking vital signs	2 (67)	7 (21)	0.14
Taking medical history	1 (33)	7 (21)	0.53
Performing physical exam	3 (100)	8 (24)	0.02
Providing medication	1 (33)	10 (29)	1.00
Bathing or cleaning patient	0 (0)	4 (12)	1.00
Lifting or positioning patient	1 (33)	12 (35)	1.00
Emptying bedpan	1 (33)	2 (6)	0.23
Changing linens	0 (0)	5 (14)	1.00
Cleaning patient room	0 (0)	4 (12)	1.00
Peripheral line insertion	0 (0)	1 (3)	1.00
Central line insertion	0 (0)	1 (3)	1.00
Drawing arterial blood gas	1 (33)	1 (3)	0.16
Drawing blood	0 (0)	5 (15)	1.00
Manipulation of oxygen mask or tubing	2 (67)	5 (15)	0.09
Manipulation of ventilator or tubing	0 (0)	7 (21)	1.00
In room while high-flow oxygen being delivered	1 (33)	9 (26)	1.00
Collecting respiratory specimen	0 (0)	3 (9)	1.00
AGPs*,†			
Airway suctioning	0 (0)	7 (21)	1.00
Noninvasive ventilation (BiPAP, CPAP)	2 (67)	4 (12)	0.06
Manual (bag) ventilation	1 (33)	2 (6)	0.23
Nebulizer treatments	2 (67)	3 (9)	0.04
Breaking ventilation circuit	0 (0)	5 (15)	1.00
Sputum induction	0 (0)	1 (3)	1.00
Intubation	1 (33)	2 (6)	0.23
Performed or assisted	1 (33)	1 (3)	0.16
Present in room	0 (0)	1 (3)	1.00
Bronchoscopy	0 (0)	3 (9)	1.00
Performed or assisted	0 (0)	1 (3)	1.00
Present in room	0 (0)	3 (9)	1.00
Any AGP	**2 (67)**	**15 (44)**	**0.58**

Abbreviations: BiPAP = bilevel positive airway pressure; COVID-19 = coronavirus disease 2019; CPAP = continuous positive airway pressure; N/A = not applicable.
* Other patient care activities addressed in the exposure assessment tool but not listed here were not reported by any interviewed HCP.
† For all AGPs listed here except intubation and bronchoscopy, exposure to AGP includes either performing or assisting with the procedure or being present in the patient's room while the procedure was being performed. For intubation and bronchoscopy, performing or assisting with the procedure and being present in the room are presented separately.

did not develop COVID-19 can inform guidance on how to best protect HCP.

Among a cohort of 121 exposed HCP, 43 of whom were symptomatic and tested, three developed confirmed COVID-19, despite multiple unprotected exposures among HCP. HCP who developed COVID-19 had longer durations of exposure to the index patient; exposures during nebulizer treatments and BiPAP were also more common among HCP

Summary

What is already known about this topic?

Health care personnel (HCP) are at heightened risk of acquiring COVID-19 infection, but limited information exists about transmission in health care settings.

What is added by this report?

Among 121 HCP exposed to a patient with unrecognized COVID-19, 43 became symptomatic and were tested for SARS-CoV-2, of whom three had positive test results; all three had unprotected patient contact. Exposures while performing physical examinations or during nebulizer treatments were more common among HCP with COVID-19.

What are the implications for public health practice?

Unprotected, prolonged patient contact, as well as certain exposures, including some aerosol-generating procedures, were associated with SARS-CoV-2 infection in HCP. Early recognition and isolation of patients with possible infection and recommended PPE use can help minimize unprotected, high-risk HCP exposures and protect the health care workforce.

who developed COVID-19. These findings underscore the heightened COVID-19 transmission risk associated with prolonged, unprotected patient contact and the importance of ensuring that HCP exposed to patients with confirmed or suspected COVID-19 are protected. CDC recommends use of N95 or higher-level respirators and airborne infection isolation rooms when performing AGPs for patients with suspected or confirmed COVID-19; for care that does not include AGPs, CDC recommends use of respirators where available.¶¶ In California, the Division of Occupational Safety and Health Aerosol Transmissible Diseases standard requires respirators for HCP exposed to potentially airborne pathogens such as SARS-CoV-2; PAPRs are required during AGPs.***

Studies of other respiratory pathogens have documented increased transmission risk associated with AGPs, many of which can generate large droplets as well as small particle aerosols (*6*). A recent study found that SARS-CoV-2 generated through nebulization can remain viable in aerosols <5 μm for hours, suggesting that SARS-CoV-2 could be transmitted at least in part through small particle aerosols (*7*). Among the three HCP with COVID-19 at hospital A, two had index patient exposures during AGPs; one did not and reported wearing a facemask but no eye protection for most of the contact time with the patient. Given multiple unprotected exposures among HCP in this investigation, separating risks associated with specific procedures from those associated with

¶¶ https://www.cdc.gov/coronavirus/2019-ncov/infection-control/control-recommendations.html.
*** Aerosol Transmissible Diseases. California Code of Regulations, Section 5199 (2009). https://www.dir.ca.gov/title8/5199.html.

TABLE 3. Reported personal protective equipment (PPE) use and exposure characteristics among 37 health care personnel (HCP) who were tested for SARS-CoV-2 and participated in interviews — Solano County, California, February 2020

Exposures	No./Total no. (%) HCP with COVID-19	No./Total no. (%) HCP without COVID-19	p-value
Reported always* using specified PPE during AGPs†,§ with index patient			
Gloves	2/2 (100)	10/16 (63)	0.53
Facemask	0/2 (0)	3/16 (19)	1.00
Reported always* using specified PPE during non-AGP activities† with index patient			
Gloves	3/3 (100)	21/34 (62)	0.54
Facemask	0/3 (0)	3/34 (9)	1.00
Duration of exposure to index patient			
Longest single duration of time in room (mins)			
<2	0/3 (0)	2/34 (6)	0.70
2–30	2/3 (67)	23/34 (68)	
31–60	0/3 (0)	4/34 (12)	
>60	1/3 (33)	3/34 (9)	
Median (IQR) total estimated time in patient room, mins	120 (120–420)	25 (10–50)	0.06
Median (IQR) total estimated time in patient room during AGPs, mins¶	95 (0–160)	0 (0–3)	0.13
Came within 6 ft of index patient	3/3 (100)	30/34 (91)	1.00
Reported direct skin-to-skin contact with index patient	0/3 (0)	8/34 (24)	1.00
Index patient either masked or on closed-system ventilator when contact occurred			
Always	0/3 (0)	7/34 (23)	0.58
Sometimes	2/3 (67)	10/34 (32)	
Never	1/3 (33)	14/34 (45)	

Abbreviations: AGPs = aerosol-generating procedures; COVID-19 = coronavirus disease 2019; IQR = interquartile range.
* Versus sometimes or never.
† No HCP reported use of gowns, N95 respirators, powered air-purifying respirators (PAPRs), or eye protection during any patient care activities for index patient.
§ Denominators for PPE use during AGPs are numbers of HCP exposed to AGPs.
¶ This was estimated by asking each interviewed staff member to report the number and average duration of each exposure to the patient during AGPs. Total estimated duration for each AGP was calculated by multiplying the number of exposures by average duration of exposure during that AGP. Total estimated exposure time for all AGPs was calculated by adding total duration of exposures across all AGPs.

duration of exposure and lack of recommended PPE is difficult. More research to determine the risks associated with specific procedures and the protectiveness of different types of PPE, as well as the extent of short-range aerosol transmission of SARS-CoV-2, is needed.

Patient source control (e.g., patient wearing a mask or connected to a closed-system ventilator during HCP exposures) might also reduce risk of SARS-CoV-2 transmission. Although the index patient was not masked or ventilated for the majority of hospital A admission, at hospital B, where the patient remained on a closed system ventilator from arrival to receiving a positive test result, none of the 146 HCP identified as exposed developed known COVID-19 infection (*8*). Source control strategies, such as masking of patients, visitors, and HCP, should be considered by health care facilities to reduce risk of SARS-CoV-2 transmission.

This findings in this report are subject to at least three limitations. First, exposures among HCP were self-reported and are subject to recall bias. Second, the low number of cases limits the ability to detect statistically significant differences in exposures and does not allow for multivariable analyses to adjust for potential confounding. Finally, additional infections might have occurred among asymptomatic exposed HCP who were not tested, or among HCP who were tested as a result of timing and limitations of nasopharyngeal and oropharyngeal specimen testing; serologic testing was not performed.

To protect HCP caring for patients with suspected or confirmed COVID-19, health care facilities should continue to follow CDC, state, and local infection control and PPE guidance. Early recognition and prompt isolation, including source control, for patients with possible infection can help minimize unprotected and high-risk HCP exposures. These measures are crucial to protect HCP and preserve the health care workforce in the face of an outbreak already straining the U.S. health care system.

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Characteristics of Health Care Personnel with COVID-19 — United States, February 12–April 9, 2020

CDC COVID-19 Response Team

On April 14, 2020, this report was posted as an MMWR *Early Release on the* MMWR *website (https://www.cdc.gov/mmwr).*

As of April 9, 2020, the coronavirus disease 2019 (COVID-19) pandemic had resulted in 1,521,252 cases and 92,798 deaths worldwide, including 459,165 cases and 16,570 deaths in the United States (*1*,*2*). Health care personnel (HCP) are essential workers defined as paid and unpaid persons serving in health care settings who have the potential for direct or indirect exposure to patients or infectious materials (*3*). During February 12–April 9, among 315,531 COVID-19 cases reported to CDC using a standardized form, 49,370 (16%) included data on whether the patient was a health care worker in the United States; including 9,282 (19%) who were identified as HCP. Among HCP patients with data available, the median age was 42 years (interquartile range [IQR] = 32–54 years), 6,603 (73%) were female, and 1,779 (38%) reported at least one underlying health condition. Among HCP patients with data on health care, household, and community exposures, 780 (55%) reported contact with a COVID-19 patient only in health care settings. Although 4,336 (92%) HCP patients reported having at least one symptom among fever, cough, or shortness of breath, the remaining 8% did not report any of these symptoms. Most HCP with COVID-19 (6,760, 90%) were not hospitalized; however, severe outcomes, including 27 deaths, occurred across all age groups; deaths most frequently occurred in HCP aged ≥65 years. These preliminary findings highlight that whether HCP acquire infection at work or in the community, it is necessary to protect the health and safety of this essential national workforce.

Data from laboratory-confirmed COVID-19 cases voluntarily reported to CDC from 50 states, four U.S. territories and affiliated islands, and the District of Columbia, during February 12–April 9 were analyzed. Cases among persons repatriated to the United States from Wuhan, China, and the Diamond Princess cruise ship during January and February were excluded. Public health departments report COVID-19 cases to CDC using a standardized case report form* that collects information on patient demographics, whether the patient is a U.S. health care worker, symptom onset date, specimen collection dates, history of exposures in the 14 days preceding illness onset, COVID-19 symptomology, preexisting medical conditions, and patient outcomes, including hospitalization, intensive care unit (ICU) admission, and death. HCP patient health outcomes, overall and stratified by age, were classified as hospitalized, hospitalized with ICU admission, and deaths. The lower bound of these percentages was estimated by including all cases within each age group in the denominators. Upper bounds were estimated by including only those cases with known information on each outcome as denominators. Data reported to CDC are preliminary and can be updated by health departments over time. The upper quartile of the lag between onset date and reporting to CDC was 10 days. Because submitted forms might have missing or unknown information at the time of report, all analyses are descriptive, and no statistical comparisons were performed. Stata (version 15.1; StataCorp) and SAS (version 9.4; SAS Institute) were used to conduct all analyses.

Among 315,531 U.S. COVID-19 cases reported to CDC during February 12–April 9, data on HCP occupational status were available for 49,370 (16%), among whom 9,282 (19%) were identified as HCP (Figure). Data completeness for HCP status varied by reporting jurisdiction; among 12 states that included HCP status on >80% of all reported cases and reported at least one HCP patient, HCP accounted for 11% (1,689 of 15,194) of all reported cases.

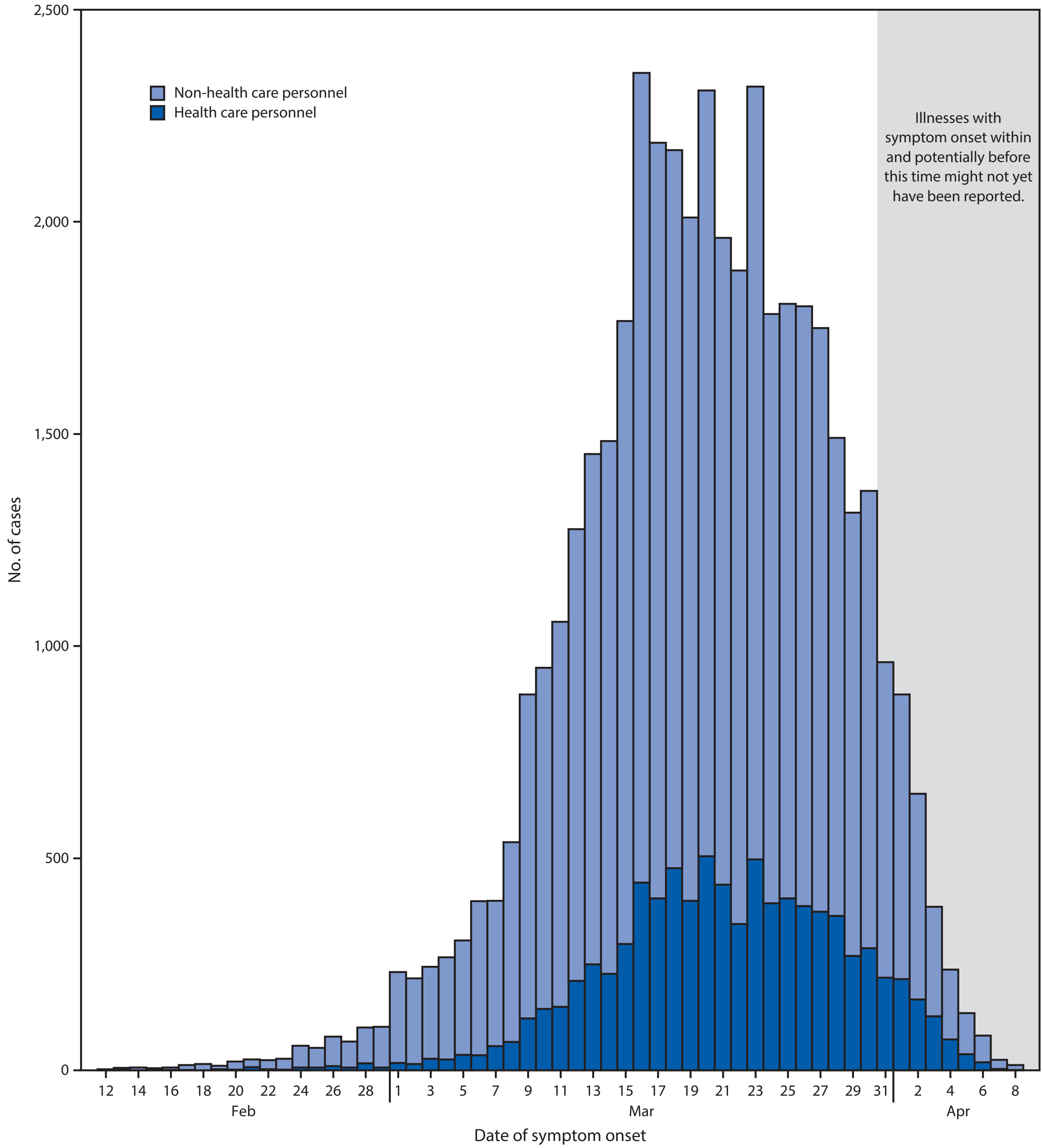
Among the 8,945 (96%) HCP patients reporting age, the median was 42 years (IQR = 32–54 years); 6,603 (73%) were female (Table 1). Among the 3,801 (41%) HCP patients with available data on race, a total of 2,743 (72%) were white, 801 (21%) were black, 199 (5%) were Asian, and 58 (2%) were other or multiple races. Among 3,624 (39%) with ethnicity specified, 3,252 (90%) were reported as non-Hispanic/Latino and 372 (10%) as Hispanic/Latino. At least one underlying health condition† was reported by 1,779 (38%) HCP patients with available information.

Among 1,423 HCP patients who reported contact with a laboratory-confirmed COVID-19 patient in either health care, household, or community settings, 780 (55%) reported having such contact only in a health care setting within the 14 days before their illness onset; 384 (27%) reported contact only

* https://www.cdc.gov/coronavirus/2019-ncov/php/reporting-pui.html.

† Preexisting medical conditions and other risk factors (yes, no, or unknown) included the following: chronic lung disease (inclusive of asthma, chronic obstructive pulmonary disease, and emphysema); diabetes mellitus; cardiovascular disease; chronic renal disease; chronic liver disease; immunocompromised condition; neurologic disorder, neurodevelopmental or intellectual disability; pregnancy; current smoker; former smoker; or other chronic disease. Data available for 4,733 (51%) HCP.

FIGURE. Daily number of COVID-19 cases, by date of symptom onset, among health care personnel and non-health care personnel (N = 43,986)*,† — United States, February 12–April 9, 2020



Abbreviation: COVID-19 = coronavirus disease 2019.

* Onset date was calculated for 5,892 (13%) cases where onset date was missing. This was done by subtracting 4 days (median interval from symptom onset to specimen collection date) from the date of earliest specimen collection. Cases with unknown onset and specimen collection dates were excluded.

† Ten-day window is used to reflect the upper quartile in lag between the date of symptom onset and date reported to CDC.

TABLE 1. Demographic characteristics, exposures, symptoms, and underlying health conditions among health care personnel with COVID-19 (N = 9,282) — United States, February 12–April 9, 2020

Characteristic (no. with available information)	No. (%)
Age group (yrs) (8,945)	
16–44	4,898 (55)
45–54	1,919 (21)
55–64	1,620 (18)
≥65	508 (6)
Sex (9,067)	
Female	6,603 (73)
Male	2,464 (27)
Race (3,801)	
Asian	199 (5)
Black	801 (21)
White	2,743 (72)
Other*	58 (2)
Ethnicity (3,624)	
Hispanic/Latino	372 (10)
Non-Hispanic/Latino	3,252 (90)
Exposures[†,§] (1,423)	
Only health care exposure	780 (55)
Only household exposure	384 (27)
Only community exposure	187(13)
Multiple exposure settings[¶]	72 (5)
Symptoms reported[§,] (4,707)**	
Fever, cough, or shortness of breath[††]	4,336 (92)
Cough	3,694 (78)
Fever[§§]	3,196 (68)
Muscle aches	3,122 (66)
Headache	3,048 (65)
Shortness of breath	1,930 (41)
Sore throat	1,790 (38)
Diarrhea	1,507 (32)
Nausea or vomiting	923 (20)
Loss of smell or taste[¶¶]	750 (16)
Abdominal pain	612 (13)
Runny nose	583 (12)
Any underlying health condition[§,*] (4,733)**	1,779 (38)

Abbreviation: COVID-19 = coronavirus disease 2019.

* "Other" includes patients who were identified as American Indian or Alaska Native (16), Native Hawaiian or Other Pacific Islander (22), or two or more races (20).

† Cases were included in the denominator if the patient reported a known contact with a laboratory-confirmed COVID-19 patient within the 14 days before illness onset in a health care, household, or community setting.

§ Responses include data from standardized fields supplemented with data from free-text fields.

¶ Includes all patients with contact reported in more than one of these settings: health care, household, and community.

** Cases were included in the denominator if the patient had a known symptom status for fever, cough, shortness of breath, nausea or vomiting, and diarrhea. HCP with mild or asymptomatic infections might have been less likely to be tested, thus less likely to be reported.

†† Includes all patients with at least one of these symptoms.

§§ Patients were included if they had information for either measured or subjective fever variables and were considered to have a fever if "yes" was indicated for either variable.

¶¶ Symptom data on loss of smell or taste was extracted only from free-text symptom fields, thus the proportion with this symptom is likely an underestimate.

*** Preexisting medical conditions and other risk factors (yes, no, or unknown) included the following: chronic lung disease (inclusive of asthma, chronic obstructive pulmonary disease, and emphysema); diabetes mellitus; cardiovascular disease; chronic renal disease; chronic liver disease; immunocompromised condition; neurologic disorder, neurodevelopmental or intellectual disability; pregnancy; current smoking status; former smoking status; or other chronic disease.

Summary

What is already known about this topic?

Limited information is available about COVID-19 infections among U.S. health care personnel (HCP).

What is added by this report?

Of 9,282 U.S. COVID-19 cases reported among HCP, median age was 42 years, and 73% were female, reflecting these distributions among the HCP workforce. HCP patients reported contact with COVID-19 patients in health care, household, and community settings. Most HCP patients were not hospitalized; however, severe outcomes, including death, were reported among all age groups.

What are the implications for public health practice?

It is critical to ensure the health and safety of HCP, both at work and in the community. Improving surveillance through routine reporting of occupation and industry not only benefits HCP, but all workers during the COVID-19 pandemic.

in a household setting; 187 (13%) reported contact only in a community setting; 72 (5%) reported contact in more than one of these settings. Among HCP patients with data available on a core set of signs and symptoms,[§] a total of 4,336 (92%) reported having at least one of fever, cough, shortness of breath. Two thirds (3,122, 66%) reported muscle aches, and 3,048 (65%) reported headache. Loss of smell or taste was written in for 750 (16%) HCP patients as an "other" symptom.

Among HCP patients with data available on age and health outcomes, 6,760 (90%) were not hospitalized, 723 (8%–10%) were hospitalized, 184 (2%–5%) were admitted to an ICU, and 27 (0.3%–0.6%) died (Table 2). Although only 6% of HCP patients were aged ≥65 years, 10 (37%) deaths occurred among persons in this age group.

Discussion

As of April 9, 2020, a total of 9,282 U.S. HCP with confirmed COVID-19 had been reported to CDC. This is likely an underestimation because HCP status was available for only 16% of reported cases nationwide. HCP with mild or asymptomatic infections might also have been less likely to be tested, thus less likely to be reported. Overall, only 3% (9,282 of 315,531) of reported cases were among HCP; however, among states with more complete reporting of HCP status, HCP accounted for 11% (1,689 of 15,194) of reported cases. The total number of COVID-19 cases among HCP is expected to rise as more U.S. communities experience widespread transmission. Compared with reports of COVID-19 patients in the overall populations of China and Italy (*4,5*), reports of

§ Cases were included in the denominator if the patient had a known symptom status for fever, cough, shortness of breath, nausea or vomiting, and diarrhea. Data available for 4,707 (51%) HCP.

TABLE 2. Hospitalizations,* intensive care unit (ICU) admissions,† and deaths,§ by age group among health care personnel with COVID-19 — United States, February 12–April 9, 2020

Age group¶ (yrs) (no. of cases)	Outcome, no. (%)**		
	Hospitalization††	ICU admission	Death
16–44 (4,898)	260 (5.3–6.4)	44 (0.9–2.2)	6 (0.1–0.3)
45–54 (1,919)	178 (9.3–11.1)	51 (2.7–6.3)	3 (0.2–0.3)
55–64 (1,620)	188 (11.6–13.8)	54 (3.3–7.5)	8 (0.5–1.0)
≥65 (508)	97 (19.1–22.3)	35 (6.9–16.0)	10 (2.0–4.2)
Total (8,945)	**723 (8.1–9.7)**	**184 (2.1–4.9)**	**27 (0.3–0.6)**

Abbreviation: COVID-19 = coronavirus disease 2019.
* Hospitalization status known for 7,483 (84%) patients.
† ICU status known for 3,739 (42%) patients.
§ Death outcomes known for 4,407 (49%) patients.
¶ Age status known for 8,945 (96%) patients.
** Lower bound of range = number of persons hospitalized, admitted to ICU, or who died among total in age group; upper bound of range = number of persons hospitalized, admitted to ICU, or who died among total in age group with known hospitalization status, ICU admission status, or death.
†† Hospitalization status includes hospitalization with or without ICU admission.

HCP patients in the United States during February 12–April 9 were slightly younger, and a higher proportion were women; this likely reflects the age and sex distributions among the U.S. HCP workforce. Race and ethnicity distributions among HCP patients reported to CDC are different from those in the overall U.S. population but are more similar to those in the HCP workforce.[¶,**]

Among HCP patients who reported having contact with a laboratory-confirmed COVID-19 patient in health care, household, or community settings, the majority reported contact that occurred in health care settings. However, there were also known exposures in households and in the community, highlighting the potential for exposure in multiple settings, especially as community transmission increases. Further, transmission might come from unrecognized sources, including presymptomatic or asymptomatic persons (*6,7*). Together, these exposure possibilities underscore several important considerations for prevention. Done alone, contact tracing after recognized occupational exposures likely will fail to identify many HCP at risk for developing COVID-19. Additional measures that will likely reduce the risk for infected HCP transmitting the virus to colleagues and patients include screening all HCP for fever and respiratory symptoms at the beginning of their shifts, prioritizing HCP for testing, and ensuring options to discourage working while ill (e.g., flexible and nonpunitive medical leave policies). Given the evidence for presymptomatic and asymptomatic transmission (*7*), covering the nose and mouth (i.e., source control) is recommended in community settings where other social distancing measures are difficult to maintain.[††] Assuring source control among all HCP, patients, and visitors in health care settings is another promising strategy for further reducing transmission. Even if everyone in a health care setting is covering their nose and mouth to contain their respiratory secretions, it is still critical that, when caring for patients, HCP continue to wear recommended personal protective equipment (PPE) (e.g., gown, N95 respirator [or facemask if N95 is not available], eye protection, and gloves for COVID-19 patient care). Training of HCP on preventive measures, including hand hygiene and PPE use, is another important safeguard against transmission in health care settings.

Among HCP with COVID-19 whose age status was known, 8%–10% were reported to be hospitalized. This is lower than the 21%–31% of U.S. COVID-19 cases with known hospitalization status described in a recent report (*8*) and might reflect the younger median age (42 years) of HCP patients compared with that of reported COVID-19 patients overall, as well as prioritization of HCP for testing, which might identify less severe illness. Similar to earlier findings (*8*), increasing age was associated with a higher prevalence of severe outcomes, although severe outcomes, including death, were observed in all age groups. Preliminary estimates of the prevalence of underlying health conditions among all patients with COVID-19 reported to CDC through March 2020 (*9*) suggested that 38% had at least one underlying condition, the same percentage found in this HCP patient population. Older HCP or those with underlying health conditions (*8,9*) should consider consulting with their health care provider and employee health program to better understand and manage their risks regarding COVID-19. The increased prevalence of severe outcomes in older HCP should be considered when mobilizing retired HCP to increase surge capacity, especially in the face of limited PPE availability[§§]; one consideration is preferential assignment of retired HCP to lower-risk settings (e.g., telemedicine, administrative assignments, or clinics for non–COVID-19 patients).

The findings in this report are subject to at least five limitations. First, approximately 84% of patients were missing data on HCP status. Thus, the number of cases in HCP reported here must be considered a lower bound because additional cases likely have gone unidentified or unreported. Second, among cases reported in HCP, the amount of missing data varied across demographic groups, exposures, symptoms, underlying conditions, and health outcomes; cases with available information might differ systematically from those without available information. Therefore, additional data are needed to confirm findings about the impact of potentially important factors (e.g., disparities in race and ethnicity or underlying health conditions

¶ https://www.bls.gov/cps/tables.htm#charemp.
** https://data.census.gov/cedsci/.
†† https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/cloth-face-cover.html.
§§ https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/index.html.

among HCP). Third, additional time will be necessary for full ascertainment of outcomes, such as hospitalization status or death. Fourth, details of occupation and health care setting were not routinely collected through case-based surveillance and, therefore, were unavailable for this analysis. Finally, among HCP patients who reported contact with a confirmed COVID-19 patient in a health care setting, the nature of this contact, including whether it was with a patient, visitor, or other HCP, and the details of potential occupational exposures, including whether HCP were unprotected (i.e., without recommended PPE) or were present during high risk procedures (e.g., aerosol-generating procedures) are unknown (*10*).

It is critical to make every effort to ensure the health and safety of this essential national workforce of approximately 18 million HCP, both at work and in the community. Surveillance is necessary for monitoring the impact of COVID-19-associated illness and better informing the implementation of infection prevention and control measures. Improving surveillance through routine reporting of occupation and industry not only benefits HCP, but all workers during the COVID-19 pandemic.

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Notes from the Field

Brucella abortus RB51 Infections Associated with Consumption of Raw Milk from Pennsylvania — 2017 and 2018

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In December 2018, the Pennsylvania Department of Agriculture (PDA) and Pennsylvania Department of Health (PADOH) were notified of a New York patient with brucellosis caused by infection with *Brucella abortus* RB51, the live attenuated vaccine strain of *B. abortus* used to prevent brucellosis in cattle (*1*). Brucellosis is a serious zoonotic infection caused by the bacteria *Brucella* spp. The most common sign is fever, followed by osteoarticular symptoms, sweating, and constitutional symptoms (*2*). Without proper treatment, infection can become chronic and potentially life-threatening (*2*). The patient had consumed raw (unpasteurized) milk from dairy A in Pennsylvania.* In July 2017, Texas health officials documented the first human case of domestically acquired RB51 infection associated with raw milk consumption from a Texas dairy (*3*). In October 2017, a second RB51 case associated with raw milk consumption was documented in New Jersey†; the milk source was not identified at the time.

To determine the RB51 source for the New York case, PDA conducted an environmental investigation at dairy A in December 2018. PDA collected individual milk samples from all cows, excluding those known not to have been vaccinated against *B. abortus*, and from the bulk milk tank, which included milk pooled from all cows. All milk samples underwent polymerase chain reaction (PCR) testing and culture; whole-genome sequencing (WGS) was performed on patient and milk sample isolates. PDA conducted a traceback investigation of any cow with a milk sample that tested positive for RB51. PADOH worked with the raw milk cooperative that distributed dairy A's milk to notify potentially exposed consumers and distributed notifications through Epi-X§ to identify cases.

Dairy A sold only raw milk and did not provide RB51 vaccination to cows born there (16 of the 30-cow herd). The remaining 14 cows were born outside the dairy and had inadequate vaccination records to determine whether they had received RB51. Because these cows might have been vaccinated, milk samples were collected from them. RB51 was detected by PCR and isolated in milk samples collected from the bulk tank and a single cow (cow 122). WGS identified two distinct RB51 strains shed by cow 122: one matched the 2018 New York patient's isolate (3 single nucleotide polymorphisms [SNPs] different) and one, unexpectedly, matched the 2017 New Jersey patient's isolate (1 SNP different). The two different RB51 strains were also shed from different quarters of cow 122's udder.

Traceback revealed that cow 122 had received RB51 in 2011 and was purchased by dairy A in 2016. During 2016–2018, dairy A distributed raw milk potentially contaminated with RB51 to 19 states; PADOH notified those states' public health veterinarians. PADOH provided a letter with RB51 information and brucellosis prophylaxis recommendations to the cooperative, which they distributed to dairy A customers. No additional cases were identified. Cow 122 was excluded from milk production, and serial PCR testing of bulk milk samples were subsequently negative for RB51.

Isolation of two different RB51 strains from different quarters of a cow's udder has not previously been reported. These infections highlight the need to prevent RB51 infections. Raw milk consumption is also associated with serious illnesses caused by other pathogens, including *Campylobacter* spp., Shiga toxin–producing *Escherichia coli,* and *Salmonella* spp. (*4*). During 2007–2012, the number of raw milk outbreaks in the United States increased; 66 (81%) of 81 reported outbreaks occurred in states where raw milk sale is legal (*5*). Pregnant women, children, older adults, and persons with immunocompromising conditions are at greatest risk for infection.¶

To eliminate infection risk from milkborne pathogens, including RB51, all milk should be pasteurized. Because limited information is available about intermittent or continuous RB51 shedding among dairy cows, more research is needed to more fully understand this emerging public health threat for milk consumers. States can also consider the United States Animal Health Associations' recommendations regarding the need for RB51 vaccination in areas where *B. abortus* is not endemic in wildlife.**

* Retail sale of raw milk is legal in Pennsylvania. http://www.pacodeandbulletin.gov/Display/pacode?file=/secure/pacode/data/007/chapter59a/subchapFtoc.html&d=reduce.
† https://nj.gov/health/news/2017/approved/20171113c.shtml.
§ https://emergency.cdc.gov/epix/index.asp.
¶ https://www.cdc.gov/foodsafety/rawmilk/raw-milk-questions-and-answers.html.
** https://www.usaha.org/upload/Resolution/2018/Resolution_35_Use_of_RB51_Vacc.pdf.

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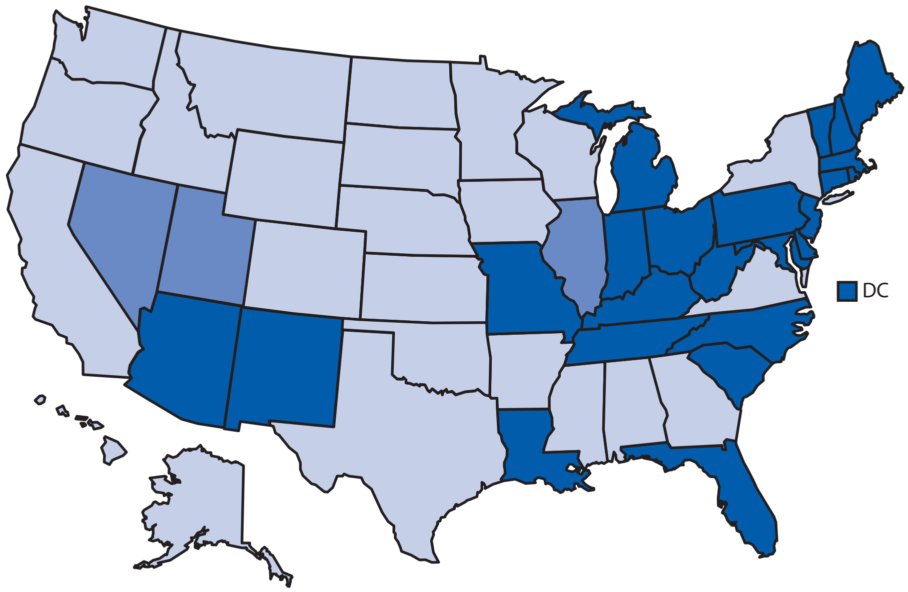
QuickStats

FROM THE NATIONAL CENTER FOR HEALTH STATISTICS

Age-Adjusted Drug Overdose Death* Rates,† by State — United States, 2018§



Abbreviation: DC = District of Columbia.

* Drug overdose deaths were identified using *International Classification of Diseases, Tenth Revision* underlying cause-of-death codes X40–X44, X60–X64, X85, and Y10–Y14.

† Age-adjusted drug overdose death rates were calculated using the direct method and the 2000 U.S. standard population.

§ In 2018, the age-adjusted drug overdose death rate in the United States was 20.7 per 100,000 population.

In 2018, 23 states and DC had drug overdose death rates that were higher than the national rate of 20.7 per 100,000. Except for Arizona and New Mexico, states with higher rates were in the eastern part of the country, including the two states with the highest rates: West Virginia (51.5) and Delaware (43.8). Twenty-four states had rates that were lower than the national rate; the states with the lowest rates were Nebraska (7.4) and South Dakota (6.9). Three states (Illinois, Nevada, and Utah) had rates that were not significantly different from the national rate.

Source: National Center for Health Statistics, National Vital Statistics System, Mortality Data. http://www.cdc.gov/nchs/deaths.htm.

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For more information on this topic, CDC recommends the following link: https://www.cdc.gov/drugoverdose/.

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